HIGHWAY LOSS DATA INSTITUTE

Bulletin | Vol. 28, No. 13 : December 2011

Mazda collision avoidance features: initial results

Three collision avoidance features offered by Mazda appear to be reducing some insurance losses, but the reductions are not completely in line with expectations. The Adaptive Front Lighting System is associated with a large reduction in claims for damage to other vehicles even though most crashes at night are single-vehicle. Blind Spot Monitoring appears to reduce the frequency of all types of injury claims and claims for damage to other vehicles, which was more expected. For backup cameras, the only significant effect on claim frequency was a paradoxical increase in collision claims. There was also a decrease in high-severity claims for bodily injury, suggesting a reduction in collisions with nonoccupants.

Introduction

Collision avoidance technologies are becoming popular in U.S. motor vehicles, and more and more automakers are touting the potential safety benefits. However, the actual benefits in terms of crash reductions still are being measured. This Highway Loss Data Institute bulletin examines the early insurance claims experience for Mazda vehicles equipped with three features:

Adaptive Front Lighting System is Mazda's term for headlamps that respond to driver steering. The system uses sensors to measure vehicle speed and steering angle while small electric motors turn the headlights accordingly to facilitate vision around a curve at night. It is functional after the headlights have been turned on, at vehicle speeds above 2 mph. The adaptive lighting can be deactivated by the driver. At the next ignition cycle, it will be in the previous on/off setting.

Blind Spot Monitoring is Mazda's term for a side view assist system that alerts drivers to vehicles that are adjacent to them. The system uses radar sensors mounted inside the rear bumper to scan a range behind the vehicle. If a vehicle has been detected in the blind spot, a warning light on the appropriate side mirror is illuminated, and an additional auditory warning is given if a turn signal is activated. The system is functional at speeds over 20 mph and can be deactivated by the driver, but will reactivate at the next ignition cycle. Additionally, the driver can eliminate the audio warning but leave the visual alert.

A back-up camera is mounted in the rear deck lid above the license plate and shows the area behind the vehicle on the navigation screen. The images are overlaid with guidelines for assistance only on the 2010 CX-9. The camera is active when the transmission is in reverse.

Method

Vehicles

Adaptive Front Lighting, Blind Spot Monitoring and back-up cameras are offered as optional equipment on various Mazda models. The presence or absence of these features is not discernible from the information encoded in the vehicle identification numbers (VINs), but rather, this must be determined from build information maintained by the manufacturer. Mazda supplied HLDI with the VINs for any vehicles that were equipped with at least one of the collision avoidance features listed above. Vehicles of the same model year and series not identified by Mazda were assumed not to have these features, and thus served as the control vehicles in the analysis. Electronic stability control was standard on most vehicles but optional on one trim level of the Mazda 3, so this trim level was excluded from the analysis. No additional features are available on these vehicles. Two high-performance vehicles, the Mazda Speed3

and Speed6, also were excluded. Table 1 lists the vehicle series and model years included in the analysis. In addition, exposure for each vehicle, measured in insured vehicle years is listed. The exposure of each feature in a given series is shown as a percentage of total exposure.

Table 1 : Feature exposure by vehicle series

Make	Series	Model year range	Adaptive Front Lighting System	Blind Spot Monitoring	Back-up camera	Total exposure
Mazda	3 4dr	2010	39%			29,492
Mazda	3 station wagon	2010	28%			34,145
Mazda	6 4dr	2009-10		45%		96,199
Mazda	CX-7 4dr	2010		5%	38%	30,505
Mazda	CX-7 4dr 2WD/4WD	2007-09			20%	264,845
Mazda	CX-7 4dr 4WD	2010		38%	65%	5,571
Mazda	CX-9 4dr	2007-10		33%	38%	91,322
Mazda	CX-9 4dr 4WD	2008-10		55%	25%	69,515

Insurance data

Automobile insurance covers damages to vehicles and property as well as injuries to people involved in crashes. Different insurance coverages pay for vehicle damage versus injuries, and different coverages may apply depending on who is at fault. The current study is based on property damage liability, collision, bodily injury liability, personal injury protection and medical payment coverages. Exposure is measured in insured vehicle years. An insured vehicle year is one vehicle insured for one year, two for six months, etc.

Because different crash avoidance features may affect different types of insurance coverage, it is important to understand how coverages vary among the states and how this affects inclusion in the analyses. Collision coverage insures against vehicle damage to an at-fault driver's vehicle sustained in a crash with an object or other vehicle; this coverage is common to all 50 states. Property damage liability (PDL) coverage insures against vehicle damage that at-fault drivers cause to other people's vehicle and property in crashes; this coverage exists in all states except Michigan, where vehicle damage is covered on a no-fault basis (each insured vehicle pays for its own damage in a crash, regardless of who's at fault). Coverage of injuries is more complex. Bodily injury (BI) liability coverage insures against medical, hospital, and other expenses for injuries that at-fault drivers inflict on occupants of other vehicles or others on the road; although motorists in most states may have BI coverage, this information is analyzed only in states where the at-fault driver has first obligation to pay for injuries (33 states with traditional tort insurance systems). Medical payment coverage (MedPay), also sold in the 33 states with traditional tort insurance systems, covers injuries to insured drivers and the passengers in their vehicles, but not injuries to people in other vehicles involved in the crash. Seventeen other states employ no-fault injury systems (personal injury protection coverage, or PIP) that pay up to a specified amount for injuries to occupants of involved-insured vehicles, regardless of who's at fault in a collision. The District of Columbia has a hybrid insurance system for injuries and is excluded from the injury analysis.

Statistical methods

Regression analysis was used to quantify the effect of each vehicle feature while controlling for the other two features and several covariates. The covariates included calendar year, model year, garaging state, vehicle density (number of registered vehicles per square mile), rated driver age group, rated driver gender, rated driver marital status, deductible range (collision coverage only), and risk. For each safety feature supplied by the manufacturer a binary variable was included. Based on the model year and series a single variable called SERIESMY was created for inclusion in the regression model. Statistically, including such a variable in the regression model is equivalent to including the inter-

action of series and model year. Effectively, this variable restricted the estimation of the effect of each feature within vehicle series and model year, preventing the confounding of the collision avoidance feature effects with other vehicle design changes that could occur from model year to model year.

Claim frequency was modeled using a Poisson distribution, whereas claim severity (average loss payment per claim) was modeled using a Gamma distribution. Both models used a logarithmic link function. Estimates for overall losses were derived from the claim frequency and claim severity models. Estimates for frequency, severity, and overall losses are presented for collision and property damage liability. For PIP, BI and MedPay three frequency estimates are presented. The first frequency is the frequency for all claims, including those that already have been paid and those for which money has been set aside for possible payment in the future, known as claims with reserves. The other two frequencies include only paid claims separated into low and high severity ranges. Note that the percentage of all injury claims that were paid by the date of analysis varies by coverage: 79.2 percent for PIP, 68.1 percent for BI, and 61.7 percent for MedPay. The low severity range was <$1,000 for PIP and MedPay, <$5,000 for BI; high severity covered all loss payments greater than that.

A separate regression was performed for each insurance loss measure for a total of 15 regressions (5 coverages x 3 loss measures each). For space reasons, only the estimates for the individual crash avoidance features are shown on the following pages. To illustrate the analyses, however, the Appendix contains full model results for collision claim frequencies. To further simplify the presentation here, the exponent of the parameter estimate was calculated, 1 was subtracted, and the resultant multiplied by 100. The resulting number corresponds to the effect of the feature on that loss measure. For example, the estimate of the effect of adaptive lighting on PDL claim frequency was -0.10692; thus, vehicles with adaptive lighting had 10.1 percent fewer PDL claims than expected ((exp(-0.10692)-1)*100=-10.1).

Results

Results for Mazda's Adaptive Front Lighting System are summarized in Table 2. The lower and upper bounds represent the 95 percent confidence limits for the estimates. For vehicle damage losses, frequency of claims are generally down as well as overall losses. The reduction in frequency of collision claims, 6.4 percent, was statistically significant. In addition, frequency, severity and overall loss reductions for property damage liability were significant.

For injury losses, overall frequency of claims (paid plus reserved) decrease for all coverages, with the decreases for medical payments and personal injury protection being significant (indicated in blue in the table). Among paid claims, reductions are seen for all coverage types at both low and high severity.

Table 2 : Change in insurance losses for Adaptive Front Lighting System

Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-12%	**-6.4%**	-0.6%	-$132	$126	$403	-$33	-$9	$17
Property damage liability	-18.3%	**-10.1%**	-1.2%	-$574	**-$381**	-$170	-$33	**-$23**	-$12

Injury coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	LOW SEVERITY FREQUENCY	Upper bound	Lower bound	HIGH SEVERITY FREQUENCY	Upper bound
Bodily injury liability	-35.3%	-12.5%	18.2%	-45.2%	-12.8%	38.7%	-54.1%	-11.1%	72.4%
Medical payments	-48.8%	**-28.9%**	-1.4%	-98.9%	**-92%**	-40.8%	-42.6%	-8%	47.5%
Personal injury protection	-43.7%	**-28.8%**	-9.9%	-48.5%	-20.6%	22.3%	-55.8%	**-37.4%**	-11.4%

Results for Mazda's Blind Spot Monitoring are summarized in Table 3. Again, the lower and upper bounds represent the 95 percent confidence limits for the estimates. For vehicle damage losses, frequency of claims are down for property damage liability but remain unchanged for collision coverage. Losses per insured vehicle year (overall losses) are down slightly. The frequency reduction for property damage liability was significant.

Under injury coverages, the frequency of paid plus reserved claims decreases for all coverages, and all of the decreases are significant. Among paid claims, reductions are seen for all coverage types at both low and high severity with the reductions at high severity being significant.

Table 3 : Change in insurance losses for Blind Spot Monitoring

Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-3.0%	0.0%	3.2%	-$148	-$17	$118	-$14	-$1	$12
Property damage liability	-11.3%	**-7.5%**	-3.4%	-$47	$61	$174	-$11	-$5	$0

Injury coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	LOW SEVERITY FREQUENCY	Upper bound	Lower bound	HIGH SEVERITY FREQUENCY	Upper bound
Bodily injury liability	-32.8%	**-20.9%**	-7.0%	-41.4%	-23.5%	0.0%	-46.5%	**-27.1%**	-0.5%
Medical payments	-35.6%	**-23.9%**	-10.0%	-36.3%	-4.2%	44.0%	-39.7%	**-22.6%**	-0.6%
Personal injury protection	-23.3%	**-14.5%**	-4.8%	-24.9%	-6.4%	16.6%	-27.0%	**-15.7%**	-2.6%

Results for Mazda's back-up camera are summarized in Table 4. The lower and upper bounds represent the 95 percent confidence limits for the estimates. For vehicle damage losses, frequency claims are down for property damage liability and up for collision coverage. The increases in frequency, severity and overall losses for collision coverage are significant.

For injury losses, overall frequency of claims (both paid and reserved) is lower for both BI and PIP, but not for MedPay, and none of the differences is statistically significant. Among paid claims, those of higher severity tend to show reductions in frequency, but only the reduction for BI is statistically significant.

Table 4 : Change in insurance losses for back up camera

Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	0.5%	**3.1%**	5.8%	$12	**$125**	$241	$7	**$18**	$30
Property damage liability	-5.8%	-2.3%	1.3%	-$56	$34	$126	-$6	-$1	$4

Injury coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	LOW SEVERITY FREQUENCY	Upper bound	Lower bound	HIGH SEVERITY FREQUENCY	Upper bound
Bodily injury liability	-14.6%	-3.1%	9.8%	-17.4%	1.3%	24.1%	-38.3%	**-22.2%**	-1.8%
Medical payments	-12.1%	0.6%	15.1%	-13.0%	24.3%	77.4%	-24.2%	-7.6%	12.6%
Personal injury protection	-10.1%	-2.1%	6.7%	-17.9%	-1.2%	18.8%	-9.2%	1.6%	13.6%

Discussion

The results for these three Mazda collision avoidance features — Adaptive Front Lighting System, Blind Spot Monitoring System, and backup cameras — are mixed. Analyses of steering responsive headlamps indicate a strong benefit in claims reductions but the pattern is not consistent with expectations. For example, the prevalence of single-vehicle crashes at night suggests that adaptive lighting would have a greater effect on collision coverage than PDL. However, to the extent that adaptive lighting is effective, it appears to reduce PDL claims more than collision claims. Making the pattern even more perplexing is the fact that the reduction in all PDL crashes (10.1 percent) is slightly larger than the 7 percent of police-reported crashes that occur between 9 p.m. and 6 a.m. and involve more than one vehicle. This raises questions about the exact source of the estimated benefits: does adaptive lighting work because the lamps are steerable or is there something else about cars with adaptive lighting that have not been adequately accounted for in the current analyses? One noteworthy difference is that the adaptive lighting lamps are high intensity discharge (HID) while the vehicles without the feature have halogen lights. A difference in the nature of the illumination provided by these two different light sources may help explain the advantage of Mazda's adaptive lighting. A small study conducted by the Insurance Institute for Highway Safety with Consumers Union compared the standard (halogen) lights with the HID adaptive lighting lamps on the Mazda 3. In that comparison, the low beams of HID lights threw light farther down the test area than the base halogen low beams — 400 vs. 350 ft. The adaptive lighting beam pattern was also wider and perceived as brighter by the testers. However, the base high beams illuminated farther down the test area than the adaptive lighting high beam — 600 vs. 500 feet. These differences were not consistent among other pairs of cars included in the tests.

The results for Blind Spot Monitoring are patterned more as expected. Incursion into occupied adjacent lanes would be expected to result in two-vehicle crashes that lead to PDL claims against the encroaching driver. The estimated reduction in PDL claims is statistically significant and much larger than that estimated for collision claims. That is consistent with the fact that any reduction in collision claims from such crashes would be diluted by the many single vehicle crashes that result in collision claims and are unaffected by blind spot information. Given that blind spot monitoring is intended to assist with lane changes which typically occur on multi-lane roads, many of which are higher speed roads, it is expected that the system would help to prevent higher speed crashes and the injuries involved. All of the injury coverages have statistically significant reductions in claim frequency, with larger reductions occurring for the more severe claims.

Back-up cameras would be expected to reduce impacts with other vehicles, objects, and some nonoccupants when operating the vehicle in reverse. This would be expected to yield reductions in collision and PDL losses and, perhaps, in BI losses. Contrary to expectation, collision claims increased significantly for the vehicles with backup cameras; although PDL claims did decrease, the change was small and not statistically significant. There was a reduction in BI claims as well, which was statistically significant for paid claims of high severity. This suggests that the cameras may be reducing some nonoccupant crashes. At a 22 percent reduction, this result was unexpected as BI-only claims (nonoccupants) make up a very small proportion of all BI claims.

This early analysis indicates that Mazda's adaptive headlights and side view blind spot assistance are reducing some insurance losses, although there remains some uncertainty about how the adaptive lamps are achieving the effect. Conclusions about the backup cameras must wait for additional data, both from additional experience with Mazdas and also from other vehicle makes equipped with similar technology.

Limitations

There are limitations to the data used in this analysis. At the time of a crash, the status of a feature is not known. The features in this study can be deactivated by the driver and there is no way to know how many, if any of the drivers in these vehicles had manually turned off the system prior to the crash. If a significant number of drivers do turn these features off, any reported reductions may actually be underestimates of the true effectiveness of these systems.

Additionally, the data supplied to HLDI does not include detailed crash information. Information including point of impact is not available. The technologies in this report target certain crash types. For example, the backup camera is designed to prevent collisions when a vehicle is backing up. Transmission status is not known – therefore, all collisions, regardless of the ability of a feature to mitigate or prevent the crash, are included in the analysis.

All of these features are optional and are associated with increased costs. In particular, the adaptive headlights could add as much as 13 percent to the price of Mazda 3 cars without them. The type of person who is willing to pay such a large additional cost for an otherwise inexpensive car may be different from the person who is not. While the analysis controls for several driver characteristics, there may be other uncontrolled attributes associated with people who select these features.

Appendix : Illustrative regression results — collision frequency

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Intercept		1	-8.6154		0.1047	-8.8205	-8.4102	6774.08	<0.0001
Calendar year	2006	1	0.0255	2.6%	0.0648	-0.1015	0.1524	0.15	0.6939
	2007	1	0.1223	13.0%	0.0225	0.0782	0.1663	29.54	<0.0001
	2008	1	0.0535	5.5%	0.0165	0.0212	0.0859	10.51	0.0012
	2009	1	0.0105	1.1%	0.0133	-0.0156	0.0366	0.62	0.4304
	2011	1	-0.0265	-2.6%	0.0124	-0.0509	-0.0022	4.57	0.0325
	2010	0	0	0	0	0	0		
Vehicle model year and series	2010 3 4dr	1	0.0289	2.9%	0.0394	-0.0483	0.1060	0.54	0.4633
	2010 3 station wagon	1	-0.1006	-9.6%	0.0386	-0.1763	-0.0249	6.79	0.0092
	2009 6 4dr	1	-0.0954	-9.1%	0.0349	-0.1638	-0.0271	7.50	0.0062
	2010 6 4dr	1	-0.0902	-8.6%	0.0370	-0.1628	-0.0177	5.94	0.0148
	2010 CX-7 4dr	1	-0.0413	-4.0%	0.0373	-0.1145	0.0319	1.22	0.2687
	2007 CX-7 4dr 2WD/4WD	1	-0.0364	-3.6%	0.0332	-0.1014	0.0286	1.21	0.2722
	2008 CX-7 4dr 2WD/4WD	1	-0.0217	-2.1%	0.0341	-0.0887	0.0452	0.41	0.5241
	2009 CX-7 4dr 2WD/4WD	1	0.0281	2.8%	0.0395	-0.0494	0.1056	0.51	0.4768
	2010 CX-7 4dr 4WD	1	0.0530	5.4%	0.0541	-0.0530	0.1590	0.96	0.3268
	2007 CX-9 4dr	1	-0.1070	-10.1%	0.0401	-0.1855	-0.0285	7.13	0.0076
	2008 CX-9 4dr	1	-0.1201	-11.3%	0.0368	-0.1922	-0.0480	10.67	0.0011
	2009 CX-9 4dr	1	-0.1570	-14.5%	0.0515	-0.2579	-0.0562	9.31	0.0023
	2010 CX-9 4dr	1	-0.0868	-8.3%	0.0459	-0.1769	0.0032	3.57	0.0587
	2008 CX-9 4dr	1	-0.0329	-3.2%	0.0356	-0.1026	0.0368	0.86	0.3546
	2009 CX-9 4dr	1	-0.0522	-5.1%	0.0456	-0.1416	0.0372	1.31	0.2520
	2010 CX-9 4dr	0	0	0	0	0	0		
Rated driver age group	14-20	1	0.3093	36.2%	0.0303	0.2500	0.3686	104.42	<0.0001
	21-24	1	0.2465	28.0%	0.0218	0.2038	0.2892	128.22	<0.0001
	25-39	1	0.0703	7.3%	0.0107	0.0493	0.0912	43.18	<0.0001

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Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	65+	1	0.0816	8.5%	0.0213	0.0399	0.1233	14.71	0.0001
	Unknown	1	0.0960	10.1%	0.0268	0.0434	0.1486	12.80	0.0003
	40-64	0	0	0	0	0	0		
Rated driver gender	Male	1	-0.0613	-5.9%	0.0115	-0.0838	-0.0387	28.40	<0.0001
	Unknown	1	-0.2003	-18.2%	0.0301	-0.2593	-0.1412	44.20	<0.0001
	Female	0	0	0	0	0	0		
Rated driver marital status	Single	1	0.2177	24.3%	0.0126	0.1929	0.2425	296.28	<0.0001
	Unknown	1	0.2337	26.3%	0.0297	0.1755	0.2920	61.80	<0.0001
	Married	0	0	0	0	0	0		
Risk	Nonstandard	1	0.1248	13.3%	0.0143	0.0969	0.1527	76.61	<0.0001
	Standard	0	0	0	0	0	0		
State	Alabama	1	-0.2114	-19.1%	0.1079	-0.4229	0.0002	3.83	0.0502
	Arizona	1	-0.3411	-28.9%	0.1053	-0.5474	-0.1347	10.49	0.0012
	Arkansas	1	-0.2209	-19.8%	0.1181	-0.4523	0.0105	3.50	0.0614
	California	1	-0.1205	-11.4%	0.0998	-0.3162	0.0751	1.46	0.2272
	Colorado	1	-0.2294	-20.5%	0.1043	-0.4339	-0.0250	4.84	0.0278
	Connecticut	1	-0.2283	-20.4%	0.1055	-0.4350	-0.0216	4.69	0.0304
	Delaware	1	-0.2260	-20.2%	0.1175	-0.4563	0.0042	3.70	0.0543
	District of Columbia	1	0.3115	36.5%	0.1304	0.0559	0.5671	5.71	0.0169
	Florida	1	-0.4675	-37.3%	0.0997	-0.6630	-0.2721	21.98	<0.0001
	Georgia	1	-0.3785	-31.5%	0.1036	-0.5815	-0.1755	13.35	0.0003
	Idaho	1	-0.4568	-36.7%	0.1509	-0.7527	-0.1610	9.16	0.0025
	Illinois	1	-0.1932	-17.6%	0.1010	-0.3911	0.0047	3.66	0.0557
	Indiana	1	-0.2002	-18.1%	0.1075	-0.4108	0.0105	3.47	0.0626
	Iowa	1	-0.2055	-18.6%	0.1193	-0.4392	0.0283	2.97	0.0849
	Kansas	1	-0.2895	-25.1%	0.1108	-0.5067	-0.0722	6.82	0.0090
	Kentucky	1	-0.3424	-29.0%	0.1092	-0.5563	-0.1284	9.83	0.0017
	Louisiana	1	-0.1002	-9.5%	0.1035	-0.3031	0.1028	0.94	0.3333
	Maine	1	-0.0156	-1.5%	0.1467	-0.3032	0.2720	0.01	0.9154
	Maryland	1	-0.1822	-16.7%	0.1024	-0.3829	0.0185	3.17	0.0752
	Massachusetts	1	-0.0440	-4.3%	0.1055	-0.2508	0.1628	0.17	0.6768
	Michigan	1	0.1219	13.0%	0.1025	-0.0790	0.3228	1.41	0.2342
	Minnesota	1	-0.2407	-21.4%	0.1043	-0.4452	-0.0362	5.32	0.0211
	Mississippi	1	-0.0858	-8.2%	0.1236	-0.3280	0.1565	0.48	0.4878
	Missouri	1	-0.3286	-28.0%	0.1058	-0.5359	-0.1214	9.66	0.0019
	Montana	1	-0.3406	-28.9%	0.1979	-0.7285	0.0473	2.96	0.0852
	Nebraska	1	-0.3528	-29.7%	0.1155	-0.5792	-0.1264	9.33	0.0023
	Nevada	1	-0.3839	-31.9%	0.1150	-0.6094	-0.1584	11.14	0.0008
	New Hampshire	1	-0.1484	-13.8%	0.1232	-0.3898	0.0930	1.45	0.2282
	New Jersey	1	-0.2244	-20.1%	0.1007	-0.4217	-0.0270	4.97	0.0259
	New Mexico	1	-0.4422	-35.7%	0.1276	-0.6922	-0.1922	12.02	0.0005
	New York	1	-0.0571	-5.6%	0.0997	-0.2526	0.1384	0.33	0.5672
	North Carolina	1	-0.4705	-37.5%	0.1033	-0.6729	-0.2681	20.77	<0.0001

Appendix : Illustrative regression results — collision frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	North Dakota	1	0.1475	15.9%	0.1617	-0.1694	0.4645	0.83	0.3616
	Ohio	1	-0.3775	-31.4%	0.1016	-0.5767	-0.1784	13.80	0.0002
	Oklahoma	1	-0.3960	-32.7%	0.1124	-0.6164	-0.1757	12.41	0.0004
	Oregon	1	-0.3606	-30.3%	0.1093	-0.5749	-0.1463	10.88	0.0010
	Pennsylvania	1	-0.0930	-8.9%	0.1002	-0.2895	0.1035	0.86	0.3536
	Rhode Island	1	-0.1051	-10.0%	0.1182	-0.3368	0.1267	0.79	0.3743
	South Carolina	1	-0.3586	-30.1%	0.1114	-0.5770	-0.1402	10.36	0.0013
	South Dakota	1	-0.0088	-0.9%	0.1606	-0.3236	0.3060	0.00	0.9562
	Tennessee	1	-0.2749	-24.0%	0.1057	-0.4821	-0.0678	6.77	0.0093
	Texas	1	-0.2990	-25.8%	0.0995	-0.4940	-0.1041	9.04	0.0026
	Utah	1	-0.4414	-35.7%	0.1119	-0.6607	-0.2221	15.57	<0.0001
	Vermont	1	-0.0636	-6.2%	0.1759	-0.4083	0.2811	0.13	0.7176
	Virginia	1	-0.1739	-16.0%	0.1014	-0.3727	0.0249	2.94	0.0865
	Washington	1	-0.2808	-24.5%	0.1035	-0.4836	-0.0780	7.36	0.0067
	West Virginia	1	-0.36090	-30.3%	0.1365	-0.6285	-0.0933	6.99	0.0082
	Wisconsin	1	-0.26700	-23.4%	0.1081	-0.4789	-0.0551	6.10	0.0135
	Wyoming	1	-0.06490	-6.3%	0.1899	-0.4372	0.3073	0.12	0.7324
	Hawaii	1	-0.0194	-1.9%	0.1127	-0.2403	0.2015	0.03	0.8632
	Alaska	0	0	0	0	0	0		
Deductible range	0-250	1	0.5311	70.1%	0.0184	0.4950	0.5672	831.81	<0.0001
	251-500	1	0.3167	37.3%	0.0161	0.2851	0.3484	385.00	<0.0001
	1001+	1	-0.2287	-20.4%	0.0997	-0.4242	-0.0332	5.26	0.0218
	501-1000	0	0	0	0	0	0		
Registered vehicle density	0-99	1	-0.1846	-16.9%	0.0170	-0.2180	-0.1513	117.85	<0.0001
	100-499	1	-0.1388	-13%	0.0113	-0.1608	-0.1167	152.08	<0.0001
	500+	0	0	0	0	0	0		
Active Front Lighting System		1	-0.0665	-6.4%	0.0311	-0.1274	-0.0055	4.57	0.0326
Blind Spot Monitoring		1	0.0004	0%	0.0158	-0.0306	0.0313	0	0.9822
Back-up camera		1	0.0305	3.1%	0.0133	0.0045	0.0565	5.29	0.0215

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The Highway Loss Data Institute is a nonprofit public service organization that gathers, processes, and publishes insurance data on the human and economic losses associated with owning and operating motor vehicles.