ARKANSAS
2017
SEAT BELT USE

Prepared for the Highway Safety Office, Arkansas State Police
by
the Department of Civil Engineering and Department of Industrial Engineering,
University of Arkansas

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EXECUTIVE SUMMARY

At 96 sites spread among 12 counties in Arkansas, observers recorded the seat belt use of drivers and of passengers in the right-front position in May and June of 2017.

The seat belt use observations were confined to passenger cars and similar light duty vehicles. Based on these observations, the unadjusted (i.e., unweighted) seat belt use rate on all public road categories in Arkansas in 2017 was 80.0%. Using statistical weighting procedures, the use rate was determined to be 81.0%, with a standard error of 0.75% estimated by the linearization method. The overall number of non-responses (unknowns) was 254 out of 11,986 attempted observations of drivers and outside front seat passengers, for a rate of 2.1%.

NOTE 1: As a result of Act 308 of 2009, effective June 30, 2009, Arkansas' Safety Belt Law was amended to include "primary enforcement." Primary enforcement means an officer can stop a motorist solely on the observation that a violation of the Safety Belt Law has occurred.

NOTE 2: As a result of Act 470 of 2001, children up to 15 years of age are now covered under the Child Passenger Protection Act. A child who is less than 6 years old and weighs less than 60 lbs. must be in a child restraint. If a child is either at least 6 years old or weighs at least 60 lbs., restraint with a seat belt is deemed sufficient under the law.

Arkansas 2017 Seat Belt Use

This report was prepared by J. L. Gattis (Department of Civil Engineering) and J. R. Chimka (Department of Industrial Engineering), University of Arkansas, Fayetteville, Arkansas, for the Highway Safety Office (HSO) of the Arkansas State Police, Little Rock, Arkansas.

1.0 INTRODUCTION

This report presents results of the May-June 2017 survey of seat belt use conducted in twelve Arkansas counties. The purpose of this survey was to estimate a statewide seat belt use rate for drivers and outboard front seat passengers in automobiles and other similar light vehicles, such as minivans, sport utility vehicles, and pickup trucks. The 2017 study did not include observations of the use of Department of Transportation (DOT)-approved helmets by riders of motorcycles.

The Highway Safety Office (HSO) of the Arkansas State Police (ASP) administers surveys of seat belt use, as well as a variety of other roadway safety initiatives, in the state. The HSO first contracted with the Department of Civil Engineering at the University of Arkansas (U of A) to conduct the survey in 2011. Subsequently, HSO contracted with the U of A to develop the revised protocol mandated by a 2011 National Highway Traffic Safety Administration (NHTSA) Final Rule, and to conduct the surveys in 2012, 2013, 2014, 2015, 2016, and 2017.

The persons making the seat belt use observations followed a protocol developed and revised in late 2011 and early 2012, and approved by NHTSA in April 2012 for use in the 2012 and subsequent-year surveys. This new protocol (*Seat Belt Use Survey Design for Arkansas*, April 2012) was created to comply with the "Uniform Criteria for State Observational Surveys of Seat Belt Use," 23 CFR Part 1340, prepared by NHTSA and published as a final rule in *Federal Register*, Vol. 76, No. 63, April 1, 2011, Rules and Regulations, pp. 18042–18059. One of the major changes initiated by the new protocol is a significantly more rigorous and involved statistical analysis. After analyzing the data collected during the initial year of this new protocol, and determining that the resulting degree of statistical error was well within the allowable limits, HSO proposed and NHTSA approved changing the number of sites surveyed in each of the 12 counties from nine to eight sites. A new set of 12 counties and eight sites within each county were selected and approved by NHTSA in early 2017. Exhibit 1-1 summarizes other differences among the surveys from 2013 through 2017.

When Act 308 became effective June 30, 2009, Arkansas became a "primary enforcement" state. Primary enforcement means an officer can stop a motorist solely on the observation that a violation of the Safety Belt Law has occurred.

1.1 TERMS AND ABBREVIATIONS

The following terms and abbreviations (Exhibit 1-2) are employed in the discussions that surrounded and in the development of this document.

EXHIBIT 1-1 Differences Among 2013 through 2017 Surveys

	2013 (revised protocol)	2014	2015	2016	2017
Vehicle volume at all sites combined during observations	14,429	15,024	14,503	15,174	10,459
Total number of yes and no observations	15,911	17,589	16,379	17,183	11,732
Other features	No observations of motorcycle helmet use	Also observed motorcycle helmet use	No observations of motorcycle helmet use		

EXHIBIT 1-2 List of Terms and Abbreviations

AHTD	Arkansas Highway and Transportation Department
CFR	Code of Federal Regulations
Co.	county
DOT	Department of Transportation
FARS	Fatality Analysis Reporting System
fat.	fatalities
HSO	Highway Safety Office (of the Arkansas State Police)
MOS	measure of size
MSA	metropolitan statistical area
MTFCC	MAF/TIGER Feature Class Code; a coding system for map features
NHTSA	National Highway Transportation Safety Administration
PMV	passenger motor vehicles
pop.	population
PPS	probability proportional to size
PSU	primary sampling unit (e.g., a county)
QC	quality control
SHAPE	a type computer file format for geographic information system data
SRS	simple random sample
SSU	secondary sampling unit (e.g., a road segment in a county)
VMT	vehicle miles of travel

2.0 DESIGNING AND CONDUCTING THE FIELD STUDY

The study design began with identifying a pool of counties (PSUs) in the state that included at least 85% of the passenger (including the driver) motor vehicle fatalities. The stratification of these counties by degree of urbanicity and by region produced two groups of urban counties and three groups of less urban and rural counties, for a total of five groups. After targeting a primary city within a county, and for Rural counties, a part of the county, road segments at which to conduct observations were selected within each target area.

Statistical procedures determined the number of samples needed. The costs to conduct the 2011 surveys, estimated at $0.73 per observation, also affected the sample size. The minimum sample size to achieve error not in excess of 2.5% was estimated to be 4895 observations, taken at an average of 89 observations per site, at 5 sites per county, in 11 counties. However, suspecting that some sites would produce far less than 89 observations, and to provide a margin of safety, the pool was increased to 9 sites in each of 12 counties. If the subsequent analysis produced an error of greater than 2.5%, additional data collection would have been required.

After reducing and processing the data from the first year under the new protocol, the standard error of the mean was computed to be less than 1.0%. NHTSA approved HSO's request in 2013 to reduce the number of sites per county from nine to eight.

2.1 CREATING AND SELECTING STRATA

In order to ultimately select a random sample of sites at which to collect data, a process of creating and selecting successively smaller geographical subsets was pursued.

2.1.a Stratify PSUs by Urbanicity and Region

After examining tabular data in 2016, it was found that the same four counties (Pulaski, Benton, Sebastian, Washington) were in the top four when ranked by population density, population, and vehicle miles of travel. When this list was expanded to include the 9 counties with the greatest population densities (above 104 persons per square mile; county #10 had 89 per square mile), it also encompassed counties with 48% of the state's population and 44% of the vehicle miles of travel, as well as 32% of the passenger motor vehicle fatalities over the latest five-year period for which data were available. All but one of these counties lie within either the central part or the northwest part of the state. We combined these Urban counties into the following groups (Exhibit 2-1), based on geographic proximity; the lone county in the northeast was assigned to the Mid-section group. Note that Pulaski County (listed on a separate row) alone recorded over 14%, or slightly more than 1/7 of the statewide VMT.

The less-urbanized (hereafter referred to as "Rural") counties in the PSU sampling frame were assigned to one of three regions, as influenced by the culture and topography, with some adjustment made so the three Rural groups had similar amounts of VMT. In the next step, we removed five counties from each of the three Rural groups by trial and error, until each of the

three Rural groups included a percentage of the statewide vehicle miles of travel roughly of magnitude as that of the previously defined Urban groups, i.e., about 15%.

EXHIBIT 2-1 County Groups

		% of VMT	% of PMV Fat
Urban, Mid-section	Craighead, Faulkner, Garland, Saline, Sebastian	15%	13%
	Pulaski	14%	10%
Urban, Northwest	Benton, Crawford, Washington	15%	9%
Rural, East (12 counties)	Clay, Cross, Greene, Jackson, Lawrence, Lonoke, Monroe, Poinsett, Prairie, Randolph, St Francis, White	14%	15%
Rural, North (21 counties)	Baxter, Boone, Carroll, Cleburne, Conway, Franklin, Fulton, Independence, Izard, Johnson, Logan, Madison, Marion, Polk, Pope, Scott, Searcy, Sharp, Stone, Van Buren, Yell	16%	22%
Rural, South (18 counties)	Arkansas, Bradley, Calhoun, Clark, Cleveland, Columbia, Grant, Hempstead, Hot Spring, Jefferson, Lafayette, Lincoln, Little River, Miller, Nevada, Ouachita, Sevier, Union	16%	20%
TOTAL		90%	88%

2.1.b Select Counties

On July 27, 2016, a random drawing was conducted to select a new set of counties for observations. For all of the county drawings, a number was assigned to each county in a given list, then by randomly selecting numbers we selected the counties to be surveyed beginning in 2017.

To create the pool of five Urban counties, we selected two from the Northwest group and two from the Mid-section group. Due to its size, Pulaski County was automatically included.

The Rural county random selection process began with a drawing to determine which of the three groups would include three counties; the other two groups would include two counties. The drawing chose the North group as the one with the third county. The Rural pool is comprised of seven counties.

The following Exhibit 2-2 lists the counties to be sampled, and Exhibit 2-3 is a map showing the selected counties. The five counties in the Urban category constitute 5/12 or 42% of the 12 counties in the study. As happened in the previous (2012 protocol) survey design, one of the selected Rural counties (Lonoke) fell within a Metropolitan Statistical Area (MSA).

EXHIBIT 2-2 County Selection Plan

Category		Number to Select	County Selected
Urban	Mid-section	select 2 counties	Saline, Sebastian
		select Pulaski Co.	Pulaski
	Northwest	select 2 counties	Crawford, Washington
Rural	East	select 2 counties	Jackson, Lonoke
	North	select 3 counties	Carroll, Johnson, Stone
	South	select 2 counties	Ouachita, Sevier

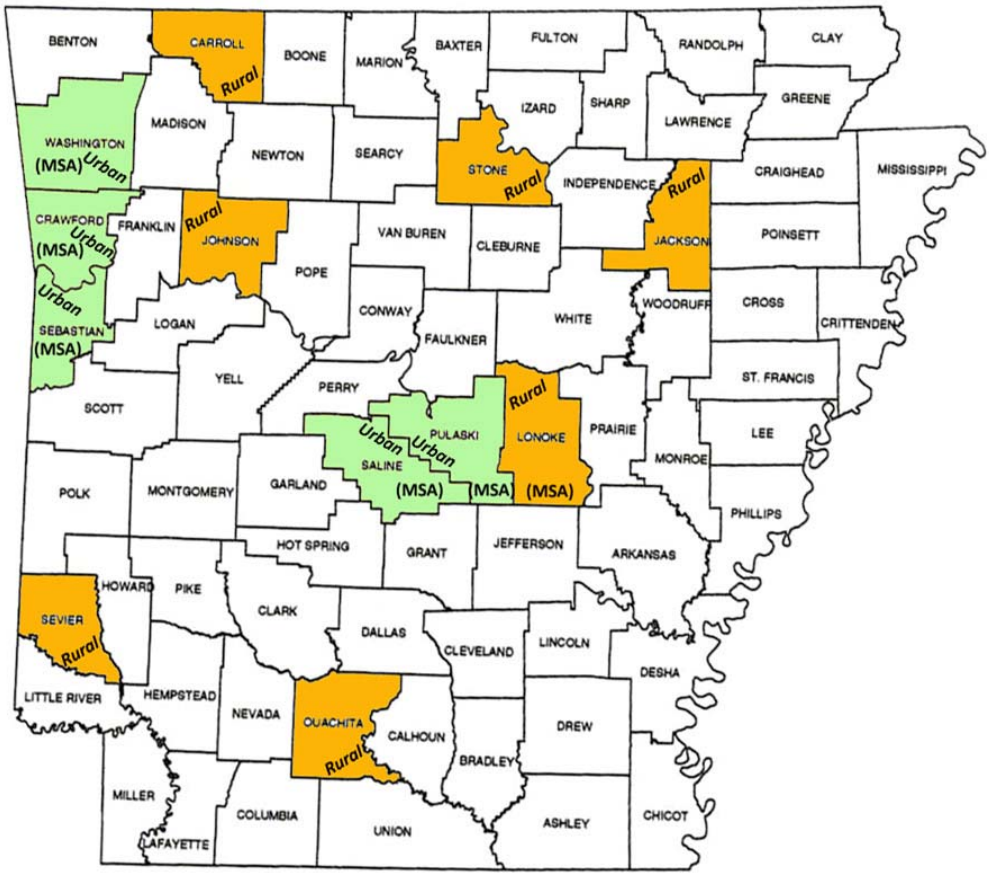

EXHIBIT 2-3 Map Showing Counties Selected

2.1.c Select Day of Week

Observations are to be made on all seven days of the week. To determine the day of the week on which to collect data in a given county, we drew days of the week without replacement until all seven days were exhausted, then fully replenished the pool from which to select. The following Exhibit 2-4 contains the outcome.

EXHIBIT 2-4 Day of Week Plan

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Saline	Pulaski	Johnson Ouachita	Carroll Sevier	Sebastian Stone	Crawford Lonoke	Jackson Washington

2.1.d Further Stratification

In the Urban counties of Crawford, Pulaski, Saline, and Sebastian, one city is paramount, much larger than the second-most populous city. We flipped a coin to choose between the two principal cities in Washington County, and selected Fayetteville. Based on a March 26, 2012 telephone conversation with Westat personnel, we apportioned the number of observation sites within the Urban counties according to the vehicle miles of travel (VMT), using the 2015 AHTD database.

In all of the selected Rural counties, the town with the largest population was considerably larger than the second-ranked town. The county with the second-ranked city population coming closest to the first-ranked city population was Carroll County, with Berryville having 5,356 and Green Forest having a population of 2,761.

Upon viewing each county map on a computer screen, we proceeded to divide the entirety of some counties in from two to four parts or tracts, based on the shape of the county (i.e., square or elongated), the pattern and coverage of roadways in the county, and the ability to arrive at somewhat equal amounts of miles of road after subdividing that county. After dividing a county into parts/tracts, we assigned numbers to the parts and used the random number generator to select the part of the county.

Exhibit 2-5 lists populations of the selected counties and cities.

2.1.e Select the Road Segment

After selecting counties, in some cases parts of that county, and the cities within those counties in which to make the observations, the next objective was to select segments (i.e., "sampling units") at which to conduct observations of seat belt use. NHTSA supplied SHAPE files for this purpose. It is our understanding that the NHTSA contractor had removed ineligible segments from the TIGER files, such as non-public roads, unnamed roads, unpaved roads, vehicular trails, access ramps, cul-de-sacs, traffic circles, and service drives, as well as rural local roads in those counties that are not within a Metropolitan Statistical Area (MSA).

The U.S. Census Bureau classified roadways in the SHAPE files according to the MAF/TIGER Feature Class Codes (MTFCC). Exhibit 2-6 lists and explains the three primary categories: Primary Roads, Secondary Roads, and Local Roads.

EXHIBIT 2-5 County and City Population

Category		County	County Pop.	City	City Pop.	% of County Pop.
Urban	Mid-section	Pulaski	382,748	Little Rock	193,524	51%
		Saline	107,118	Benton	30,681	29%
		Sebastian	125,744	Ft. Smith	86,209	69%
	Northwest	Crawford	61,948	Van Buren	22,791	37%
		Washington	203,065	Fayetteville	73,580	36%
Rural	East	Jackson	17,997	Newport	7,879	44%
		Lonoke	68,356	Cabot	23,776	35%
	North	Carroll	27,446	Berryville	5,356	20%
		Johnson	25,540	Clarksville	9,178	36%
		Stone	12,394	Mountain View	2,748	22%
	South	Ouachita	26,120	Camden	12,183	47%
		Sevier	17,058	DeQueen	6,594	39%

source: populations listed on 2015-2016 Arkansas state highway map, AHTD

EXHIBIT 2-6 Codes for MTFCC Segments in the SHAPE File

Category	Numeric Code	Description
Primary Road	S1100	Generally divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.
Secondary Road	S1200	Main arteries, usually in the U.S. Highway, State Highway or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. They often have both a local name and a route number.
Local Road, Rural Road, City Street	S1400	Generally, paved non-arterial streets, roads, or byways that usually have a single lane of traffic in each direction. Roads in this feature class may be privately or publicly maintained. Scenic park roads would be included in this feature class, as would (depending on the region of the country) some unpaved roads.

Past experience in the field taught that if a segment selected for study is very short, there is an increased probability that no safe, suitable observation station can be found along its length. Also, major roadways in urban areas, and both major and local roads in rural areas, are likely to extend for some distance, whereas many local streets within a city may extend for only a few blocks. Combining these two factors led to a process of, for some of the roadway segment types,

first merging the roadways in the SHAPE files, splitting them into segments of equal length, then selecting study segments.

At this point the question of how to apportion or allocate the number of survey sites within each county arises. For those counties having more than one of the three roadway categories, this allocation was based on the relative amounts of vehicle miles of travel recorded for various categories in a recent AHTD database.

After determining the number of segments to select from each of the categories, an online random number generator was employed to select numbers corresponding to the position (i.e., row number) of segments in the list of county segments. The selected segments were mapped and recorded in a table, along with other segment attributes. A coin toss determined the direction of travel to be surveyed.

2.2 DATA COLLECTION

Training conducted in May 2017 provided the data collectors with the information and practice needed to successfully collect data. All field data were collected between May 30 and June 10, 2017. Observations began no earlier than 7:00 am, and all data collection was completed before 6:00 pm. At all sites, the duration of the data collection was 45 minutes.

In 2017, rain showers affected data collection in three counties, causing either short interruptions or suspension of data collection until later in the day. No return visits to any county were required to conduct observations.

For each geographic area (i.e., city and county), supervisors prepared and furnished to the data collectors both a list of sites and maps indicating the exact locations of the pre-designated site. The instructions specified which road and which direction of traffic on that road was to be observed.

During the actual field data collection, the Observers adhered to the following practices.

- The observations were confined to public roads. The number of Observers at a site varied, depending upon the volume and speed of the traffic.
- For the assigned direction, the Observer collected data from as many traffic lanes in the assigned direction as could reliably be recorded.
- For the controlled-access roadway segments, observations were made at the first exit ramp downstream of the selected freeway segment. When two or more selected freeway segments were in such close proximity that they shared a common “first downstream exit ramp”, observations for each of the segments were made at different time periods.
- If it was determined that within a selected segment, there was not a place from which observations could be efficiently and safely made, the observation site was repositioned to another segment on the same roadway, with the constraint that such a site may not be

relocated in a way that results in it being positioned past (i.e., on the other side of) a roadway intersecting with the subject roadway.

- The observations were confined to those passenger vehicles with a gross vehicle weight up to 10,000 pounds, including small commercial vehicles.
- Within this group of vehicles, the Observer examined belt use by drivers and outboard-front seat passengers, including children in booster seats, but excluding children in child safety seats with harness straps.
- The Observer viewed and recorded occupant seat belt use in as many eligible vehicles as possible during the time period at each site. The Observer recorded the following data (Fed. Reg., p. 18057, §1340.7[d and e])
  (1) Status of seat belt use by driver
  (2) Status of seat belt use by a right-front passenger, if one was present
- The observation outcome choices were:
  (1) "Yes" - if the shoulder belt was observed to be in front of the person's shoulder;
  (2) "No" - if the shoulder belt was not in front of the person's shoulder; or
  (3) "Unknown" - if it could not reasonably be determined whether the person was belted.

If the cumulative percent of unknowns for any county had exceeded 10%, then additional data collection at that county would have been required. Fortunately, this situation did not arise.

Data collectors were instructed that if a situation arose so that observations could not be made at an assigned site (due to street construction, no appropriate or safe observation position, etc.), they were to contact their supervisor, so that the observations could be made at a substitute segment of the same class. The need to use alternate sites did not arise during 2017; all data were collected at primary sites. Exhibit 2-7 lists data collection dates for each county.

EXHIBIT 2-7 List of Data Collection Dates in 2017

County	Original Survey Date	Sites Surveyed	Return Survey Date	Sites Surveyed on Return Date
Johnson	Tue, May 30	all	--	--
Carroll	Wed, May 31	all	--	--
Stone	Thur, June 1	all	--	--
Lonoke	Fri, June 2	all	--	--
Jackson	Sat, June 3	all	--	--
Saline	Sun, June 4	all	--	--
Pulaski	Mon, June 5	all	--	--
Ouachita	Tue, June 6	all	--	--
Sevier	Wed, June 7	all	--	--
Sebastian	Thur, June 8	all	--	--
Crawford	Fri, June 9	all	--	--
Washington	Sat, June 10	all	--	--

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3.0 DATA REDUCTION AND ANALYSIS

The standard practice was to record raw totals and report them to the Highway Safety Office contact the night after the study had been conducted. Exhibit 3-1 lists totals for all of the counties combined, grouped in columns by driver and right-front passenger observations, and in rows by Urban or Rural counties. One group of rows includes the "Unknowns" in the calculation of percentages, another group of rows excludes the "Unknowns" in the calculation of percentages.

EXHIBIT 3-1 Initial Seat Belt Use Data Reduction

	Driver			Right-front passenger			Driver + Passenger		
	Yes	No	Unknown	Yes	No	Unknown	Yes	No	Unknown
ALL									
w Unknown	7458	1822	186	1930	522	68	9388	2344	254
	78.8%	19.2%	2.0%	76.6%	20.7%	2.7%	78.3%	19.6%	2.1%
		sum=	9,466		sum=	2,520		sum=	11,986
w/o Unknown	7458	1822	--	1930	522	--	9388	2344	--
	80.4%	19.6%	--	78.7%	21.3%	--	80.0%	20.0%	--
		sum=	9,280		sum=	2,452		sum=	11,732
URBAN									
w Unknown	4216	728	112	1013	194	41	5229	922	153
	83.4%	14.4%	2.2%	81.2%	15.5%	3.3%	82.9%	14.6%	2.4%
		sum=	5,056		sum=	1,248		sum=	6,304
w/o Unknown	4216	728	--	1013	194	--	5229	922	--
	85.3%	14.7%	--	83.9%	16.1%	--	85.0%	15.0%	--
		sum=	4,944		sum=	1,207		sum=	6,151
RURAL									
w Unknown	3242	1094	74	917	328	27	4159	1422	101
	73.5%	24.8%	1.7%	72.1%	25.8%	2.1%	73.2%	25.0%	1.8%
		sum=	4,410		sum=	1,272		sum=	5,682
w/o Unknown	3242	1094	--	917	328	--	4159	1422	--
	74.8%	25.2%	--	73.7%	26.3%	--	74.5%	25.5%	--
		sum=	4,336		sum=	1,245		sum=	5,581

The county with the greatest percentages of non-responses (i.e., unknown readings) was Saline County (4.2%); in all other counties, the fraction of unknowns was less than 3.3%. The highest percentages of unknowns occurred at two low-volume sites in Saline County: Sa7

(missed 2 of 9 attempts) and Sa8 (missed 4 of 25 attempts). In no other county did the proportion of unknowns at any one site exceed 10%. The overall number of unknowns was 254 out of 11,986 observations, or 2.1%. In 2017, there was 1 site (Ca8) at which no vehicles were observed, and three sites with only one vehicle during the 45-minute observation period (Ja8, W4, and W8).

3.1 COMPARISONS OF COUNTY SEAT BELT USE

Exhibit 3-2 displays the vehicle volumes and the unweighted seat belt use rates for each of the 12 counties over recent years. Data had been collected in the preceding five years at four of the 12 counties included in the current observation sample. The changes from 2016 to 2017 in the total volume of vehicles counted at the sites during data collection fluctuated among these four counties, ranging from a decrease of over two-thirds in Washington County to an increase of 19% in Sebastian County. In the previous five years, Washington County observations had been made on a weekday, whereas they are now conducted on a Saturday; Sebastian County was previously observed on a Sunday, but is now observed on a weekday. Overall, traffic volume during the times at which seat belt use was observed decreased by over 30%. Among the four "carryover" counties, the observed seat belt use rates decreased in two and increased in two counties.

EXHIBIT 3-2 Comparing Volumes and Unweighted Percent Using Seat Belt

County	Volume during observations				Percent wearing belt (excluding unknown)			
	2015	2016	2017	Change from 2016 to 2017	2015	2016	2017	Change from 2016 to 2017
Carroll	--	--	1238	--	--	--	76.0%	--
Crawford	--	--	1187	--	--	--	85.1%	--
Jackson	--	--	307	--	--	--	70.8%	--
Johnson	--	--	445	--	--	--	80.0%	--
Lonoke	--	--	956	--	--	--	80.1%	--
Ouachita	540	620	486	-21.6%	78.5%	77.7%	77.3%	-0.4%
Pulaski	2724	2607	2140	-17.9%	81.4%	79.7%	83.9%	4.2%
Saline	--	--	488	--	--	--	80.2%	--
Sebastian	1132	905	1077	19.0%	84.4%	87.0%	**87.2%**	0.2%
Sevier	--	--	668	--	--	--	79.1%	--
Stone	--	--	870	--	--	--	**61.6%**	--
Washington	1622	1916	597	-68.8%	89.3%	87.7%	86.2%	-1.5%
Overall	14,503	15,174	10,459	-31.1%	79.1%	77.9%	80.0%	2.1%

Exhibit 3-3 plots the county seat belt use rates for 2017, and for the four "carryover" counties, also displays the 2016 rates for comparison.

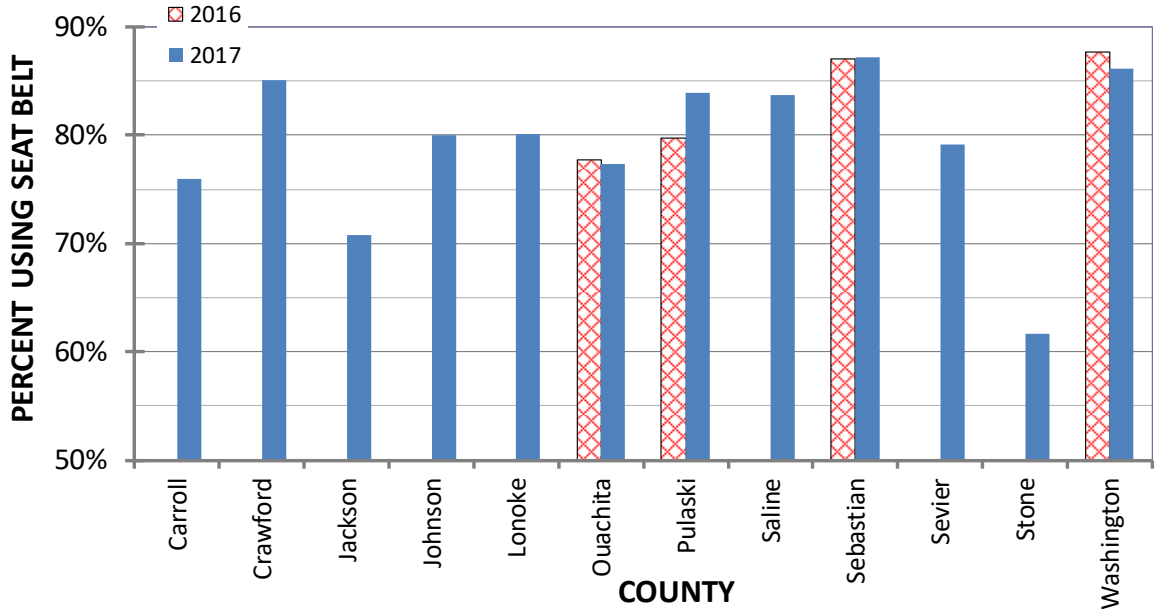

EXHIBIT 3-3 Comparing Seat Belt Use Rates from 2016 and 2017

3.2 COMPARISONS OF RURAL AND URBAN USE

Exhibit 3-4 contrasts unweighted seat belt use rates over recent years between those counties classified as more Urban and those classified as more Rural. Under the new protocol that went into effect in 2012, some of the sites are at segments with speeds of 55 mph or more, which could result in the underreporting of seat belt use. There is a somewhat greater tendency for such sites to be in those counties categorized as Rural.

In 2014, there was a slight drop in use rates, in 2015 the rates rebounded, and in 2016 the trend again went slightly downward. From 2016 to 2017, the observed use rates increased in both Urban and in Rural counties; the extent to which this increase may be due to simply collecting data from a different pool of counties and/or sites is unknown. The gap between Urban and Rural seat belt use continues.

EXHIBIT 3-4 Comparing Rural and Urban Unweighted Seat Belt Rates

	2013	change	2014	change	2015	change	2016	change	2017
Urban	82.1%	-0.1%	82.0%	1.0%	83.0%	-0.9%	82.1%	2.9%	85.0%
Rural	70.3%	-1.9%	68.4%	5.9%	74.3%	-1.1%	73.2%	1.3%	74.5%
Overall	76.7%	-0.8%	75.9%	3.2%	79.1%	-1.2%	77.9%	2.1%	80.0%

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4.0 STATISTICAL ANALYSIS

The seat belt use study protocol mandated by NHTSA beginning in 2012 entailed a procedure to produce a weighted seat belt use rate based on statistical theory. The explanation and outcome, employing the notation listed below, follows.

g – Subscript for PSU strata
c – Subscript for county (PSU)
p – Subscript for part of a county
h – Subscript for road segment strata
i – Subscript for road segment
j – Subscript for time segment
k – Subscript for direction of travel
l – Subscript for lane
m – Subscript for vehicle
n – Subscript for front-seat occupant

Under this stratified multistage sample design, the inclusion probability for each observed vehicle is the product of selection probabilities at all stages: π_{gc} for county, $\pi_{p|gc}$ for part, $\pi_{hi|gcp}$ for road segment, $\pi_{j|gcphi}$ for time segment, $\pi_{k|gcphij}$ for direction, $\pi_{l|gcphij}$ for lane, and $\pi_{m|gcphijl}$ for vehicle. Therefore, the overall vehicle inclusion probability is:

$$\pi_{gcphijklm} = \pi_{gc}\pi_{p|gc}\pi_{hi|gcp}\pi_{j|gcphi}\pi_{k|gcphij}\pi_{l|gcphij}\pi_{m|gcphijl}$$

The sampling weight (design weight) for vehicle *m* is as follows.

$$W_{gcphijklm} = \frac{1}{\pi_{gcphijklm}}$$

The selection probabilities at all stages are calculated as follows.

- County: Counties were first assigned to Urban or Rural groups. A simple random sample of counties was selected from each group, and the corresponding inclusion probability is $\pi_{gc} = n_g / N_g$, where n_g is the number of the selected counties and N_g is the total number of counties in stratum g. Note that due to its attributes (i.e., large amount of VMT, population, fatal crashes), Pulaski County was selected with certainty.
- Part: For Rural counties, after identifying and selecting the primary town in a given county, the remainder of the entire county was divided into from two to four parts. The number of parts for a given county was based on the shape of the county, the visual distribution of the eligible roadway network in that county, and the ability to carve out parts with close-to-equal numbers of segments. One of those parts was randomly chosen. The selection probability is $\pi_{p|gc} = 1/N_{gc}$, where N_{gc} is the number of tracts/parts in rural county c in stratum g. Urban counties were not subdivided.

- Road segment: The database listing the roadway segments assigned them to one of three categories (S1100, S1200, and S1400). All of the Urban counties selected for observation contained all three types of segments. For the most part, the eligible roadways in the selected Rural counties were confined to the S1100 and S1200 categories; the one exception was Lonoke County, also included S1400 roadways, since that county lies within a MSA. The selection probability at this stage is $\pi_{h|gcp} = n_{h|gcp} / N_{h|gcp}$, where $n_{h|gcp}$ is the number of the selected h^{th} type road segments and $N_{h|gcp}$ is the total number of h^{th} type road segments in tract/part p, county c, and stratum g.

- Time segment: Since the same observation time (45 minutes) was used for all sites in the survey, the selection probability of time segment was not considered in the calculation of the sampling weight, $\pi_{j|gcphi} = 1$.

- Direction of travel: Most of the selected road segments on which the vehicles were observed are two-way. One direction was randomly selected, and the probability is $\pi_{k|gcphij} = 1/2$ over the two-way road segments. For one-way segments, the selection probability was given by 1.

- Lane: For the assigned direction, the Observer collected data from all traffic lanes in the assigned direction. Hence, the selection probability of a lane was not considered in the calculation of the sampling weight, $\pi_{l|gcphijk} = 1$.

- Vehicle: The vehicle selection probability is given by $\pi_{m|gcphijkl} = n_{gcphijkl} / N_{gcphijkl}$, where $n_{gcphijkl}$ is the number of vehicles observed at the site and $N_{gcphijkl}$ is the total number of vehicles passing the site during the observation.

- The data collectors did not attempt to observe all vehicles or occupants that passed through a site. For instance, in order to concentrate on a given vehicle or a given occupant for a sufficient amount of time, an Observer might have to ignore the other occupant or the following vehicle. In some cases, an Observer was able to observe a driver but not a passenger, and in other cases observe the passenger but not the driver. The Observers did not record data to later make associations among vehicles, drivers, or passengers. To account for this in the statistical analyses, a NHTSA statistician, Fan Zhang, recommended producing, for each site, new records that summed the following:
  the number of drivers using seat belt (DRIVE_YES),
  the number of drivers not using seat belt (DRIVE_NO),
  the number of right-front passengers using seat belt (PASS_YES), and
  the number of right-front passengers using seat belt not using seat belt (PASS_NO).
  Each record was assigned a new binary variable (BELT_USE_STATUS) indicting seat belt status with the corresponding sampling weight $\pi_{gcphijklm}$ above. The seat belt use rate was estimated by computing the mean of BELT_STATUS with the sampling

weight. Appendix D lists the weights and the numbers of observations in each of the three categories for each site.

Given the data collection protocol described in this plan, including the provision for the use of alternate observation sites, road segments with non-zero eligible volume and yet zero observations conducted should be a rare event. Nevertheless, the procedure dictated that if eligible vehicles passed an eligible site or an alternate eligible site during the observation time but no usable data were collected for some reason, then this site would be considered as a "nonresponding site." However, if there were no vehicles passing the site during the selected observation time, then this would constitute simply an empty block at this site, and this site would not be considered as a nonresponding site, and would not require a nonresponse adjustment. In the analysis of the 2017 survey data, the nonresponse adjustment was not required, since there were no nonresponding sites.

Noting that all front-seat occupants were observed, let the driver/passenger seat belt use status be:

$$y_{gcphijklm} = \begin{cases} 1, & \text{if belt used} \\ 0, & \text{otherwise} \end{cases}$$

The seat belt use rate estimator is a ratio estimator:

$$\rho = \frac{\sum_{all\ gcphijklmn} w_{gcphijklm} y_{gcphijklmn}}{\sum_{all\ gcphijklmn} w_{gcphijklm}}$$

This estimator captures traffic volume and vehicle miles traveled through design at various stages and it does not require knowledge of VMT/DVMT. The unweighted estimate is 0.800 (80.0%), but the resulting weighted estimate is 0.810 (81.0%).

Due to the stratified multistage sample design used for these calculations, direct variance estimation for the seat belt use rate estimator is complicated, tedious, and costly. For the ratio estimator ρ above, the statistician employed the ratio procedure in the statistical package "Stata" to calculate the seat belt use rate and its standard error. The survey package in Stata provides a means for analyzing data from complex sample survey designs. At the suggestion of a NHTSA statistician, the standard error was approximated by the linearization method, with replacement of PSUs; since the PSUs were not replaced after they were selected, this method slightly overestimates the standard error. The resulting estimate of standard error was 0.0075 (0.75%) under assuming with-replacement selection of PSUs, which is within the allowable margin of error (2.5%).

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5.0 CLOSING

In May and June 2017, Observers recorded seat belt use at eight sites each in 12 counties, for a total of 96 sites in Arkansas.

Exhibit 5-1 presents the number of observations and vehicles counted during the time in which the observations were made. With a new pool of counties and observation sites beginning in 2017, the sum of the number of vehicles counted at each site during the seat belt use data collection periods decreased by 31% from 2016. There were similar declines in the numbers of both attempted and successful observations.

EXHIBIT 5-1 Summary of Numbers of Vehicles and Observations

	2014	2015	2016	2017
Volume of motor vehicles during observations	15,024	14,503	15,174	10,459
Number of attempted seat belt use observations	17,917	16,571	17,422	11,986
Number of successful seat belt use observations	17,589	16,379	17,183	11,732

The 2014 observed unweighted seat belt use rate fell to 75.9% (a decrease of 0.8% from 2013), then jumped by 3.2% to 79.1% in 2015. The 2016 use rate dropped to 77.9%, a decline of 1.2%. The 2017 rate rose 2.1% to 80.0%.

The **weighted seat belt use rates** were as follows:

2013: 76.7% 2014: 74.4% 2015: 77.7% 2016: 75.1% 2017: 80.0%

Thus the weighted rate dropped from 2013 to 2014, rose from 2014 to 2015, regressed in 2016, then rose in 2017. Evaluating trends over the five-year interval, one could optimistically infer a slight upward trend in seat belt use rates.

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APPENDIX A

Sample Data Collection Form

Johnson County					***rev 2 May 2017***				count each site 45 minutes					do not count P-car before 1968 or pick-up before 1972				
Date and Day of Survey:			**30 May**	**2017**	Su M Tu W Th F Sa				person(s) collecting data:									
Record begin/end miles:											Begin time:							
					-- WRITE ONLY THE DATA THAT YOU COLLECTED --						End time:							
#	**Roadway**	**Longitude**	**Latitude**	**Segment Length (mi.)**	**Location**		**Which Side of Road**	**Direction of Travel**	**Begin Time**	**Driver**			**Front-right passenger**			**Volume in one direction**		
										Yes	No	?	Yes	No	?			
Jo1	I- 40 WB	35.49748	-93.66029	0.042	Exit 47, AR 164			WB										
Jo2	I- 40 WB	35.41197	-93.38152	0.055	Exit 64, US 64 near Lamar			WB										
Jo3	I- 40 EB	35.50093	-93.68851	1.920	Exit 47, AR 164			EB										
Jo4	I- 40 EB	35.49748	-93.63955	0.093	Exit 55, US 64 west of Clarksville			EB										
Jo5	I- 40 WB	35.33825	-93.30298	0.029	Exit 67, AR 315, Knoxville			WB										
Jo6	I- 40 EB	35.45918	-93.48733	0.146	Exit 57, Crawford Street, Clarksville			EB										
Jo7	I- 40 EB	35.41290	-93.38279	0.229	Exit 67, AR 315, Knoxville			EB										
Jo8	AR 103 / S Rogers St	35.45618	-93.46369	0.250	at Porter Industrial Rd			NB										
										TOTALS								
										% BOTH								
										w/o unknown								

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APPENDIX B

List of Sites

Carroll County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Ca1	US 62 / S Main St	36.35824	-93.55792	0.250	E of jct High St	WB
Ca2	AR 21 / N Springfield St	36.37384	-93.56725	0.250	at North St (from Morse to Mountain Av)	SB
Ca3	US 62 / W Trimble Ave	36.38120	-93.59304	0.159	US 62 W, E of Lemmon Ln	EB
Ca4	US 62 / Eureka Ave	36.36706	-93.57091	0.250	W of Main St curve	WB
Ca5	AR 221	36.46159	-93.55581	1.000	S of jct Co Rd 422	SB
Ca6	AR 21	36.45632	-93.44217	1.000	at jct AR 102, Oak Grove	EB
Ca7	AR 103	36.39932	-93.43493	1.000	S of Co Rd 636, S of Yocum	SB
Ca8	AR 311	36.44218	-93.32647	1.000	NE of Farewell, W of jct Co Rd 822	SB

Crawford County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Cr1	I-540 NB	35.42453	-94.34478	0.149	Exit 3, AR 59	NB
Cr2	I-40 WB	35.45610	-94.32390	0.347	Exit 5, AR 59	WB
Cr3	I-40 EB	35.46420	-94.36820	0.705	Exit 5, AR 59	EB
Cr4	I-49 SB (540)	35.51400	-94.23710	1.026	Exit 21, Collum Lane	SB
Cr5	I-49 SB (540)	35.59450	-94.20610	0.111	Exit 24, AR 282 at Rudy	SB
Cr6	US 64 / Broadway St SB	35.43020	-94.35687	0.187	near end of bridge, jct 4th St (stand on rt turn island)	WB
Cr7	Webster St	35.43527	-94.35305	0.059	from 6th to 7th	WB
Cr8	Dora Cove	35.45313	-94.44129	0.049	from state line to Dora Rd (if WB on I-40, take Exit 1 to Dora Rd)	WB

Jackson County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Ja1	US 67 SB	35.65190	-91.23110	0.132	Exit 85, Airbase Road AR 18	SB
Ja2	US 67 SB (WB)	35.67130	-91.16960	0.421	Exit 87, County Road 43	WB
Ja3	US 67 SB	35.60580	-91.23990	0.286	Exit 82, AR 17	SB
Ja4	US 67 SB	35.61560	-91.23910	0.444	Exit 83, Stegall Road AR 384	SB
Ja5	AR 18 / Air Base Rd	35.63887	-91.22043	0.001	near jct AR 980	SB
Ja6	AR 14 / S State St	35.60466	-91.26006	0.161	south of Malcolm St	NB
Ja7	AR 367	35.72085	-91.20475	1.000	in Tuckerman, at jct AR 37 / Hosea Rd	NB
Ja8	AR 384	35.65159	-91.13733	1.000	west of Grubbs	NB

Johnson County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Jo1	I-40 WB	35.49748	-93.66029	0.042	Exit 47, AR 164	WB
Jo2	I-40 WB	35.41197	-93.38152	0.055	Exit 64, US 64 near Lamar	WB
Jo3	I-40 EB	35.50093	-93.68851	1.920	Exit 47, AR 164	EB
Jo4	I-40 EB	35.49748	-93.63955	0.093	Exit 55, US 64 west of Clarksville	EB
Jo5	I-40 WB	35.33825	-93.30298	0.029	Exit 67, AR 315, Knoxville	WB
Jo6	I-40 EB	35.45918	-93.48733	0.146	Exit 57, Crawford Street, Clarksville	EB
Jo7	I-40 EB	35.41290	-93.38279	0.229	Exit 67, AR 315, Knoxville	EB
Jo8	AR 103 / S Rogers St	35.45618	-93.46369	0.250	at jct Porter Industrial Rd	NB

Lonoke County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
L 1	US 67 NB	34.97745	-92.03577	0.004	Cabot; Exit 19, AR 89 (cloverleaf ramp)	NB
L 2	US 67 SB	35.02032	-91.97036	0.007	Austin; Exit 22, AR 305	SB
L 3	US 67 NB	35.02414	-91.96713	0.004	Ward: Exit 25, AR 319 / North St	NB
L 4	US 67 SB	35.00179	-91.99636	0.009	Cabot; Exit 19, AR 89 (cloverleaf ramp)	SB
L 5	AR 89 / S Pine St	34.94411	-92.00863	0.250	near Panther Trail	NB
L 6	AR 367 / N 2nd St	34.97826	-92.01285	0.250	near Locust St	SB
L 7	AR 321	34.97389	-91.92869	1.000	south of AR 38	SB
L 8	Deller Rd	34.94219	-91.87849	0.495	north of AR 31 jct AR 321 Spur; at jct AR 31	EB

Ouachita County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
O1	US 278 / Branyan-Hunnicutt Byp WB	33.57125	-92.84526	0.250	US 278 east of Cash Rd	WB
O2	US 79 Bus / Van Buren St NW	33.58654	-92.83090	0.103	from Harrison to Adams	EB
O3	AR 7 / S Adams Ave SB	33.56963	-92.82753	0.209	vicinity of AR 7 over the bypass; in front of church	SB
O4	AR 7 / S Adams Ave	33.58587	-92.82961	0.030	from Washington to Jefferson	NB
O5	AR 57	33.67950	-93.04786	1.000	SW of Chidester, north of AR 76 / 387	SB
O6	AR 24	33.60565	-92.90832	1.000	NW of Country Club, Co Rd 516	EB
O7	US 278	33.56204	-92.90922	1.000	near jct AR 376, Two Bayou Relief	NB
O8	AR 57	33.54756	-93.07685	1.000	either side of US 278	SB

Pulaski County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
P 1	I-30 EB	34.67235	-92.37418	0.181	Exit 131, Chicot; at jct Distribution Dr	EB
P 2	I-30 EB (NB)	34.74395	-92.26285	0.016	downtown exit, 2nd St	on the ramp, it is WB
P 3	I-430 NB	34.72925	-92.40061	0.042	Exit 5, Shackleford	NB
P 4	I-630 EB	34.74536	-92.34659	0.269	Exit 5, University	EB
P 5	AR 300	34.81423	-92.49742	0.250	from Cantrell to Chenall	SB
P 6	US 70 / Asher Ave	34.71893	-92.33551	0.159	west of Fair Park Blvd	WB
P 7	Pleasant Valley Dr	34.78692	-92.38708	0.009	@ AR10 / Cantrell Rd	NB
P 8	Glen Dr	34.77960	-92.35589	0.197	from Youngwood to Indian Trail	WB

Saline County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Sa1	I-30 WB	34.59821	-92.55439	0.037	Exit 118, W of Military Rd overpass	WB
Sa2	I-30 WB	34.60892	-92.52455	0.003	Exit 121, Alcoa Rd	WB
Sa3	I-30 EB	34.59846	-92.55322	0.116	Exit 121, Alcoa Rd	EB
Sa4	I-30 EB	34.53834	-92.66722	0.290	Exit 114, old US 67	EB
Sa5	AR 5	34.59828	-92.55472	0.250	south of Long Hills (part is one-way)	SB
Sa6	AR 298	34.66660	-92.68255	1.000	NW of Benton	EB
Sa7	Hickory Ridge	34.58181	-92.57954	0.133	E of jct Wright Av	EB
Sa8	Cynamide Rd	34.57873	-92.53467	0.183	SW of Alcoa Rd	NB

Sebastian County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Sb1	I-49 SB (540)	35.35963	-94.36512	0.008	exit @ AR 22 / Rogers Ave	SB
Sb2	AR 255 / Zero St	35.32828	-94.42714	0.046	E of jct Wheeler Ave (see NOTE 1)	WB
Sb3	US 71 Bus NB	35.32059	-94.40429	0.250	S of jct 31st St	NB
Sb4	US 64 / Midland Blvd	35.42318	-94.37494	0.250	near 50th St	EB
Sb5	AR 252 / W Crescent St	35.07999	-94.27407	0.374	in Huntington; near Washington Ave	WB
Sb6	Deerfield Ct	35.27175	-94.35831	0.078	US 71 south, E on Riley Park Rd	WB
Sb7	Riverlyn Ter	35.37199	-94.34820	0.209	close to jct S 74th and Free Ferry Rd; at jct Riverlyn Dr	WB
Sb8	M St S	35.37024	-94.41757	0.059	near S 16th	EB

Sevier County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
Sv1	US 71 / N Lakeside Dr SB	34.04555	-94.33016	0.051	N side of jct US 70 / Collin Raye	SB
Sv2	AR 41	34.02630	-94.33717	0.170	from 4th to Red Bridge Rd	EB
Sv3	US 70 / W Collin Raye Dr	34.04582	-94.36122	0.250	near Johnson Bridge Rd (vacant driveways to west)	WB
Sv4	N 9th St	34.03800	-94.34739	0.037	from DeQueen Ave to Locke Ave	NB
Sv5	US 71	33.96328	-94.16940	0.462	in Lockesburg, S of jct AR 24	NB
Sv6	AR 317	33.85463	-94.07331	1.000	near Dellinger Rd	SB
Sv7	AR 24	33.97451	-94.23829	0.690	W of Lockesburg; E of jct AR 329	WB
Sv8	AR 317	33.92519	-94.10882	1.000	near Co Rd 318 (along pair of curves at W end of segment)	NB

Stone County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
St1	AR 87 / Lancaster Ave	35.87001	-92.12130	0.250	N of jct W Main	SB
St2	AR 66 / W Main St	35.86306	-92.14230	0.250	E of Baxter Av	WB
St3	AR 66 / E Main St	35.86419	-92.10603	0.250	E side of Sylamore	EB
St4	AR 9/5/14 / Sylamore Ave	35.86637	-92.10719	0.250	N side of E Main	NB
St5	AR 5 / Mtn View Rd	35.78792	-91.96508	1.000	~ 9 mi S of AR 14, near Murray Rd, @ Arbanna Bapt Church	NB
St6	AR 5	35.96241	-92.10029	1.000	N of Green Mtn Rd	NB
St7	AR 58	35.86856	-91.99305	1.000	N side of AR 14	SB
St8	AR 14	35.80405	-91.88704	0.234	between Marcella and Pleas Grove, SE of Mill Creek Rd	EB

Washington County

#	Roadway	Longitude	Latitude	Segment Length (mi.)	Location	Direction of Travel
W1	I-49 NB	36.08743	-94.19493	0.002	near Porter Rd exit	NB
W2	I-49 NB	36.04991	-94.19239	0.001	near MLK exit	NB
W3	AR 16 / E 15th St	36.04795	-94.14424	0.250	from Morningside Dr to Armstrong	WB
W4	AR 112 / S Maestri Rd	36.11819	-94.19401	0.074	from Howard Nickell to Pierre Crossing	NB
W5	Barrington Rd / Wheeler Rd / Co Rd 84	36.12986	-94.24683	0.194	west on Reed Valley Rd until rd ends @ T-int; site is S side of jct	SB
W6	E Ash St	36.08632	-94.15184	0.001	from curve at Walnut Ave to Rayview Dr	EB
W7	W Pierre Crossing	36.11997	-94.19362	0.001	E of jct AR 112	EB
W8	Roxbury Way	36.14054	-94.16485	0.183	from I-49, go E on Johnson Mill Rd; turn Lt (N) on Carley Rd; turn Rt (E) on Drexelwood Dr to Roxbury Way	SB

APPENDIX C

Seat Belt Survey Raw Data by County

Carroll County			Date and Day of Survey:		**31 May**		**2017**	Su M Tu **W** Th F Sa			
	#	**Roadway**	**Direction of Travel**	**Begin Time**	**Driver**			**Front-right passenger**			**Volume in one direction**
					Yes	No	?	Yes	No	?	
S1200	Ca1	US 62 / S Main St	WB	11:30	245	61	1	74	21	7	355
S1200	Ca2	AR 21 / N Springfield St	SB	8:20	91	39	4	25	11	1	152
S1200	Ca3	US 62 / W Trimble Ave	EB	9:35	185	56	0	60	18	0	256
S1200	Ca4	US 62 / Eureka Ave	WB	10:35	231	86	2	57	21	3	348
S1200	Ca5	AR 221	SB	8:15	43	6	3	12	4	1	59
S1200	Ca6	AR 21	EB	11:00	23	9	0	9	4	0	37
S1200	Ca7	AR 103	SB	9:45	19	5	3	5	0	0	31
S1200	Ca8	AR 311	SB	12:15	0	0	0	0	0	0	0
			TOTALS		837	262	13	242	79	12	1238
			% BOTH	1445	74.7%	23.6%	1.7%				
			w/o unknown	1420	76.0%	24.0%					

Crawford County			Date and Day of Survey:		**9 June**		**2017**	Su M Tu W Th **F** Sa			
	#	**Roadway**	**Direction of Travel**	**Begin Time**	**Driver**			**Front-right passenger**			**Volume in one direction**
					Yes	No	?	Yes	No	?	
S1100	Cr1	I-540 NB	NB	10:35	153	30	3	38	12	0	203
S1100	Cr2	I-40 WB	WB	9:35	232	38	2	73	10	1	301
S1100	Cr3	I-40 EB	EB	8:35	75	18	0	23	0	1	103
S1100	Cr4	I-49 SB (540)	SB	11:55	30	2	0	11	1	0	32
S1100	Cr5	I-49 SB (540)	SB	10:40	29	5	0	11	1	0	47
S1200	Cr6	US 64 / Broadway St SB	WB	7:50	335	46	26	48	18	9	471
S1400	Cr7	Webster St	WB	9:10	18	3	0	5	0	0	21
S1400	Cr8	Dora Cove	WB	7:40	4	4	0	0	2	0	9
			TOTALS		876	146	31	209	44	11	1187
			% BOTH	1317	82.4%	14.4%	3.2%				
			w/o unknown	1275	85.1%	14.9%					

Jackson County

Date and Day of Survey: **3 June** **2017** Su M Tu W Th F **Sa**

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	Ja1	US 67 SB	SB	8:55	20	4	2	9	5	0	33
S1100	Ja2	US 67 SB (WB)	WB	8:00	1	1	0	1	0	0	4
S1100	Ja3	US 67 SB	SB	9:00	21	10	0	9	4	0	34
S1100	Ja4	US 67 SB	SB	11:20	17	3	0	10	2	0	21
S1200	Ja5	AR 18 / Air Base Rd	SB	10:00	10	6	0	2	1	0	17
S1200	Ja6	AR 14 / S State St	NB	8:05	42	15	0	15	3	0	61
S1200	Ja7	AR 367	NB	11:00	85	45	3	37	15	1	136
S1200	Ja8	AR 384	NB	10:20	0	1	0	0	0	0	1
			NB								
			TOTALS		196	85	5	83	30	1	307
			% BOTH	400	69.8%	28.8%	1.5%				
			w/o unknown	394	70.8%	29.2%					

Johnson County

Date and Day of Survey: **30 May** **2017** Su M **Tu** W Th F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	Jo1	I- 40 WB	WB	8:20	7	2	0	0	0	0	10
S1100	Jo2	I- 40 WB	WB	10:35	38	7	3	15	1	0	55
S1100	Jo3	I- 40 EB	EB	7:20	5	2	0	2	1	0	9
S1100	Jo4	I- 40 EB	EB	9:20	13	3	0	1	1	1	28
S1100	Jo5	I- 40 WB	WB	9:25	12	0	0	1	0	0	15
S1100	Jo6	I- 40 EB	EB	10:25	40	6	0	16	5	0	55
S1100	Jo7	I- 40 EB	EB	8:25	8	3	0	1	1	0	12
S1200	Jo8	AR 103 / S Rogers St	NB	7:15	192	52	4	13	7	2	261
			TOTALS		315	75	7	49	16	3	445
			% BOTH	465	78.3%	19.6%	2.2%				
			w/o unknown	455	80.0%	20.0%					

Lonoke County

Date and Day of Survey: **2 June** **2017** Su M Tu W Th **F** Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	L 1	US 67 NB	NB	* 9:45 10:20	58	9	0	16	1	0	75
S1100	L 2	US 67 SB	SB	8:00	42	6	1	12	3	0	51
S1100	L 3	US 67 NB	NB	7:45	24	10	1	1	0	0	40
S1100	L 4	US 67 SB	SB	8:45	73	6	3	11	4	0	137
S1200	L 5	AR 89 / S Pine St	NB	9:10	179	65	0	48	14	1	256
S1200	L 6	AR 367 / N 2nd St	SB	*11:00 12:20	283	70	8	107	19	3	373
S1200	L 7	AR 321	SB	10:25	16	4	0	2	6	0	21
S1400	L 8	Deller Rd	EB	11:25	2	1	0	1	0	0	3
		NOTE: "*" indicates count interrupted by rain	**TOTALS**		677	171	13	198	47	4	956
			% BOTH	1110	78.8%	19.6%	1.5%				
			w/o unknown	1093	80.1%	19.9%					

Ouachita County

Date and Day of Survey: **6 June** **2017** Su M **Tu** W Th F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1200	O1	US 278 / Branyan-Hunnicutt Byp WB	WB	8:05	111	26	7	25	6	0	177
S1200	O2	US 79 Bus / Van Buren St NW	EB	8:10	42	16	1	3	6	0	59
S1200	O3	AR 7 / S Adams Ave SB	SB	7:10	42	16	0	10	6	0	69
S1200	O4	AR 7 / S Adams Ave	NB	7:15	42	10	0	7	3	0	61
S1200	O5	AR 57	SB	11:15	6	1	0	3	0	0	11
S1200	O6	AR 24	EB	10:10	39	8	2	14	2	2	62
S1200	O7	US 278	NB	10:00	25	9	2	11	4	1	42
S1200	O8	AR 57	SB	11:05	3	0	0	2	0	0	5
			TOTALS		310	86	12	75	27	3	486
			% BOTH	513	75.0%	22.0%	2.9%				
			w/o unknown	498	77.3%	22.7%					

Pulaski County

Date and Day of Survey: **5 June** **2017** Su **M** Tu W Th F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	P 1	I-30 EB	EB	2:30	35	8	2	5	3	0	58
S1100	P 2	I-30 EB (NB)	on the ramp, it is WB	10:10	118	22	4	34	8	0	158
S1100	P 3	I-430 NB	NB	7:45	653	90	11	76	17	0	766
S1100	P 4	I-630 EB	EB	8:50	469	102	4	97	17	0	607
S1200	P 5	AR 300	SB	9:25	16	4	0	2	0	0	20
S1200	P 6	US 70 / Asher Ave	WB	8:00	270	67	12	41	13	1	385
S1400	P 7	Pleasant Valley Dr	NB	1:10	114	19	2	25	4	0	140
S1400	P 8	Glen Dr	WB	10:30	4	2	0	0	0	0	6
			TOTALS		1679	314	35	280	62	1	2140
			% BOTH	2371	82.6%	15.9%	1.5%				
			w/o unknown	2335	83.9%	16.1%					

Saline County

Date and Day of Survey: **4 June** **2017** **Su** M Tu W Th F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	Sa1	I-30 WB	WB	7:55	45	15	1	15	4	1	64
S1100	Sa2	I-30 WB	WB	2:15	179	30	9	104	11	4	229
S1100	Sa3	I-30 EB	EB	9:25	56	24	1	30	9	2	88
S1100	Sa4	I-30 EB	EB	1:10	33	2	3	14	5	1	39
S1200	Sa5	AR 5	SB	8:15	25	2	1	8	1	0	28
S1200	Sa6	AR 298	EB	2:10	3	2	0	3	0	0	6
S1400	Sa7	Hickory Ridge	EB	1:00	8	1	0	3	0	2	9
S1400	Sa8	Cynamide Rd	NB	9:30	20	2	3	8	0	1	25
			TOTALS		369	78	18	185	30	11	488
			% BOTH	691	80.2%	15.6%	4.2%				
			w/o unknown	662	83.7%	16.3%					

Sebastian County

Date and Day of Survey: **8 June** **2017** Su M Tu W **Th** F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	Sb1	I-49 SB (540)	SB	10:35	241	29	2	65	14	4	280
S1200	Sb2	AR 255 / Zero St	WB	9:25	102	19	4	25	2	1	154
S1200	Sb3	US 71 Bus NB	NB	8:20	264	37	7	50	9	4	381
S1200	Sb4	US 64 / Midland Blvd	EB	7:15	189	23	5	36	4	1	220
S1200	Sb5	AR 252 / W Crescent St	WB	10:50	14	4	0	6	2	0	19
S1400	Sb6	Deerfield Ct	WB	9:30	7	1	0	0	0	0	8
S1400	Sb7	Riverlyn Ter	WB	7:10	3	0	0	2	1	0	3
S1400	Sb8	M St S	EB	8:15	7	4	0	3	0	0	12
			TOTALS		827	117	18	187	32	10	1077
			% BOTH	1191	85.1%	12.5%	2.4%				
			w/o unknown	1163	87.2%	12.8%					

Sevier County

Date and Day of Survey: **7 June** **2017** Su M Tu **W** Th F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1200	Sv1	US 71 / N Lakeside Dr SB	SB	8:50	169	33	5	44	11	1	263
S1200	Sv2	AR 41	EB	7:00	38	14	0	5	2	0	59
S1200	Sv3	US 70 / W Collin Raye Dr	WB	9:50	72	19	5	10	9	0	116
S1200	Sv4	N 9th St	NB	7:55	50	20	0	11	2	0	71
S1200	Sv5	US 71	NB	9:55	80	16	4	32	4	1	132
S1200	Sv6	AR 317	SB	7:45	3	2	0	1	0	0	7
S1200	Sv7	AR 24	WB	11:00	9	5	0	2	1	0	18
S1200	Sv8	AR 317	NB	8:50	1	0	0	0	1	0	2
			TOTALS		422	109	14	105	30	2	668
			% BOTH	682	77.3%	20.4%	2.3%				
			w/o unknown	666	79.1%	20.9%					

Stone County

Date and Day of Survey: **1 June** **2017** Su M Tu W **Th** F Sa

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1200	St1	AR 87 / Lancaster Ave	SB	10:00	44	25	0	22	9	0	72
S1200	St2	AR 66 / W Main St	WB	10:55	73	59	2	24	13	0	156
S1200	St3	AR 66 / E Main St	EB	9:00	151	95	1	60	34	0	269
S1200	St4	AR 9/5/14 / Sylamore Ave	NB	8:10	129	105	3	30	29	0	248
S1200	St5	AR 5 / Mtn View Rd	NB	12:20	22	4	2	7	2	0	30
S1200	St6	AR 5	NB	8:30	25	7	1	11	3	1	35
S1200	St7	AR 58	SB	10:00	14	2	0	3	0	0	17
S1200	St8	AR 14	EB	11:10	27	9	1	8	9	1	43
			TOTALS		485	306	10	165	99	2	870
			% BOTH	1067	60.9%	38.0%	1.1%				
			w/o unknown	1055	61.6%	38.4%					

Washington County

Date and Day of Survey: **10 June** **2017** Su M Tu W Th F **Sa**

	#	Roadway	Direction of Travel	Begin Time	Driver			Front-right passenger			Volume in one direction
					Yes	No	?	Yes	No	?	
S1100	W1	I-49 NB	NB	11:05	101	13	1	36	5	0	117
S1100	W2	I-49 NB	NB	7:00	67	9	1	20	7	0	83
S1200	W3	AR 16 / E 15th St	WB	7:05	130	23	4	35	9	7	181
S1200	W4	AR 112 / S Maestri Rd	NB	8:55	1	0	0	0	0	0	1
S1200	W5	Barrington Rd / Wheeler Rd / Co Rd 84	SB	9:55	9	3	0	3	2	0	14
S1400	W6	E Ash St	EB	11:10	58	6	0	19	2	0	66
S1400	W7	W Pierre Crossing	EB	9:05	99	18	4	39	1	1	134
S1400	W8	Roxbury Way	SB	10:00	0	1	0	0	0	0	1
			TOTALS		465	73	10	152	26	8	597
			% BOTH	734	84.1%	13.5%	2.5%				
			w/o unknown	716	86.2%	13.8%					

APPENDIX D

Data Collected at Observation Sites

Site ID	Site Type	Date Observed	Sample Weight	Number of Drivers	Number of Front Passengers (outboard side only)	Number of Drivers and Front Passengers Belted	Number of Drivers and Front Passengers Unbelted	Number of Drivers and Front Passengers With Unknown Belt Use
Ca1	original	May 31	223.3	307	102	319	82	8
Ca2	original	May 31	225.1	134	37	116	50	5
Ca3	original	May 31	204.5	241	78	245	74	0
Ca4	original	May 31	211.3	319	81	288	107	5
Ca5	original	May 31	885.0	52	17	55	10	4
Ca6	original	May 31	849.8	32	13	32	13	0
Ca7	original	May 31	949.4	27	5	24	5	3
Cr1	original	Jun 9	72.7	186	50	191	42	3
Cr2	original	Jun 9	73.0	272	84	305	48	3
Cr3	original	Jun 9	72.5	93	24	98	18	1
Cr4	original	Jun 9	141.0	32	12	41	3	0
Cr5	original	Jun 9	194.9	34	12	40	6	0
Cr6	original	Jun 9	116.8	407	75	383	64	35
Cr7	original	Jun 9	5100.0	21	5	23	3	0
Cr8	original	Jun 9	10,064.3	8	2	4	6	0
Ja1	original	Jun 3	264.0	26	14	29	9	2
Ja2	original	Jun 3	384.0	2	1	2	1	0
Ja3	original	Jun 3	210.6	31	13	30	14	0
Ja4	original	Jun 3	201.6	20	12	27	5	0
Ja5	original	Jun 3	382.5	16	3	12	7	0
Ja6	original	Jun 3	385.3	57	18	57	18	0
Ja7	original	Jun 3	1682.2	133	53	122	60	4
Ja8	original	Jun 3	1608.0	1	0	0	1	0
Jo1	original	May 30	266.7	9	0	7	2	0
Jo2	original	May 30	293.3	48	16	53	8	3
Jo3	original	May 30	308.6	7	3	7	3	0
Jo4	original	May 30	420.0	16	3	14	4	1
Jo5	original	May 30	300.0	12	1	13	0	0
Jo6	original	May 30	287.0	46	21	56	11	0
Jo7	original	May 30	261.8	11	2	9	4	0
Jo8	original	May 30	1018.3	248	22	205	59	6
L1	original	Jun 2	134.3	67	17	74	10	0
L2	original	Jun 2	382.5	49	15	54	9	1
L3	original	Jun 2	423.5	35	1	25	10	1
L4	original	Jun 2	624.3	82	15	84	10	3
L5	original	Jun 2	572.9	244	63	227	79	1

Site ID	Site Type	Date Observed	Sample Weight	Number of Drivers	Number of Front Passengers (outboard side only)	Number of Drivers and Front Passengers Belted	Number of Drivers and Front Passengers Unbelted	Number of Drivers and Front Passengers With Unknown Belt Use
L6	original	Jun 2	576.9	361	129	390	89	11
L7	original	Jun 2	1757.7	20	8	18	10	0
L8	original	Jun 2	1674.0	3	1	3	1	0
O1	original	Jun 6	372.1	144	31	136	32	7
O2	original	Jun 6	293.0	59	9	45	22	1
O3	original	Jun 6	342.6	58	16	52	22	0
O4	original	Jun 6	675.7	52	10	49	13	0
O5	original	Jun 6	1527.4	7	3	9	1	0
O6	original	Jun 6	1282.2	49	18	53	10	4
O7	original	Jun 6	1200.7	36	16	36	13	3
O8	original	Jun 6	1620.0	3	2	5	0	0
P1	original	Jun 5	213.5	45	8	40	11	2
P2	original	Jun 5	178.6	144	42	152	30	4
P3	original	Jun 5	163.1	754	93	729	107	11
P4	original	Jun 5	168.2	575	114	566	119	4
P5	original	Jun 5	244.0	20	2	18	4	0
P6	original	Jun 5	278.8	349	55	311	80	13
P7	original	Jun 5	17,365.3	135	29	139	23	2
P8	original	Jun 5	16,497.0	6	0	4	2	0
Sa1	original	Jun 4	102.2	61	20	60	19	2
Sa2	original	Jun 4	105.0	218	119	283	41	13
Sa3	original	Jun 4	105.4	81	41	86	33	3
Sa4	original	Jun 4	206.1	38	20	47	7	4
Sa5	original	Jun 4	404.4	28	9	33	3	1
Sa6	original	Jun 4	840.0	5	3	6	2	0
Sa7	original	Jun 4	6835.0	9	5	11	1	2
Sa8	original	Jun 4	7767.0	25	9	28	2	4
Sb1	original	Jun 8	334.4	272	83	306	43	6
Sb2	original	Jun 8	466.7	125	28	127	21	5
Sb3	original	Jun 8	232.1	308	63	314	46	11
Sb4	original	Jun 8	380.5	217	41	225	27	6
Sb5	original	Jun 8	1403.9	18	8	20	6	0
Sb6	original	Jun 8	11,316.7	8	0	7	1	0
Sb7	original	Jun 8	11,316.7	3	3	5	1	0
Sb8	original	Jun 8	12,345.5	11	3	10	4	0
Sv1	original	Jun 7	146.5	207	56	213	44	6
Sv2	original	Jun 7	255.3	52	7	43	16	0
Sv3	original	Jun 7	286.8	96	19	82	28	5
Sv4	original	Jun 7	228.2	70	13	61	22	0
Sv5	original	Jun 7	977.6	100	37	112	20	5
Sv6	original	Jun 7	995.4	5	1	4	2	0

Site ID	Site Type	Date Observed	Sample Weight	Number of Drivers	Number of Front Passengers (outboard side only)	Number of Drivers and Front Passengers Belted	Number of Drivers and Front Passengers Unbelted	Number of Drivers and Front Passengers With Unknown Belt Use
Sv7	original	Jun 7	914.1	14	3	11	6	0
Sv8	original	Jun 7	1422.0	1	1	1	1	0
St1	original	Jun 1	226.4	69	31	66	34	0
St2	original	Jun 1	256.5	134	37	97	72	2
St3	original	Jun 1	237.3	247	94	211	129	1
St4	original	Jun 1	230.0	237	59	159	134	3
St5	original	Jun 1	726.9	28	9	29	6	2
St6	original	Jun 1	689.1	33	15	36	10	2
St7	original	Jun 1	669.4	16	3	17	2	0
St8	original	Jun 1	752.5	37	18	35	18	2
W1	original	Jun 10	60.8	115	41	137	18	1
W2	original	Jun 10	64.7	77	27	87	16	1
W3	original	Jun 10	454.3	157	51	165	32	11
W4	original	Jun 10	384.0	1	0	1	0	0
W5	original	Jun 10	742.0	12	5	12	5	0
W6	original	Jun 10	2408.5	64	21	77	8	0
W7	original	Jun 10	2674.8	121	41	138	19	5
W8	original	Jun 10	73,332.0	1	0	0	1	0

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APPENDIX E

Qualifications of Statistician

Justin R Chimka is an associate professor in the Department of Industrial Engineering at the University of Arkansas. His main area of expertise is applied statistics. Justin is an editorial board member of the *International Journal of Quality Engineering & Technology* and associate editor of the journal *Economic Quality Control*.

Education

PhD, Industrial Engineering, University of Pittsburgh, 2001
MS, Industrial Engineering, University of Pittsburgh, 1998
BS, Industrial Engineering, University of Pittsburgh, 1995

Professional Associations

American Society for Quality
Institute for Operations Research and the Management Sciences
Institute of Industrial Engineers

Relevant Project Experience

Nachtmann, H, EA Pohl and JR Chimka, Supporting Secure and Resilient Inland Waterways, Department of Homeland Security via the Mack-Blackwell National Transportation Security Center of Excellence: 2010-present.

Chimka, JR, Information Enhancement Among Aviation Security Partners, Department of Homeland Security via the Mack-Blackwell National Transportation Security Center of Excellence: 2009-2010.

Chimka, JR, RDC Scheduled Delivery, Walmart via the Center for Engineering Logistics & Distribution: 2007.

Relevant Publications

Smith, BK, JR Chimka and H Nachtmann (2014), A 0-1 Quadratic Program for the Case of Missing Data in Regression, *Int J of Data Analysis Techniques & Strategies* 6(1): 94-104.

Black, R and JR Chimka (2012), A Theoretically Appropriate Poisson Process Monitor, *Int J of Performability Engineering* 8(4): 457-461.

Chimka, JR and J Zhou (2012), Theoretical Errors and Economic Design for Individual Measures, *Advances & Applications in Statistics* 27(2): 97-108.

Black, R and JR Chimka (2011), Re-estimating and Remodeling General Aviation Operations, *Int J of Applied Aviation Studies* 11(1): 47-56.

Chimka, JR and H Wolfe (2010), Comparing With Relative Accuracy Two Independent Ordinal Samples, *Quality Technology & Quantitative Management* 7(2): 185-198.