Louisiana Crash Costs

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Introduction: KABCO and MAIS codes:

The State of Louisiana Uniform Motor Vehicle Traffic Crash Report uses five codes (A-E) to describe the injury severity of a vehicle occupant or pedestrian involved in a crash (see Table 1). The Louisiana report follows the KABCO scale recommended in the Minimum Model Uniform Crash Criteria (MMUCC) guidelines for crash data (DOT, 2012). The KABCO scale is used by police officers to judge the injury level of each person involved in a crash. The injury codes are defined as: K for killed, A for incapacitating injury, B for probable Injury, C for possible injury and O for no injury.

The Abbreviated Injury Scale (AIS), developed by the Association for the Advancement of Automotive Medicine (Gennarelli and Wodzin, 2005), uses six (6) codes from 1 (minor) to 6 (life threatening). This scale is presented in Table 2. Several AIS codes may be assigned to an injured person who has multiple injuries. Therefore, a Maximum AIS (MAIS), from all recorded injury codes, is used as a measure of the overall injury level for an occupant. A MAIS of 3 or greater (MAIS 3+) is suggested as the cutoff for defining serious injury (Flannagan,2012).

Matching KABCO and MAIS scales is difficult because an AIS is assigned by trained coders using medical records and the KABCO scale, used by police officers, gives a general impression of overall injury severity at the scene. Research that has tried to correlate the injury severity between the two scales has not found a good match. For instance, Compton (2005) compared KABCO to MAIS as coded in a nationally representative dataset and found that A injuries on the KABCO scale include over 65% of MAIS 2+ injured occupants in the AIS scale while Farmer (2003) analyzed the same dataset and found that 49% of drivers coded as severe injuries (A) had only minor injuries when coded with the AIS codes. Flannagan (2012) found a 20% match of A injuries on the KABCO scale with MAIS3+ injuries on the AIS scale in a dataset of 33 million injuries. Using MAIS codes to evaluate trends in injury severity would require that crash reports be recoded based on medical records which are not readily available.

Hospitals use the International Classification of Diseases (ICD) code for diagnoses of all health conditions. Flannagan at al. (2012) suggest that the “best method of assessing injury level is direct linkage between crash, EMS, and hospital databases”. Some attempts have been made to match ICD-9

codes, from hospital discharge data, to AIS codes (see ICDMAP and ICDPIC methods). However, individuals with traffic injuries, even if transported to a hospital, are not always admitted to the hospital. Many may only be treated in the emergency room. ICD-9 codes are not made available for those injured and not admitted to the hospital, because the codes are not captured in the field by EMS in Louisiana.

Table 1: Injury Codes for The State of Louisiana Uniform Motor Vehicle Traffic Crash Report

Injury Code	Injury
E	No Injury
D	Possible / Complaint
C	Non-Incapacitating / Moderate
B	Incapacitating / Severe
A	Fatal

Table 2: Abbreviated Injury Score (AIS) Codes

AIS-Code	Injury	Example	AIS % Prob. of Death
1	Minor	superficial laceration	0
2	Moderate	fractured sternum	1 – 2
3	Serious	open fracture of humerus	8 – 10
4	Severe	perforated trachea	5 – 50
5	Critical	ruptured liver with tissue loss	5 – 50
6	Maximum	total severance of aorta	100
9	Not Further Specified (NFS)		

Frequencies of Injury Severities in Crashes

The most recent estimate of crash costs (NHTSA, 2014) provides estimates for each of the six MAIS codes. However, as pointed out above, there is no easy way of matching these injury codes. In the past, the following match was done: 1=D, 2-3=C, 4-5=B and 6=A. Table 3 displays national and Louisiana crash data. The MAIS scale applies to the US and the KABCO scale is specific to Louisiana. The percentage of fatalities of all injuries is very similar in the US and Louisiana (1.1% and 1.0%, respectively). However, converting MAIS1-MAIS5 to the KABCO scale, for Louisiana crash data, is difficult. MAIS3+ is often suggested to be incapacitating/severe injuries (Flannagan, 2012). However, while national statistics (Blincoe, 2014) show that 4% of injuries are MAIS3+, Louisiana crash reports only reflect 1.9% with incapacitating injuries. In addition, 9% of injuries are MAIS2 (moderate) for national statistics and 16% are moderate injuries (B on KABCO scale, C on LA crash report). Louisiana also reports 5.7% more

complaints/minor injuries than national statistics. Thus, Louisiana has only half the percentage of severe injuries, but about twice the percentage of moderate injuries (in comparison to national statistics). The national percentages were computed by Blincoe (2014) and are reproduced in Table 4.

Table 3: Frequencies of Injury Severity MAIS, KABCO for US and Louisiana Data

US				Louisiana			
Injury Codes	Number of Crashes	% of Injuries	% of All Crashes	KABCO (A – E)	2010 - 2013	% of Injuries	% of All Crashes
MAIS0	2,147,857			No Injury – O,E	1,136,918		
MAIS1	2,578,993	85.9%	50.1%	Complaint – C,D	219,959	80.2%	15.6%
MAIS2	271,160	9.0%	5.3%	Moderate – B,C	46,192	16.9%	3.3%
MAIS3	96,397	3.2%	1.9%				
MAIS4	17,086	0.6%	0.3%				
MAIS5	5,749	0.2%	0.1%	Incapacitating – A,B	5,244	1.9%	0.4%
Fatal	32,999	1.1%	0.6%	Fatal – K,A	2,719	1.0%	0.2%

Source: Lawrence at al. (2014), and LA crash data 2010-2013

Table 4: Injuries in US (Blincoe, 2014)

Severity	Police-reported	Not Police-reported	Total	Percent Unreported
Vehicles				
Injury Vehicles	3,225,839	2,121,769	5,347,608	39.7%
PDO Vehicles	7,454,761	11,053,871	18,508,632	59.7%
Total Vehicles	10,680,601	13,175,640	23,856,241	55.2%
People in Injury Crashes				
MAIS0	2,147,857	2,435,409	4,583,265	53.1%
MAIS1	2,578,993	880,207	3,459,200	25.4%
MAIS2	271,160	67,570	338,730	19.9%
MAIS3	96,397	4,343	100,740	4.3%
MAIS4	17,086	0	17,086	0.0%
MAIS5	5,749	0	5,749	0.0%
Fatal	32,999	0	32,999	0.0%
Total	5,150,241	3,387,528	8,537,770	39.7%
Total Injuries	3,002,385	952,120	3,954,504	24.1%

Economic Costs of Motor Vehicle Crashes

Matching national MAIS to the KABCO scale is necessary for estimating costs associated with crashes in Louisiana. Table 5 shows the unit costs estimate for the US. It was developed by Blincoe (2014) for the year 2010. These costs do not include pain and suffering estimates. There are costs associated with the vehicle as well as no injury (MAIS0). In fact, the unit cost for a person in a crash with no injury is $4,380 which only 28% less than the unit cost for property damage of the vehicle.

Table 5: Summary of Unit Costs for Police Reported Crashes in 2010 Dollars (Blincoe, 2014 Table 1-10)

	PDO Vehicle	MAIS0	MAIS1	MAIS2	MAIS3	MAIS4	MAIS5	Fatal
Medical	$0	$0	$3,801	$24,481	$70,902	$196,911	$441,618	$11,317
EMS	$59	$38	$109	$221	$416	$838	$855	$902
Market	$0	$0	$2,858	$39,637	$110,088	$174,728	$352,178	$933,262
Household	$60	$45	$941	$11,921	$33,505	$44,593	$107,070	$289,910
Insurance	$191	$143	$3,935	$9,370	$24,348	$37,372	$79,967	$28,322
Workplace	$62	$46	$341	$2,644	$5,776	$6,361	$11,091	$11,783
Legal Costs	$0	$0	$1,410	$6,739	$19,645	$35,307	$91,197	$106,488
Subtotal	$372	$272	$13,395	$95,013	$264,680	$496,110	$1,083,976	$1,381,984
Congestion	$2,104	$1,416	$1,426	$1,450	$1,490	$1,511	$1,529	$5,720
Prop. Damage	$3,599	$2,692	$7,959	$8,510	$16,027	$16,328	$15,092	$11,212
Subtotal	$5,704	$4,108	$9,385	$9,960	$17,517	$17,839	$16,621	$16,932
Total	$6,076	$4,380	$22,779	$104,974	$282,197	$513,949	$1,100,597	$1,398,916

*Note: Unit costs are expressed on a per-person basis for all injury levels. PDO costs are expressed on a per-damaged-vehicle basis.

Figure 1 shows the cost components of the total economic costs depicted in Table 5. It is noted that the medical costs make up only 13% of the total economic costs.

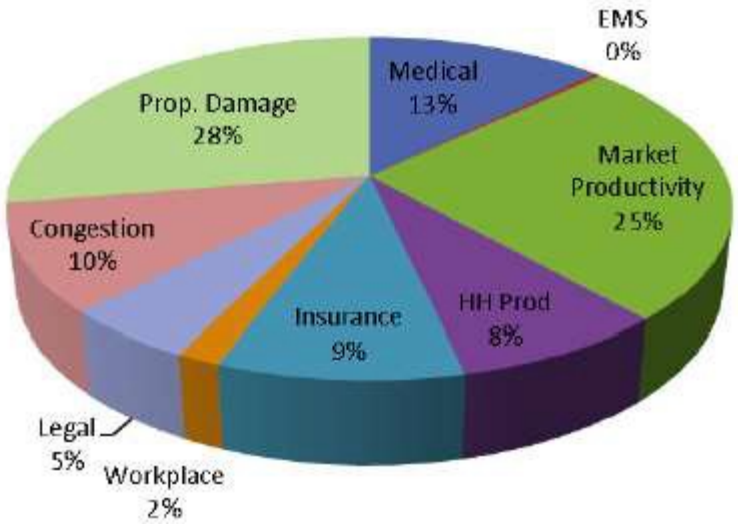

Figure 1: Component Cost of Total Economic Cost (reproduced from Blincoe (2014))

Blincoe at al. (2014) also provides a breakdown according to who bears the costs. Private insurance covers slightly more than half of the costs.

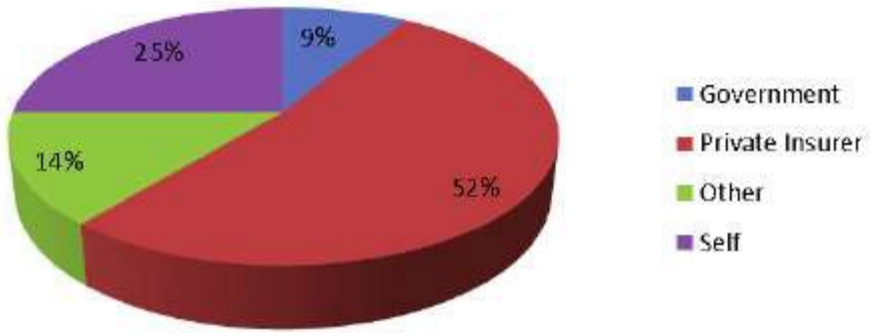

Figure 2: Costs by who Covers (Blincoe, 2014)

Table 6 provides the estimated unit costs for the KABCO scale using MAIS3+ as a severe injury class (B) as commonly suggested (Flannagan, 2012). To obtain a unit cost estimate for MAIS3+ we used a weighted average of the unit costs for MAIS3, MAIS4, MAIS5, where the weights are taken from the percentage of injuries occurring in the U.S., namely 3.2%, 0.6% and 0.2%, respectively. This results in a unit cost estimate for a severe injury (B in the Louisiana crash report) of $357,820 for 2010.

Table 6: 2010 Unit Costs for Louisiana's Police Report Injury Scale

Injury Codes	Number of Crashes	% of Injuries	Total unit Costs	Louisiana Unit Cost Estimates	Louisiana Code
MAIS0	2,147,857		$4,380	$4,380	E
MAIS1	2,578,993	85.90%	$22,779	$22,779	D
MAIS2	271,160	9.00%	$104,974	$104,974	C
MAIS3	96,397	3.20%	$282,197	$357,880	B
MAIS4	17,086	0.60%	$513,949		
MAIS5	5,749	0.20%	$1,100,597		
Fatal	32,999	1.10%	$1,398,916	$ 1,398,916	A
PDO			$6,076	$6,076	PDO

Based on these unit cost estimates we can compute yearly crash costs for Louisiana for each year after

2010 by updating the costs using the CPI for the year the costs are computed. For instance, Table 7 provides estimates for the total cost for 2019 based on the reported number of injuries. The first column describes the type of injury or damage and the second column depicts the unit costs which were developed in Table 4 and adjusted by the CPI for the year 2015. Column three lists the number of people or vehicles involved. Column four provides the total cost for each type in billion dollars. Based on these unit cost figures the total cost for Louisiana crashes was estimated to be $8.87 billion in 2019.

Table 7: Cost of Louisiana Crashes for 2019

Type	Unit Cost	Injuries	Total Cost by Injury Category in Billion Dollars
Fatal Injuries	$1,650,721	727	$1.20
Severe Injuries	$422,227	1,348	$0.57
Moderate Injuries	$123,869	11,536	$1.43
Complaint Injuries	$26,879	59,629	$1.60
Occupants with No Injury	$5,168	360,402	$1.86
Property Damage	$7,170	307,202	$2.20
Grand Total Cost		740,844	$8.87
Cost per licensed Driver			$2,993
Percent Increase from past year			-0.4%

Figure 3 shows the contribution of the injury severity to the total costs. The injury crashes with severity moderate, complaint and no injury have a higher contribution to the overall costs than severe and fatal crashes because of the large number of crashes in these categories.

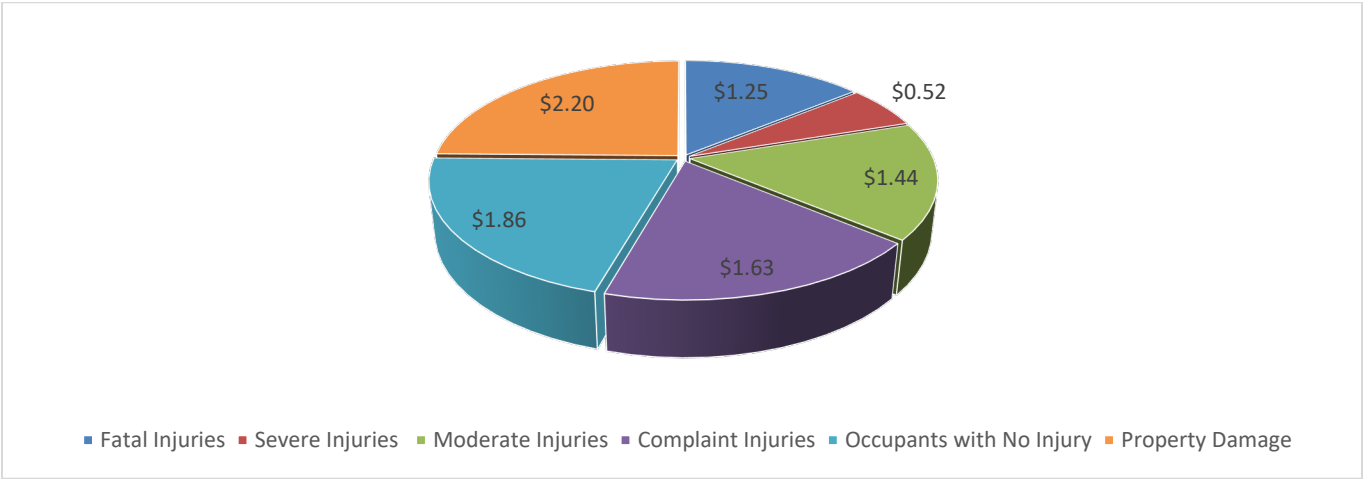

Figure 3: Total Cost (in Billions Dollars) of Louisiana Crashes by Injury Severity of Persons Involved and Property Damage (2019)

Costs of Motor Vehicle Crashes Including Loss of Quality of Life

The economic or human capital costs in Table 7 represent tangible costs associated with resources such as medical care, lost productivity, workplace, legal, administrative, property damage and travel delay, used to restore the status quo before the crash. However, in cases of serious injury and death economic costs fail to capture intangible issues related to lost quality-of-life. These cannot be measured directly in dollars. Nevertheless, assessing the value of the impact provides a more complete basis for quantifying the impact of crashes on society. This value is referred to as the "Value of a Statistical Life (VLS)" (Blinco, 2014) is "a measure of the implied value consumers place on their lives as revealed by the price they are willing to pay to avoid risk of death. There have been numerous studies that attempted to assess this VLS. These studies provide estimates on average of $2.2 million to $7 million. The 203 Circular A-4 from the Office of Management and Budget recommends values between $1 million and $10 million to be used by government agencies when the impact of proposed regulation that affect risk of death is assessed. The Office of the Secretary of the Department of Transportation (T. Duvall, Assistant Secretary for Transportation Policy, & D.J. Gribbon, General Council. Treatment of the Economic Value of a Statistical Life in Departmental Analysis. Memorandum to Secretarial Officers and Modal Administrators, Department of Transportation, February 5, 2008) provided guidance in 2008 setting a VSL of $5.8. This guidance has been updated several times to account for inflation. Blinco et al, (2014) adopted the 2010 value from OST adjusted for both economic and real changes in wages of $8.86 million. The department of transportation uses the following method for updating costs (Moran et al, 2016):

$$VSLT = VSL_0 * (P_T / P_0) * (I_T / I_0)^{\varepsilon}$$

where

0 = Original Base Year

T = Updated Base Year

P_t = Price Index in Year t

I_t = Real Incomes in Year t

Ɛ = Income Elasticity of VSL

The $(I_T / I_0)^{\varepsilon}$ was not included because of the lack of reliable estimates for Louisiana.

However, for injuries that are not fatal "the loss to the victim is a direct function of the extent to which the victim is disabled or made to suffer through physical pain or emotional distress, as well as the

duration through which these impacts occur" (Blinco, 2014). The metric used to value these nonfatal injury losses is quality-adjusted life year (QALY). QALYs are used in evaluating the outcomes of clinical trials of medical interventions, in approval of pharmaceuticals, and in studies of the return on investment in preventive health and safety measures (Miller, 2000). A study in 2010 study by Spicer and Miller (2010) provides the basis for the nonfatal injury QALY values used in Blinco's 2014 report.

Table 8 provides the costs when loss of quality of life is included. These costs are the sum of the economic costs and the VSL for fatalities and QALY for injuries. The unit costs are obtained from Blincoe et al. (2014) and adjusted in the same way the direct costs were adjusted using the CPI. The total costs are three times as high as the economic costs in Table 7 because of the much higher unit costs for fatalities and severe to moderate injuries. For instance, the cost for a fatality including loss of quality of life was estimated to be $10.79 million versus $1.65 million in 2019. These costs were estimated to be $9.97 million and $1.52 in 2015, respectively. For comparison, the USDOT guidance on treatment of the economic value of a statistical life in the U.S in 2015 was $9.4 million which is only slightly lower than the estimate used in this report (Moran, M.J., Carlos Monje, 2016). This is due to the different adjustments made from year to year. No adjustment for real changes in wages is made here.

Table 8: Cost of Louisiana Crashes for 2019 Including Loss of Quality of Life

Type	Unit Cost	Injuries	Total Cost by Injury Category in Billion Dollars Including Loss of Quality of Life
Fatal Injuries	$10,792,277	752	$7.85
Severe Injuries	$1,813,643	1,386	$2.44
Moderate Injuries	$526,098	12,693	$6.07
Complaint Injuries	$54,303	64,591	$3.24
Occupants with No Injury	$5,168	373,384	$1.86
Property Damage	$7,169	320,542	$2.20
Grand Total Cost		773,348	$23.66
Cost per licensed Driver			$7,989

Table 9 shows the cost computations for economic unit crash costs for the highest severity of a crash. Based on the Louisiana crash data, the average cost per fatal crash in 2019 was $1.87 billion and the average cost for a crash with a severe injury was $522,092. The average costs per crash will change from year to year because the make-up of a crash may change for each injury code. For instance, the 681 fatal crashes

had 727 fatalities and 79 severe injuries, 206 moderate injuries, 252 complaints, and 350 occupants not injured and 1,100 vehicles involved. All these numbers will vary from year to year and thus the unit cost for crashes will also vary from year to year.

Table 9: Computations of Economic Unit Crash Costs (2019)

Highest Severity	Fatal	Severe Injuries	Moderate Injuries	Complaint Injuries	No Injury	Vehicles	Crashes	Total Cost in Million $	Unit Crash Costs in million $
Fatal	727	79	206	252	350	1100	681	$ 1,275	1.873
Severe Injuries	0	1269	319	461	1111	1989	1164	$ 608	0.522
Moderate Injuries	0	0	11011	4645	8653	16264	8809	$ 1,650	0.187
Complaint Injuries	0	0	0	54271	49229	68466	34612	$ 2,204	0.064
No Injury	0	0	0	0	301059	219383	115146	$ 3,129	0.027

Table 10 shows the Table 10 shows the cost computations for unit crash costs including loss of quality of life for the highest severity of a crash. The unit costs for a fatal crash in 2019 on Louisiana roads were $11.925 million and the costs for a severe injury crash was $2.160 million.

Table 10: Computation of Unit Crash Costs Including Loss of Quality of Life

Highest Severity	Fatal	Severe Injuries	Moderate Injuries	Complaint Injuries	No Injury	Vehicles	Crashes	Total Cost in Million of $	Unit Crash Costs in Million of $
Fatal	727	79	206	252	350	1100	681	$ 8,121	11.925
Severe Injuries	0	1269	319	461	1111	1989	1164	$ 2,514	2.160
Moderate Injuries	0	0	11011	4645	8653	16264	8809	$ 6,206	0.705
Complaint Injuries	0	0	0	54271	49229	68466	34612	$ 3,692	0.107
No Injury	0	0	0	0	301059	219383	115146	$ 3,129	0.027

When road safety programs are evaluated, the costs that include loss of quality of life are recommended.

Louisiana Trends in Economic Crash Costs

The cost estimates from 2014 on are significantly higher than the estimates prior to 2014. The reason is that the new estimates are based on the 2014 NHTSA cost study (Blincoe, 2014) which provided new unit costs estimates for 2010, and research (Flannagan, 2012) suggests that MAIS3+ are considered equivalent to severe/decapitating injuries. Based on this new research, unit costs for the KAPCO scale were remapped to the MAIS scale and recomputed based on 2010 cost estimates. The costs of prior years were recomputed using the new cost estimates.

Based on the percentages shown in Table 3, Louisiana reports on average only about half (1.9%) of the MAIS3+ injuries reported in the U.S., namely (4%) when severe injuries (Code B) are considered as

MAIS3+. Either Louisiana has fewer MAI3+ injuries in crashes, or some of the injuries are misclassified by police officers. The latter could be the case since MAIS2 injuries are significantly higher in Louisiana than in the U.S., 16.9% versus 9%. Thus, using only severe injuries on Louisiana crash reports may significantly underestimate MAIS3+ injuries in Louisiana. It should be noted that fatal and severe injury costs make up only less than a quarter of all crash costs. Therefore, using only the latter cost would not adequately assess the true cost of vehicle crashes nor allow us to reliably assess improvements over time. For instance, while the total economic costs as shown in Figure 4 have increased over the past five years, the costs for severe and moderate injuries have increased only significantly over the past year (Figure 5).

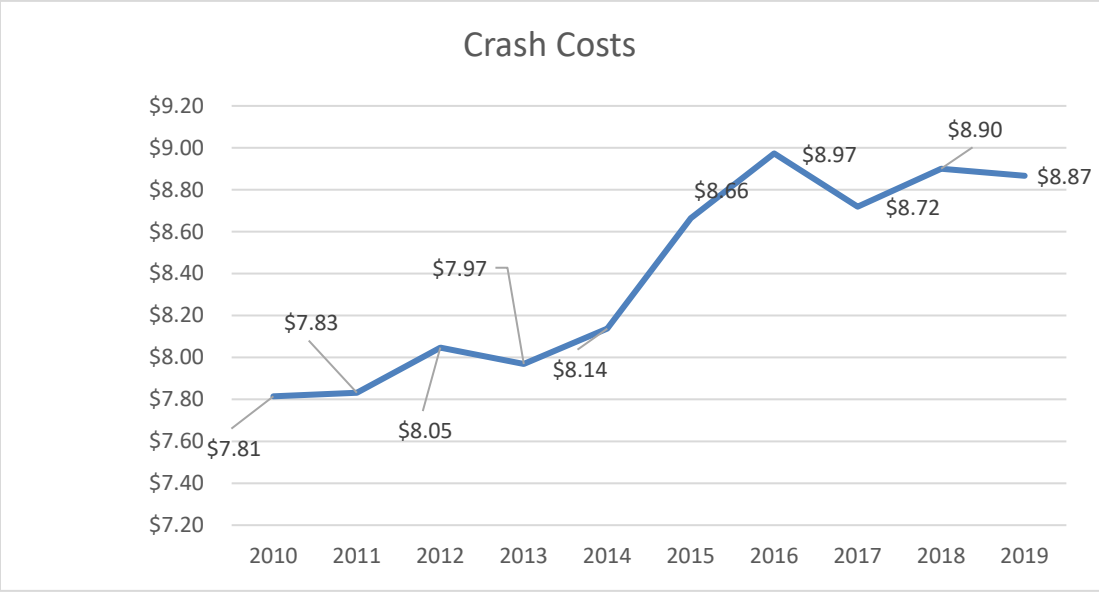

Figure 4: Economic Crash Cost Trend (in Billion Dollars) 2010 to 2019

As Figure 5 shows, the cost for severe and moderate injuries have increased inly slightly from the 5 years 2020-2014 to 2015-2019, namely 3.5 % on average.

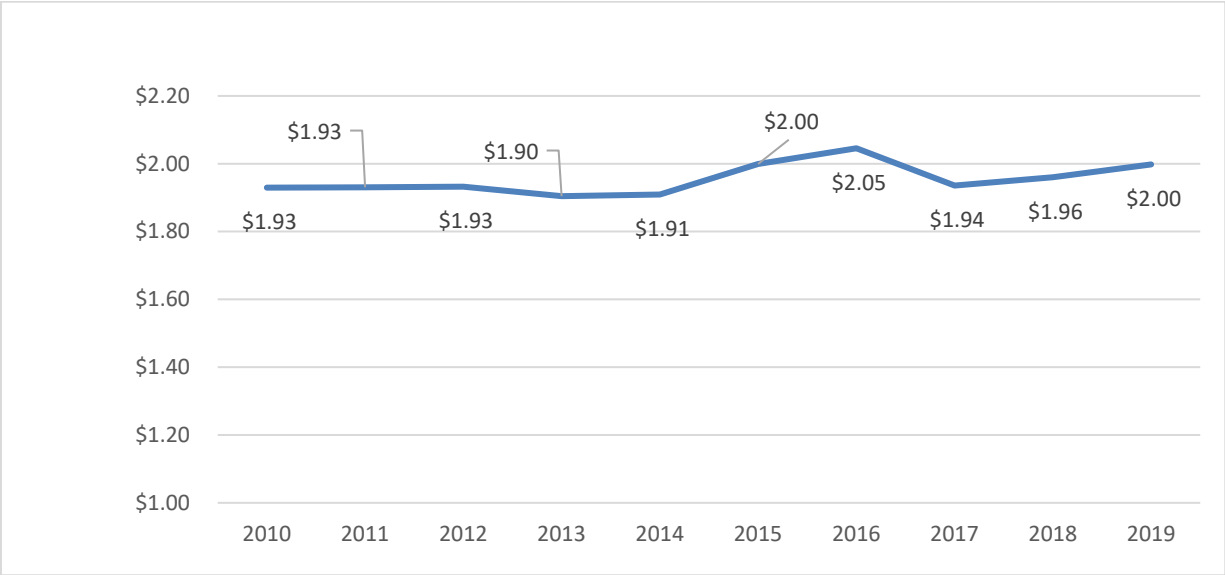

Figure 5:Trend of economic cost in billions for critically and severe and fatal injuries from 2010 to 2019

Figure 6 shows the crash costs per licensed driver in Louisiana from 2010 to 2019. The cost per licensed driver increased significantly from 2013 to 2016, partly due to the new unit cost estimates. However, the costs have been relative flat for the past four years.

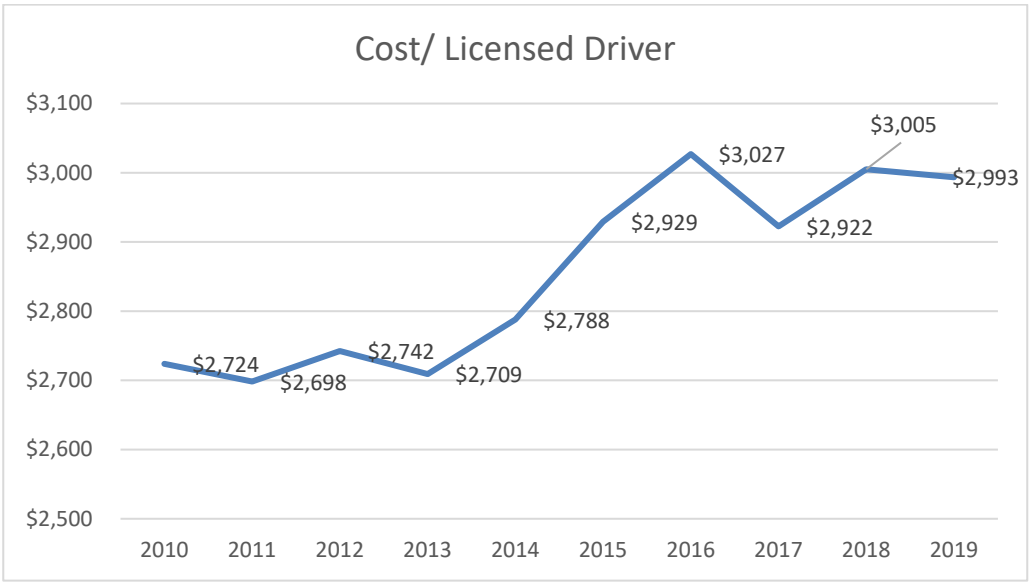

Figure 6: Economic Cost per Licensed Driver 2010-2019

The total crash costs for the U.S. increased from 1.7% of GDP in 2000 to 1.9% of GDP in 2010. The crash costs for Louisiana were 3.4% of GDP in 2010. Thus, the Louisiana crash cost as a percent of GDP were 79% higher than in the U.S. overall in 2010. However, this assumes that the unit crash costs estimated

for the U.S. are applicable to Louisiana which may not be the case. If we assume that the crash costs in Louisiana are the same percentage of GDP as in the U.S., then the total Louisiana crash costs in 2010 would have been only $4.31 billion, instead of $7.81 billion. However, given that Louisiana has one of the highest insurance premiums of all 50 states it is also likely that the Louisiana's crash costs as a percent of GDP is higher than the national average.

The Louisiana crash cost estimates should be considered with caution, given the many assumptions made and the injury reporting issues involved in the calculations that can lead to measurement errors. Obtaining more accurate crash cost estimates would require a survey of Louisiana crash costs to be conducted. However, for a trend analysis, it might be sufficient to use the unit cost estimates based on the U.S. survey. Given that three quarters of the total crash costs are associated with crashes with no-to-moderate injuries it would be advisable to track all types of crashes and their costs over time.

Economic versus Loss of Quality-of-Life Estimates

The economic costs for injuries and non-injuries provided for Louisiana in this report represent measurable tangible costs associated with resources such as medical care, lost productivity, workplace, legal, administrative, property damage and travel delay, used to restore the status quo before the crash. However, in cases of serious injury and death economic costs fail to capture intangible issues related to lost quality-of-life. Therefore, the economic costs depicted in Tables 7 and 9 are not recommended to be used in the evaluation of road safety programs. For evaluation of safety programs, the costs associated with economic plus an assessment of loss of quality of life depicted in Tables 8 and 10 are recommended. The 2019 estimates of the latter unit costs are Fatal Injury ($10,792,277), Severe Injury ($1,813,643), Moderate Injury ($526,098), Complaint Injury ($54,303), Occupants with No Injury ($5,168), Property Damage ($7,169). When a cost estimate per crash is needed then the following unit costs should be used: ($11,925,140) for a fatality crash, ($2,160,117) for a crash involving a severe injury, ($704,557) for a crash involving a moderate injury, ($106,680) for a crash involving a complaint injury, ($27,173) for a property-damage-only crash. These costs might be slightly different than the costs recommended by the USDOT because of a difference in the yearly adjustment of the costs and the injury severity distribution among Louisiana crashes. However, these differences are not significant given the wide range of estimates of quality of life costs in the literature.

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