Mercedes-Benz collision avoidance features: initial results

Mercedes-Benz offers a wide range of collision avoidance features. Results for its forward collision warning systems, Distronic and Distronic Plus, are particularly promising. These systems reduce claims under property damage liability (PDL) coverage and, to a lesser extent, collision coverage. The effects are more pronounced for Distronic Plus, which includes adaptive brake assistance and autonomous braking. Headlamp improvements also appeared beneficial. However, the biggest effect for Active Curve Illumination was seen in PDL claims and not, as had been expected, collision claims. Both collision and PDL claim frequency decreased significantly for vehicles with Night View Assist or Night View Assist Plus. Other features did not show significant reductions in claims.

▶ 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 (HLDI) bulletin examines the early insurance claims experience for Mercedes-Benz vehicles fitted with 15 features:

Forward collision warning

Distronic is an adaptive cruise control system that uses a radar sensor mounted on the front bumper to monitor traffic ahead and maintain the driver's selected following distance. As traffic conditions dictate, the system employs up to 20 percent of the vehicle's braking force to maintain the set following distance. The system also provides forward collision warning functionality. Collision warning is active even when adaptive cruise control is turned off. If the system detects the risk of a collision, warnings are both auditory and visual (a dashboard icon). If the driver brakes, the warnings are canceled. Adaptive cruise control is available at speeds of 20 mph or higher and can bring the car to a stop in traffic. The forward collision warning system is active at speeds of 20 mph or higher.

Distronic Plus, like its predecessor Distronic, provides adaptive cruise control and forward collision warning. It is functional at speeds of 20 mph and over if no lead vehicle is detected and at speeds of 0-120 mph when a lead vehicle is detected. Distronic Plus gets additional functionality from two other systems that are available only as part of Distronic Plus: Pre-Safe® Brake and Brake Assist Plus.

Pre-Safe® Brake alerts inattentive drivers when braking is required. If the driver does not respond to the auditory and visual alerts, the system can trigger partial braking as a warning and eventually trigger full braking to mitigate an inevitable rear-end collision. Additionally all Pre-Safe® measures are activated at the final stage. The functional speed range of Pre-Safe® Brake is above 20 mph when following a moving vehicle and 20-45 mph if approaching a stationary vehicle. The system is enabled and deactivated via instrument panel controls. It will intervene unless the driver makes a recognized evasive maneuver (e.g., acceleration, release brake pedal, evasive steering).

Brake Assist Plus supports a driver who is braking to avoid a rear-end collision. If the driver does not brake strongly enough, the system applies the calculated brake pressure needed, up to full braking, without warning to avoid a collision. The functional speed range of Brake Assist Plus is above 20 mph when following a moving vehicle and 20-45 mph if approaching a stationary vehicle. Once activated, the system will stay active until the situation is resolved, even below the 20 mph threshold. Brake Assist Plus is enabled via instrument cluster controls and deactivated via either instrument panel controls or based upon driver intervention (i.e., acceleration, release brake pedal, evasive steering).

Headlamp improvements

Active Curve Illumination improves visibility through curves during nighttime driving by swiveling the headlamps as the driver steers to increase usable illumination. Once the headlights are turned on, Active Curve Illumination is active and functional at all speeds.

High Intensity Discharge (HID) Headlights create light with an arc of electrified gas, typically xenon, rather than a glowing filament. HIDs produce more light than standard tungsten-halogen bulbs.

Active Cornering Lights (ACLS) improve visibility during low speed turning maneuvers. When the driver activates a turn signal or turns the steering wheel, the appropriate fog lamp illuminates the side area in front of the vehicle to a range of approximately 30 meters. The cornering lights are deactivated when the indicator is turned off or when the steering wheel returns to the straight ahead position. Cornering lights are operational at speeds up to 25 mph.

Adaptive High Beam Assist increases visibility by enabling greater use of high and low beams. It automatically dims the headlights when other illuminated traffic is recognized by a camera mounted behind the windshield. After switching from high beam to low beam, the system uses the camera's continuous input to automatically vary the range of low beams, based on the distance both to oncoming vehicles and to those ahead of the vehicle. Therefore, the range of the low beam can be significantly improved and less driver action is required. Adaptive High Beam Assist must be turned on by the driver and can be activated/deactivated via the instrument cluster controls. At the next ignition cycle, the system will be in the previous on/off setting. The system is functional at speeds above 30 mph.

Night Vision Enhancement

Night View Assist is a vision aid system that uses infrared headlamps to illuminate upcoming obstacles (pedestrians, cyclists, animals etc) whose images are projected onto a multifunction display in the instrument cluster to give the driver advance notice beyond typical low beam headlamp range. The system must be turned on by the driver and can be activated/deactivated with a button beside the light switch. The system is functional at speeds above 6 mph.

Night View Assist Plus is a vision aid system that uses infrared headlamps to illuminate upcoming obstacles (pedestrians, cyclists, animals etc) whose images are projected onto a multifunction display in the instrument cluster to give the driver advance notice beyond typical low beam headlamp range. An advanced algorithm enables additional highlighting of pedestrians. The system must be turned on by the driver and can be activated/deactivated with a button beside the light switch. The system is functional at speeds above 6 mph.

Side systems

Blind Spot Assist uses radar sensors integrated in the rear bumper to monitor the area up to 10 feet behind and directly next to the vehicle. The system provides a warning display in the exterior mirrors to alert the driver to the presence of vehicles in the monitored area. If a vehicle is present in the monitored area, a red warning lamp is illuminated in the corresponding exterior rearview mirror. If the driver signals to change into that lane, the warning lamp flashes, accompanied by a warning tone. Blind Spot Assist must be turned on by the driver and can be activated/deactivated via the instrument cluster controls. At the next ignition cycle, the system will be in the previous on/off setting. The system is functional at speeds above 20 mph.

Lane Keeping Assist monitors the area in front of the vehicle by means of a camera at the top of the windshield. The system detects lane markings on the road and provides a 1.5-second steering wheel vibration as a warning when the front wheel passes over a lane marking. Lane Keeping Assist is activated/deactivated via the instrument cluster controls and is functional at speeds above 40 mph.

Low-speed maneuvering systems

Parktronic is an electronic parking aid which uses ultrasonic sensors in the front and rear bumpers to provide visual and audible indications of the distance between the vehicle and an object. The system helps drivers avoid obstacles outside the typical field of vision. Parktronic is functional at or below 11 mph and is activated automatically when both the parking brake is released and the transmission position is D, R or N. The system can be activated manually via a center console switch. Results for another, nearly identical system known as Park Assist are included with the Parktronic results.

Parking Guidance, using ultrasonic sensors in the front bumper, detects appropriately-sized parking spaces, measures them, and then displays steering instructions in the instrument cluster to guide the vehicle into the space. The system is automatically activated at or below 22 mph and can be deactivated/reactivated via a center console switch.

The **backup camera** is an optical parking aid that uses a rear-facing camera mounted at the rear of the vehicle to show the area behind the vehicle on a central display screen. The image may include static distance/guidance lines to aid in parking maneuvers. The display is activated when reverse gear is engaged.

▸ Method

Vehicles

These features are offered as optional equipment on various Mercedes-Benz models. The number of features, and the number of models on which the features were available has increased over the years. 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. Mercedes-Benz 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 Mercedes-Benz were assumed not to have these features and thus served as the control vehicles in the analysis.

In addition to the listed features, Mercedes-Benz also provided information on feature availability for Attention Assist (driver drowsiness detection) and Pre-Safe® (which tightens seat belts, closes windows, and makes other adjustments ahead of a collision, but does not include autonomous braking). However, for every series and model year combination these features are either standard equipment or not available. They are never optional equipment; consequently, the analysis technique used in this study cannot separate the effect of the feature from the vehicle series.

Some of the analyzed features are always bundled together on a vehicle and are not available individually. The bundled features vary between vehicle series and by model year. For example, the 2010 E-Class vehicles that have Blind Spot Assist also have Lane Keeping Assist. The functionality of several of the features varied by vehicle series and/or by model year. For example, vehicles with rear cameras can have one of three display types. Some displays have no guidelines, some have static guidelines while others have dynamic guidelines. Additional analysis was conducted to determine if the feature differences were associated with measurable differences in loss results. For every feature, the variant with the most exposure had an estimate that was similar to the combined estimate. **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. For each vehicle, the percentage of the exposure that can be attributed to each feature is listed. The Maybach 57 and Maybach 62 are included in the analysis because Maybach and Mercedes-Benz are both owned by Daimler AG, and the two makes have similar crash avoidance features. However, the Maybach vehicles do not contribute significant exposure.

Table 1 : Feature exposure by vehicle series

Make	Series	Model year range	Distronic	Distronic Plus	High Intensity Discharge Headlights	Active Curve Illumination	Active Cornering Lights	Adaptive High Beam Assist	Night View Assist/Plus	Blind Spot Assist	Lane Keeping Assist	Parktronic	Parking Guidance	Backup camera	Total exposure (insured vehicle years)
Maybach	57 4dr	2004-10	100%		32%	32%	32%							24%	1,396
Maybach	62 4dr	2004-10	100%		40%	40%	40%							32%	377
Mercedes-Benz	C class 2dr	2003-05			3%		1%								96,166
Mercedes-Benz	C class 4dr	2003-10			11%		5%							<1%	1,065,426
Mercedes-Benz	C class 4dr 4WD	2003-10			7%		6%							<1%	369,242
Mercedes-Benz	C class station wagon	2003-05			4%		1%								19,489
Mercedes-Benz	C class station wagon 4WD	2003-05			7%		1%								23,493
Mercedes-Benz	CL class 2dr	2000-10	9%	5%	13%	13%	13%		12%	2%		46%	2%	12%	100,834
Mercedes-Benz	CL class 2dr 4WD	2009-10		20%	100%	100%	100%		95%	20%		100%	20%	95%	1,515
Mercedes-Benz	CLK class 2dr	2003-09	1%		34%	7%	9%					4%			196,186
Mercedes-Benz	CLK class convertible	2004-09	<1%		33%	12%	18%					5%			203,180
Mercedes-Benz	CLS class 4dr	2006-10	2%		57%	57%	28%					33%			127,286
Mercedes-Benz	E class 2dr	2010		7%	43%	43%	43%	43%				7%	7%	96%	10,331
Mercedes-Benz	E class 4dr	2000-10	<1%	<1%	15%	8%	3%	1%	<1%	<1%	<1%	4%	<1%	2%	1,523,146
Mercedes-Benz	E class 4dr 4WD	2000-02, 2004-10	<1%	1%	13%	11%	6%	2%	<1%	1%	1%	5%	1%	5%	404,621
Mercedes-Benz	E class station wagon	2000-09	<1%		6%	4%	<1%					1%			58,974
Mercedes-Benz	E class station wagon 4WD	2000-09	1%		16%	10%	3%					1%			92,929
Mercedes-Benz	G class 4dr 4WD	2003-10										70%		10%	29,319
Mercedes-Benz	GL class 4dr 4WD	2007-10	1%		40%	40%	37%					91%		69%	174,304
Mercedes-Benz	GLK class 4dr	2010			3%	3%	3%					3%		25%	11,585
Mercedes-Benz	GLK class 4dr 4WD	2010			9%	9%	9%					7%		44%	30,135
Mercedes-Benz	M class 4dr	2009-10	<1%		3%	3%	3%					7%		91%	9,734
Mercedes-Benz	M class 4dr 4WD	2002-10	<1%		13%	7%	7%					6%		18%	956,934
Mercedes-Benz	M class hybrid 4dr 4WD	2010			33%	33%	33%					34%		99%	672
Mercedes-Benz	R class 4dr	2008	<1%		3%	3%	3%					96%		39%	5,578
Mercedes-Benz	R class 4dr 4WD	2006-10	1%		10%	10%	10%					49%		21%	124,906
Mercedes-Benz	S class 4dr	2000-10	3%	2%	27%	15%	15%	1%	4%	1%	<1%	24%	1%	6%	861,865

Make	Series	Model year range	Distronic	Distronic Plus	High Intensity Discharge Headlights	Active Curve Illumination	Active Cornering Lights	Adaptive High Beam Assist	Night View Assist/Plus	Blind Spot Assist	Lane Keeping Assist	Parktronic	Parking Guidance	Backup camera	Total exposure (insured vehicle years)
Mercedes-Benz	S class 4dr 4WD	2003-10	2%	3%	74%	37%	37%	3%	13%	2%	<1%	43%	4%	19%	136,225
Mercedes-Benz	S class hybrid 4dr	2010		18%	100%	97%	96%	97%	18%	18%	18%	83%	83%	83%	968
Mercedes-Benz	SL class convertible	2003-09	7%		67%	4%	18%					26%			285,781
Mercedes-Benz	SLK class convertible	2005-10			22%		11%					<1%			144,386

Table 1 : Feature exposure by vehicle series

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 can be 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 results.

Statistical methods

Regression analysis was used to quantify the effect of each vehicle feature while controlling for the other features and covariates. The covariates included calendar year, model year, garaging state, vehicle density (number of registered vehicles per square mile), rated driver age, 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 interaction of series and model year. Effectively, this variable restricted the estimation of the effect of each feature within 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: 79.6 percent for PIP, 68.4 percent for BI, and 67.5 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 Distronic's effect on PDL claim frequency was -0.07373; thus, vehicles with Distronic had 7.1 percent fewer PDL claims than expected (exp(-0.07373)-1*100=-7.1).

▶ Results

Table 2 lists all of the PDL claim frequency, severity and overall loss results by feature. Two-thirds of the features show a frequency benefit. Severities and overall losses show mixed results with overall losses for most features showing a benefit. Significant results are indicated in blue in this and subsequent tables.

Table 2 : Property damage liability losses by feature									
Feature	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Distronic	-12.0%	**-7.1%**	-1.9%	-$100	$58	$225	-$10	-$4	$2
Distronic Plus	-23.3%	**-14.3%**	-4.2%	-$191	$126	$479	-$19	-$8	$4
High Intensity Discharge Headlights	-7.2%	**-5.5%**	-3.7%	$15	**$70**	$126	-$5	**-$3**	$0
Active Curve Illumination	-7.7%	**-4.7%**	-1.6%	-$52	$41	$136	-$6	-$3	$1
Active Cornering Lights	-1.4%	1.7%	4.9%	-$148	-$60	$30	-$4	$0	$3
Adaptive High Beam Assist	-16.7%	-5.9%	6.2%	-$555	-$252	$91	-$22	-$11	$2
Night View Assist/Plus	-14.3%	**-8.1%**	-1.3%	-$313	-$125	$77	-$16	**-$10**	-$2
Blind Spot Assist	-20.5%	0.4%	26.9%	-$746	-$158	$590	-$26	-$4	$27
Lane Keeping Assist	-14.6%	10.9%	43.9%	-$548	$150	$1,057	-$16	$13	$55
Parktronic	-3.7%	-1.8%	0.2%	$60	**$119**	$180	$0	$2	$4
Parking Guidance	-9.1%	5.0%	21.2%	-$297	$128	$623	-$9	$8	$28
Backup camera	-3.9%	-0.5%	3.1%	-$13	$91	$199	-$2	$2	$6

Results for Mercedes-Benz's Distronic, an adaptive cruise control and forward collision warning system, are summarized in Table 3. Here and in subsequent tables, the lower and upper bounds represent the 95 percent confidence limits for the estimates. For vehicle damage losses, frequency of claims are generally down while the average cost of the remaining claims is higher. The reduction in frequency of property damage liability claims, 7.1 percent was statistically significant as was the increase in severity and overall losses for collision.

For injury losses, overall frequency of claims (paid plus reserved) decrease for all coverages, with the decrease for medical payments being significant. Among paid claims, MedPay had a significant reduction at the higher severity.

Table 3 : Change in insurance losses for Distronic								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-6.1%	-3.1%	0.0%	$586	$813	$1,049	$24	$45	$67
Property damage liability	-12.0%	-7.1%	-1.9%	-$100	$58	$225	-$10	-$4	$2

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	-15.6%	-4.0%	9.1%	-15.2%	5.7%	31.7%	-25.5%	-7.3%	15.3%
Medical payments	-34.8%	-23.1%	-9.3%	-60.9%	-35.0%	7.9%	-37.0%	-21.3%	-1.6%
Personal injury protection	-13.3%	-1.7%	11.4%	-35.2%	-11.2%	21.7%	-12.0%	3.0%	20.5%

Results for Mercedes-Benz's Distronic Plus, an adaptive cruise control and forward collision warning system with collision mitigation braking functionality, are summarized in Table 4. Reductions in loss claims are estimated for both first- and third-party vehicle damage coverages, resulting in somewhat lower losses per insured vehicle year (overall losses). Only the frequency reductions for collision and PDL were significant.

Under injury coverages, the frequency of paid and reserved claims is lower for all coverage types but none of the differences is statistically significant. Among paid claims, reductions are seen for all coverage types at both low and high severity.

Table 4 : Change in insurance losses for Distronic Plus								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-12.8%	-7.1%	-1.0%	-$258	$145	$578	-$54	-$18	$20
Property damage liability	-23.3%	-14.3%	-4.2%	-$191	$126	$479	-$19	-$8	$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	-36.7%	-16.0%	11.4%	-49.3%	-14.6%	44.1%	-44.8%	-11.1%	43.4%
Medical payments	-43.2%	-21.1%	9.6%	-74.7%	-24.9%	123.4%	-50.5%	-21.6%	24.2%
Personal injury protection	-34.9%	-15.1%	10.7%	-73.9%	-42.8%	25.3%	-42.0%	-17.3%	17.9%

Results for Mercedes-Benz's High Intensity Discharge Headlights are summarized in **Table 5**. For vehicle damage losses, the frequency of claims is down for property damage liability and little-changed for collision coverage. Claim severity is significantly higher for both coverages, resulting in significantly higher overall collision losses and a small significant decrease in PDL overall losses.

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

Table 5 : Change in insurance losses for High Intensity Discharge Headlights								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-0.3%	0.8%	1.9%	$478	**$553**	$629	$36	**$44**	$51
Property damage liability	-7.2%	**-5.5%**	-3.7%	$15	**$70**	$126	-$5	**-$3**	$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	-9.0%	-4.5%	0.3%	-14.9%	-7.4%	0.8%	-11.3%	-3.8%	4.4%
Medical payments	-14.4%	**-9.7%**	-4.8%	-15.8%	-2.9%	11.9%	-18.3%	**-12.1%**	-5.5%
Personal injury protection	-10.2%	**-6.4%**	-2.6%	-19.1%	**-11.0%**	-2.0%	-10.7%	**-5.9%**	-0.9%

Results for Mercedes-Benz's Active Curve Illumination are summarized in **Table 6**. For vehicle damage losses, frequency of claims are down for PDL and little-changed for collision. The severity of claims increased for both coverages, resulting in a small increase in overall losses under collision and a small decrease in PDL overall losses, while the average cost of the remaining claims is higher. The change in frequency under PDL coverage is significant while the increase in severity for collision coverage is also significant.

Under injury coverages, the frequency of paid plus reserved claims decreases for all coverage types, and the decreases for bodily injury and MedPay are significant. Among paid claims, reductions are seen for all coverage types at both low and high severity although most of the reductions were not statistically significant.

Table 6 : Change in insurance losses for Active Curve Illumination								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-2.7%	-0.8%	1.1%	$50	**$172**	$296	-$2	$9	$21
Property damage liability	-7.7%	**-4.7%**	-1.6%	-$52	$41	$136	-$6	-$3	$1

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	-17.3%	**-9.9%**	-1.7%	-22.7%	-9.9%	5.0%	-18.0%	-5.1%	9.8%
Medical payments	-21.7%	**-14.0%**	-5.5%	-46.2%	**-29.1%**	-6.5%	-25.5%	**-15.3%**	-3.6%
Personal injury protection	-8.6%	-1.9%	5.3%	-16.0%	-0.9%	16.9%	-9.5%	-0.7%	8.9%

Results for Mercedes-Benz's Active Cornering Light System are summarized in **Table 7**. For vehicle damage losses, frequency claims are down for collision and up for property damage liability. The decrease in frequency, severity and overall losses for collision are significant.

For injury losses, overall frequency of claims (reserved plus paid) is higher for both BI and MedPay, but not for PIP, and the decrease for PIP is statistically significant. Among paid claims, the pattern is unclear.

Table 7 : Change in insurance losses for Active Cornering Lights								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-4.5%	**-2.7%**	-0.9%	-$308	**-$198**	-$85	-$35	**-$24**	-$14
Property damage liability	-1.4%	1.7%	4.9%	-$148	-$60	$30	-$4	$0	$3

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	-5.1%	3.2%	12.2%	-11.5%	2.8%	19.5%	-7.4%	6.6%	22.8%
Medical payments	-2.9%	6.2%	16.2%	-20.2%	3.5%	34.2%	-0.1%	13.1%	28.0%
Personal injury protection	-13.5%	**-7.4%**	-0.8%	-16.2%	-1.5%	15.8%	-19.6%	**-12.1%**	-3.8%

Results for Mercedes-Benz's Adaptive High Beam Assist System are summarized in **Table 8**. Non-significant reductions in loss claims, severity and overall losses are estimated for both first- and third-party vehicle damage coverages.

For injury losses, overall frequency of claims (reserved plus paid) is higher for both BI and PIP, but not for MedPay. Among paid claims, a similar pattern appears with increases for BI and PIP, and a decrease for MedPay. None of the estimates are significant.

Table 8 : Change in insurance losses for Adaptive High Beam Assist								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-7.2%	-0.7%	6.3%	-$544	-$136	$305	-$51	-$13	$30
Property damage liability	-16.7%	-5.9%	6.2%	-$555	-$252	$91	-$22	-$11	$2

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	-13.3%	32.6%	102.9%	-34.5%	73.1%	357.2%	-51.6%	8.8%	144.6%
Medical payments	-43.5%	-17.0%	21.9%	-73.6%	-23.2%	123.6%	-45.5%	-6.5%	60.4%
Personal injury protection	-14.0%	12.9%	48.2%	-29.5%	27.3%	130.1%	-20.4%	14.7%	65.4%

Combined results for Mercedes-Benz's Night View Assist and Night View Assist Plus, vision aid systems are summarized in **Table 9**. Again, the lower and upper bounds represent the 95 percent confidence limits for the estimates. Significant reductions in loss claims are estimated for both 1st and 3rd party vehicle damage coverages.

For injury losses, overall frequency of claims (reserved plus paid) decrease for all coverages, but none of the decreases is significant. The pattern is unclear for paid claims.

Table 9 : Change in insurance losses for Night View Assist/Plus								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-8.1%	**-4.1%**	-0.1%	$160	**$441**	$736	-$11	$14	$41
Property damage liability	-14.3%	**-8.1%**	-1.3%	-$313	-$125	$77	-$16	**-$10**	-$2

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	-20.0%	-2.5%	18.9%	-35.4%	-7.3%	33.0%	-31.9%	-4.5%	34.1%
Medical payments	-23.2%	-4.1%	19.9%	-44.0%	11.9%	123.6%	-23.5%	4.4%	42.6%
Personal injury protection	-23.3%	-9.7%	6.3%	-45.1%	-18.7%	20.6%	-21.9%	-2.8%	21.1%

Results for Mercedes-Benz's Blind Spot Assist are summarized in **Table 10**. For vehicle damage losses, frequency claims are down for collision and up for property damage liability coverage, neither is significant. Severity and overall losses are down non-significantly for both coverages.

 For injury losses, overall frequency of claims (reserved plus paid) decrease for all coverages, but none of the decreases are significant. The pattern is unclear for low- and high-severity paid claims.

Table 10 : Change in insurance losses for Blind Spot Assist								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-12.4%	-0.1%	13.8%	-$1,161	-$433	$415	-$99	-$32	$50
Property damage liability	-20.5%	0.4%	26.9%	-$746	-$158	$590	-$26	-$4	$27

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	-50.8%	-3.6%	88.8%	-81.6%	-30.8%	160.3%	-67.8%	37.3%	485.9%
Medical payments	-65.0%	-26.5%	54.4%	-96.5%	-56.5%	436.5%	-79.5%	-40.3%	73.7%
Personal injury protection	-49.7%	-7.2%	71.2%	-54.0%	108.5%	845.4%	-61.7%	-10.0%	111.5%

Results for Mercedes-Benz's Lane Keeping Assist are summarized in **Table 11**. For vehicle damage losses, frequency of claims, severity and overall losses are generally up. The increases in severity and overall losses for collision coverage are significant.

Under injury coverages, the pattern is unclear, and the confidence bounds for all estimated effects are quite large. The central finding here is that data are insufficient.

Table 11 : Change in insurance losses for Lane Keeping Assist								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-8.5%	5.6%	22.0%	$3	**$1,010**	$2,199	$1	**$99**	$222
Property damage liability	-14.6%	10.9%	43.9%	-$548	$150	$1,057	-$16	$13	$55

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	-56.7%	-2.8%	118.3%	-46.4%	138.8%	964.6%	-85.5%	-19.5%	346.7%
Medical payments	-8.0%	106.5%	363.8%	-21.9%	844.4%	11,321.2%	-52.5%	67.0%	486.6%
Personal injury protection	-43.7%	10.6%	117.4%	-85.2%	-25.6%	274.7%	-43.0%	41.7%	252.3%

Results for Mercedes-Benz's Parktronic are summarized in **Table 12**. 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, but neither result is significant. Claim severity is significantly higher for both coverages, resulting in significantly higher overall collision losses and a small, statistically insignificant increase in PDL overall losses.

Under injury coverages, the frequency of paid and reserved claims is significantly lower for both MedPay and PIP, but not for BI. Among paid claims, reductions are seen for all coverage types at both low and high severity with the reductions at high seveity for MedPay and PIP being significant.

Table 12 : Change in insurance losses for Parktronic								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-0.5%	0.8%	2.0%	$185	**$264**	$343	$15	**$22**	$30
Property damage liability	-3.7%	-1.8%	0.2%	$60	**$119**	$180	$0	$2	$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	-4.7%	0.5%	5.9%	-9.5%	-0.6%	9.1%	-11.2%	-2.8%	6.2%
Medical payments	-12.1%	**-6.7%**	-0.9%	-19.9%	-5.0%	12.6%	-17.6%	**-10.5%**	-2.7%
Personal injury protection	-11.6%	**-7.3%**	-2.8%	-15.0%	-5.0%	6.1%	-13.6%	**-8.1%**	-2.3%

Results for Mercedes-Benz's Parking Guidance system are summarized in **Table 13**. Non-significant increases in loss claims, severity and overall losses are estimated for both first- and third-party vehicle damage coverages.

Under injury coverages, the pattern is unclear and some of the confidence bounds are quite large.

Table 13 : Change in insurance losses for Parking Guidance								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-1.8%	6.3%	15.2%	-$326	$198	$775	-$11	$40	$99
Property damage liability	-9.1%	5.0%	21.2%	-$297	$128	$623	-$9	$8	$28

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	-37.4%	1.6%	65.2%	-43.9%	57.4%	341.5%	-84.2%	-51.8%	46.8%
Medical payments	-28.1%	10.7%	70.3%	-64.2%	15.5%	272.9%	-40.3%	11.8%	109.3%
Personal injury protection	-30.8%	-1.6%	39.9%	-77.4%	-46.3%	27.4%	-35.8%	2.7%	64.4%

Results for Mercedes-Benz's backup camera are summarized in **Table 14**. For physical damage losses, frequency claims are down slightly for property damage liability and up slightly for collision coverage, neither is significant.

For injury losses, overall frequency of claims (reserved plus paid) is higher for both BI and MedPay, but not for PIP. Among paid claims, the pattern is unclear.

Table 14 : Change in insurance losses for backup camera								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-1.9%	0.5%	2.9%	-$156	-$6	$149	-$13	$1	$16
Property damage liability	-3.9%	-0.5%	3.1%	-$13	$91	$199	-$2	$2	$6

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	-0.8%	10.8%	23.7%	-12.5%	6.4%	29.3%	-5.2%	14.7%	38.8%
Medical payments	-10.7%	1.3%	14.9%	-24.7%	8.1%	55.1%	-17.4%	-1.2%	18.1%
Personal injury protection	-11.9%	-4.0%	4.7%	-24.3%	-7.8%	12.4%	-11.9%	-1.3%	10.7%

‣ Discussion

Forward collision warning

Distronic and Distronic Plus are forward collision warning systems that differ in two principal ways: In addition to warnings, Distronic Plus will apply brakes autonomously in certain situations, and it is active at lower speeds in following traffic (0-120 mph vs. 20-120 mph for Distronic). Both systems are expected to have larger benefits for PDL coverage than collision coverage because a larger proportion of PDL crashes are two-vehicle front-to-rear-end crashes that occur in following traffic where the systems would be active (compared with collision coverage, under which some number of crashes are single-vehicle). In addition, Distronic Plus should have larger effects than Distronic because of the autonomous braking feature and because it is operative at lower speeds. Although there is overlap among the relevant confidence intervals, results are directionally consistent with these expectations. Both Distronic Plus and Distronic reduced PDL claim frequency significantly and to a greater extent than collision claim frequency. Additionally, Distronic Plus was associated with greater reductions in PDL claim frequency than Distronic.

To further explore the differences between Distronic and Distronic Plus, PDL claims were categorized as low cost (<$1500), medium cost ($1500-$6999), or high cost ($7000+). Results (see **Table 15**) indicate that Distronic and Distronic Plus had similar effects on medium severity claims, while Distronic Plus had much stronger effects on low severity claims (perhaps because of the lower activation speed in following traffic) and in high severity claims (perhaps because of the adaptive braking assistance and/or the autonomous braking features), although the high severity estimates have wide confidence bounds. Mercedes-Benz's own studies have shown that the addition of autonomous braking to vehicles reduces or mitigates crashes (Breuer and Feldmann, 2011).

Both Distronic and Distronic Plus also appear to reduce the frequency of injury claims, although only the reduction under medical payments coverage for Distronic is statistically significant. Ultimately, one would expect a reduction in bodily injury liability claims corresponding to the reduction in PDL claims, but that effect is not yet statistically reliable.

Table 15 : Property damage liability claim frequencies by claim severity range, Distronic and Distronic Plus								
	Lower bound	Frequency <$1,500	Upper bound	Lower bound	Frequency $1,500 - $6,999	Upper bound	Lower bound	Frequency $7,000+	Upper bound
Distronic	-12.9%	-5.6%	2.3%	-16.8%	**-9.6%**	-1.8%	-17.9%	-3.3%	13.8%
Distronic Plus	-31.7%	**-18.7%**	-3.3%	-24.8%	-11.5%	4.2%	-34.0%	-9.4%	24.3%

In sum, Mercedes-Benz's forward collision warning systems appear to be reducing front-to-rear crashes with observable benefits for PDL coverage but not yet for BI liability coverage. Encouragingly, the increase in collision coverage costs observed for Distronic — associated with a greater average severity of claim — appears to have dissipated for Distronic Plus.

Headlamp improvements

Mercedes-Benz has introduced several new headlamp systems in recent years. From a collision avoidance perspective, their Active Curve Illumination system is similar to adaptive headlamp systems introduced by other automakers. In these systems, headlamps respond to steering inputs to help drivers illuminate curves. It was expected that these lamps would reduce crashes, but it was also expected that the crashes affected would be largely single-vehicle, run-off-road crashes. However, collision claims were least affected by Mercedes-Benz's Active Curve Illumination. Instead, PDL claims, along with some injury coverages, saw significant reductions in frequency. Although these results confirm a significant benefit for insurance claims of adaptive headlamps, further research is needed to explore the kinds of crashes that are being affected.

In addition to Active Curve Illumination, benefits also were observed for Mercedes-Benz's HID lamps. HID lamps resulted in significant reductions in claim frequency for PDL, MedPay and PIP compared with halogen lamps. One important caveat, however, is that the severity of collision coverage claims rose more than $500, resulting in increased loss costs of $44 per insured vehicle year.

Mercedes-Benz's active cornering light system also seemed beneficial. Although effects were small, this low speed corner illumination system reduced collision overall losses by $24 per insured vehicle year and PIP coverage claims by more than 7 percent.

Night vision enhancement

Both collision and PDL claim frequency decreased significantly for vehicles with Night View Assist or Night View Assist Plus. However, the average collision claim severity increased sharply for these vehicles. An additional analysis (see Table 16) of collision claim frequency categorized into four severity ranges indicated that the increase in average claim cost was likely due to a much larger frequency reduction among low-cost claims than more expensive ones, rather than a higher cost to repair vehicles with the night vision system. None of the injury coverages were affected significantly, although all showed declines in claim frequency.

	Table 16 : Collision claim frequencies by claim severity range, Night View Assist/Plus										
	Lower bound	Frequency < $2,000	Upper bound	Lower bound	Frequency $2,000 to $4,999	Upper bound	Lower bound	Frequency $5,000 to $11,999	Upper bound	Lower bound	Frequency $12,000+	Upper bound
Night View Assit/Plus	-13.6%	**-7.4%**	-0.7%	-10.5%	-2.9%	5.4%	-11.1%	-2.6%	6.7%	-10.9%	-1.5%	8.9%

Side systems

Blind Spot Assist: Collision and PDL coverages essentially showed no effect. Injury coverages all indicated reduced claim frequency, but reductions were not statistically significant and the confidence intervals were quite large.

Lane Keeping Assist: Again, lack of data meant that confidence intervals for all coverages were large, and no effects were statistically significant. However, it is noteworthy that only a single coverage, BI liability, showed a reduction in claim frequency. All other estimates suggested an increase in claim frequency with Lane Keeping Assist.

Low-speed maneuvering

Parktronic: This system is intended to reduce low-speed collisions occurring in parking maneuvers, which would be expected to lead to benefits for collision and PDL coverages. Despite high exposure rates and correspondingly small confidence intervals for estimated effects, there was no evidence of these expected benefits. Not only did collision and PDL claim frequency not decline, but the severity of those claims actually increased for vehicles with Parktronic, such that overall losses were higher. While the increase in collision costs might be explained by the expense of replacing damaged sensors that support this system, the increase in average PDL cost suggests higher-severity crashes. Equally unexpected was that Parktronic was associated with fewer MedPay and PIP claims. These findings will require further research to understand.

An additional analysis (see Table 17) of collision claim frequency categorized into four severity ranges indicated that the minimal increase in claim frequency is the result of a significant decrease for low-cost claims and significant increases for higher-cost claims. This reduction in low-cost claims may indicate that Parktronic is performing as expected in reducing low speed collisions. The increasing frequencies at higher severities may indicate that there is something else happening with these vehicles that needs to be explored with further research. Similar results are seen for property damage liability claim frequency by severity range (see Table 18). A significant decline is seen for low cost claims and non-significant increases at the higher ranges.

Table 17 : Collision claim frequencies by claim severity range, Parktronic											
	Lower bound	Frequency < $2,000	Upper bound	Lower bound	Frequency $2,000 to $4,999	Upper bound	Lower bound	Frequency $5,000 to $11,999	Upper bound	Lower bound	Frequency $12,000+	Upper bound
Parktronic	-6.1%	**-4.2%**	-2.2%	0.2%	**2.6%**	5.1%	0.8%	**3.6%**	6.5%	3.1%	**6.4%**	9.8%

Table 18 : Property damage liability claim frequencies by claim severity range, Parktronic									
	Lower bound	Frequency <$1,500	Upper bound	Lower bound	Frequency $1,500 - $6,999	Upper bound	Lower bound	Frequency $7,000+	Upper bound
Parktronic	-7.4%	**-4.6%**	-1.8%	-2.6%	0.3%	3.4%	-4.1%	2.2%	8.9%

Parking Guidance: This system is intended to help drivers identify and enter parallel parking spaces. Parking Guidance had no significant effect on claims experience. Although confidence intervals were large, it should be noted that most effect estimates suggested an increase in claims.

Backup camera: It has been thought that rearview cameras could reduce not only minor property damage from parking incidents, but also injuries from crashes involving cars backing into children. In this case, the Mercedes-Benz system showed no effect on any insurance coverage. However, this is a relatively weak analysis for injury effects involving pedestrians. Additional analyses, looking at bodily injury liability claims in the absence of collision or PDL claims, are under way.

▶ 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. Many of 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 do 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. The type of person who selects these options may be different from the person who declines. While the analysis controls for several driver characteristics, there may be other uncontrolled attributes associated with people who select these features.

Reference

Breuer, J. and Feldmann, M. 2011. Safety potential of advanced driver assistance systems. Proceedings of the 20th Aachen Colloquium — Automobile and Engine Technology, 771-79. Aachen, Germany.

Appendix : Illustrative regression results — collision frequency								
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Intercept		1	-8.5886		0.1060	-8.7963	-8.3808	6565.82	<0.0001
Calendar year	1999	1	-0.0245	-2.4%	0.0688	-0.1593	0.1103	0.13	0.7213
	2000	1	0.1690	18.4%	0.0207	0.1285	0.2095	66.88	<0.0001
	2001	1	0.1586	17.2%	0.0141	0.1310	0.1862	126.58	<0.0001
	2002	1	0.0350	3.6%	0.0112	0.0130	0.0570	9.74	0.0018
	2003	1	-0.0785	-7.5%	0.0093	-0.0968	-0.0602	70.88	<0.0001
	2004	1	-0.1047	-9.9%	0.0077	-0.1198	-0.0895	183.44	<0.0001
	2005	1	-0.0961	-9.2%	0.0066	-0.1090	-0.0831	211.64	<0.0001
	2006	1	-0.0942	-9.0%	0.0059	-0.1059	-0.0826	251.32	<0.0001
	2007	1	0.0007	0.1%	0.0053	-0.0098	0.0111	0.02	0.9017
	2008	1	0.0010	0.1%	0.0051	-0.0089	0.0109	0.04	0.8407
	2009	1	-0.0078	-0.8%	0.0049	-0.0174	0.0018	2.55	0.1102
	2011	1	-0.0359	-3.5%	0.0056	-0.0468	-0.0250	41.59	<0.0001
	2010	0	0	0	0	0	0		
Vehicle model year and series	2003 C class 2dr	1	-0.1732	-15.9%	0.1001	-0.3695	0.0230	2.99	0.0835
	2004 C class 2dr	1	-0.1781	-16.3%	0.1019	-0.3779	0.0217	3.05	0.0806
	2005 C class 2dr	1	-0.2557	-22.6%	0.1080	-0.4673	-0.0440	5.61	0.0179
	2003 C class 4dr	1	-0.1904	-17.3%	0.0994	-0.3853	0.0044	3.67	0.0554
	2004 C class 4dr	1	-0.1374	-12.8%	0.0995	-0.3324	0.0576	1.91	0.1673
	2005 C class 4dr	1	-0.0483	-4.7%	0.0993	-0.2430	0.1464	0.24	0.6271
	2006 C class 4dr	1	-0.0480	-4.7%	0.0995	-0.2430	0.1469	0.23	0.6291
	2007 C class 4dr	1	-0.0467	-4.6%	0.0996	-0.2419	0.1485	0.22	0.6393
	2008 C class 4dr	1	-0.0222	-2.2%	0.0995	-0.2173	0.1728	0.05	0.8233
	2009 C class 4dr	1	0.0001	0.0%	0.1001	-0.1960	0.1962	0.00	0.9993
	2010 C class 4dr	1	-0.0218	-2.2%	0.1016	-0.2208	0.1773	0.05	0.8301
	2003 C class 4dr 4WD	1	-0.1579	-14.6%	0.1004	-0.3547	0.0388	2.48	0.1157
	2004 C class 4dr 4WD	1	-0.1549	-14.3%	0.1004	-0.3517	0.0419	2.38	0.1230
	2005 C class 4dr 4WD	1	-0.1388	-13.0%	0.1001	-0.3349	0.0574	1.92	0.1655
	2006 C class 4dr 4WD	1	-0.1655	-15.3%	0.1005	-0.3624	0.0315	2.71	0.0996
	2007 C class 4dr 4WD	1	-0.1468	-13.7%	0.1005	-0.3438	0.0501	2.13	0.1440
	2008 C class 4dr 4WD	1	-0.0427	-4.2%	0.1001	-0.2389	0.1535	0.18	0.6699
	2009 C class 4dr 4WD	1	0.0034	0.3%	0.1007	-0.1939	0.2007	0.00	0.9733
	2010 C class 4dr 4WD	1	-0.0106	-1.1%	0.1015	-0.2096	0.1884	0.01	0.9166
	2003 C class station wagon	1	-0.2678	-23.5%	0.1071	-0.4778	-0.0579	6.25	0.0124
	2004 C class station wagon	1	-0.1472	-13.7%	0.1098	-0.3623	0.0679	1.80	0.1799
	2005 C class station wagon	1	-0.2400	-21.3%	0.1204	-0.4759	-0.0041	3.98	0.0462
	2003 C class station wagon 4WD	1	-0.3310	-28.2%	0.1068	-0.5404	-0.1216	9.60	0.0019
	2004 C class station wagon 4WD	1	-0.1207	-11.4%	0.1083	-0.3329	0.0915	1.24	0.2650
	2005 C class station wagon 4WD	1	-0.2071	-18.7%	0.1106	-0.4239	0.0096	3.51	0.0611
	2000 CL class 2dr	1	-0.2675	-23.5%	0.1107	-0.4845	-0.0504	5.83	0.0157
	2001 CL class 2dr	1	-0.2191	-19.7%	0.1037	-0.4223	-0.0160	4.47	0.0345
	2002 CL class 2dr	1	-0.2194	-19.7%	0.1019	-0.4192	-0.0196	4.63	0.0314
	2003 CL class 2dr	1	-0.2367	-21.1%	0.1039	-0.4403	-0.0330	5.19	0.0227

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	2004 CL class 2dr	1	-0.2469	-21.9%	0.1070	-0.4566	-0.0372	5.32	0.0210
	2005 CL class 2dr	1	-0.2552	-22.5%	0.1104	-0.4715	-0.0389	5.35	0.0207
	2006 CL class 2dr	1	-0.2752	-24.1%	0.1225	-0.5153	-0.0351	5.05	0.0247
	2007 CL class 2dr	1	-0.0752	-7.2%	0.1149	-0.3003	0.1500	0.43	0.5129
	2008 CL class 2dr	1	0.0551	5.7%	0.1090	-0.1585	0.2687	0.26	0.6134
	2009 CL class 2dr	1	0.1648	17.9%	0.1673	-0.1631	0.4928	0.97	0.3246
	2010 CL class 2dr	1	-0.0482	-4.7%	0.3329	-0.7007	0.6043	0.02	0.8849
	2009 CL class 2dr 4WD	1	0.2946	34.3%	0.1439	0.0127	0.5766	4.19	0.0405
	2010 CL class 2dr 4WD	1	0.0942	9.9%	0.1777	-0.2541	0.4424	0.28	0.5961
	2003 CLK class 2dr	1	-0.0595	-5.8%	0.1005	-0.2564	0.1374	0.35	0.5535
	2004 CLK class 2dr	1	-0.0560	-5.4%	0.1001	-0.2522	0.1403	0.31	0.5760
	2005 CLK class 2dr	1	-0.0221	-2.2%	0.1010	-0.2200	0.1758	0.05	0.8268
	2006 CLK class 2dr	1	-0.0363	-3.6%	0.1013	-0.2350	0.1623	0.13	0.7200
	2007 CLK class 2dr	1	-0.0112	-1.1%	0.1026	-0.2124	0.1899	0.01	0.9129
	2008 CLK class 2dr	1	-0.1314	-12.3%	0.1043	-0.3359	0.0731	1.59	0.2078
	2009 CLK class 2dr	1	-0.0655	-6.3%	0.1092	-0.2795	0.1485	0.36	0.5487
	2004 CLK class convertible	1	-0.2387	-21.2%	0.1011	-0.4369	-0.0406	5.58	0.0182
	2005 CLK class convertible	1	-0.2089	-18.9%	0.1002	-0.4053	-0.0124	4.34	0.0372
	2006 CLK class convertible	1	-0.2577	-22.7%	0.1012	-0.4560	-0.0594	6.49	0.0109
	2007 CLK class convertible	1	-0.2499	-22.1%	0.1021	-0.4499	-0.0498	5.99	0.0144
	2008 CLK class convertible	1	-0.1873	-17.1%	0.1026	-0.3884	0.0139	3.33	0.0680
	2009 CLK class convertible	1	-0.0782	-7.5%	0.1063	-0.2866	0.1303	0.54	0.4623
	2006 CLS class 4dr	1	0.0260	2.6%	0.0999	-0.1698	0.2218	0.07	0.7945
	2007 CLS class 4dr	1	0.0073	0.7%	0.1016	-0.1917	0.2064	0.01	0.9426
	2008 CLS class 4dr	1	-0.0510	-5.0%	0.1033	-0.2535	0.1515	0.24	0.6213
	2009 CLS class 4dr	1	0.0171	1.7%	0.1088	-0.1962	0.2305	0.02	0.8749
	2010 CLS class 4dr	1	0.0175	1.8%	0.1491	-0.2747	0.3096	0.01	0.9068
	2010 E class 2dr	1	-0.0442	-4.3%	0.1067	-0.2532	0.1649	0.17	0.6789
	2000 E class 4dr	1	-0.1959	-17.8%	0.0995	-0.3910	-0.0008	3.87	0.0491
	2001 E class 4dr	1	-0.1199	-11.3%	0.0994	-0.3147	0.0749	1.46	0.2276
	2002 E class 4dr	1	-0.0897	-8.6%	0.0997	-0.2850	0.1057	0.81	0.3682
	2003 E class 4dr	1	-0.1666	-15.3%	0.0993	-0.3612	0.0280	2.81	0.0934
	2004 E class 4dr	1	-0.1646	-15.2%	0.0996	-0.3598	0.0305	2.73	0.0982
	2005 E class 4dr	1	-0.2088	-18.8%	0.0997	-0.4042	-0.0133	4.38	0.0363
	2006 E class 4dr	1	-0.1868	-17.0%	0.0995	-0.3819	0.0083	3.52	0.0606
	2007 E class 4dr	1	-0.0915	-8.7%	0.0997	-0.2870	0.1039	0.84	0.3587
	2008 E class 4dr	1	-0.1292	-12.1%	0.1001	-0.3255	0.0671	1.66	0.1971
	2009 E class 4dr	1	-0.0823	-7.9%	0.1017	-0.2816	0.1170	0.65	0.4184
	2010 E class 4dr	1	-0.0690	-6.7%	0.1026	-0.2700	0.1320	0.45	0.5008
	2000 E class 4dr 4WD	1	-0.1559	-14.4%	0.1009	-0.3536	0.0418	2.39	0.1222
	2001 E class 4dr 4WD	1	-0.1350	-12.6%	0.1006	-0.3321	0.0621	1.80	0.1796
	2002 E class 4dr 4WD	1	-0.0601	-5.8%	0.1006	-0.2572	0.1371	0.36	0.5504
	2004 E class 4dr 4WD	1	-0.1062	-10.1%	0.1007	-0.3035	0.0911	1.11	0.2916
	2005 E class 4dr 4WD	1	-0.1231	-11.6%	0.1006	-0.3203	0.0741	1.50	0.2212

Appendix : Illustrative regression results — collision frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
2006 E class 4dr 4WD	1	-0.1067	-10.1%	0.1001	-0.3028	0.0894	1.14	0.2864
2007 E class 4dr 4WD	1	-0.0688	-6.6%	0.1007	-0.2662	0.1286	0.47	0.4946
2008 E class 4dr 4WD	1	-0.0675	-6.5%	0.1003	-0.2641	0.1292	0.45	0.5012
2009 E class 4dr 4WD	1	0.0163	1.6%	0.1029	-0.1853	0.2179	0.03	0.8741
2010 E class 4dr 4WD	1	-0.0057	-0.6%	0.1028	-0.2073	0.1958	0.00	0.9555
2000 E class station wagon	1	-0.1539	-14.3%	0.1041	-0.3579	0.0502	2.19	0.1393
2001 E class station wagon	1	-0.2003	-18.2%	0.1043	-0.4047	0.0041	3.69	0.0548
2002 E class station wagon	1	-0.0901	-8.6%	0.1061	-0.2981	0.1178	0.72	0.3957
2003 E class station wagon	1	-0.2203	-19.8%	0.1274	-0.4700	0.0294	2.99	0.0837
2004 E class station wagon	1	-0.2036	-18.4%	0.1062	-0.4119	0.0046	3.67	0.0552
2005 E class station wagon	1	-0.2604	-22.9%	0.1293	-0.5138	-0.0070	4.06	0.0440
2006 E class station wagon	1	-0.2526	-22.3%	0.1194	-0.4865	-0.0187	4.48	0.0343
2007 E class station wagon	1	-0.5124	-40.1%	0.3672	-1.2322	0.2073	1.95	0.1629
2008 E class station wagon	1	-2.0276	-86.8%	1.0049	-3.9972	-0.0580	4.07	0.0436
2009 E class station wagon	1	-0.2848	-24.8%	0.7140	-1.6843	1.1147	0.16	0.6900
2000 E class station wagon 4WD	1	-0.1552	-14.4%	0.1041	-0.3593	0.0489	2.22	0.1360
2001 E class station wagon 4WD	1	-0.1550	-14.4%	0.1030	-0.3569	0.0469	2.26	0.1324
2002 E class station wagon 4WD	1	-0.0794	-7.6%	0.1035	-0.2824	0.1235	0.59	0.4429
2003 E class station wagon 4WD	1	-0.1156	-10.9%	0.1150	-0.3409	0.1098	1.01	0.3147
2004 E class station wagon 4WD	1	-0.1355	-12.7%	0.1030	-0.3373	0.0664	1.73	0.1884
2005 E class station wagon 4WD	1	-0.1009	-9.6%	0.1065	-0.3095	0.1077	0.90	0.3432
2006 E class station wagon 4WD	1	-0.0994	-9.5%	0.1093	-0.3135	0.1148	0.83	0.3632
2007 E class station wagon 4WD	1	-0.1806	-16.5%	0.1161	-0.4082	0.0469	2.42	0.1197
2008 E class station wagon 4WD	1	-0.1521	-14.1%	0.1194	-0.3860	0.0818	1.62	0.2026
2009 E class station wagon 4WD	1	-0.1669	-15.4%	0.1397	-0.4408	0.1070	1.43	0.2322
2003 G class 4dr 4WD	1	-0.2011	-18.2%	0.1054	-0.4077	0.0055	3.64	0.0564
2004 G class 4dr 4WD	1	-0.1877	-17.1%	0.1111	-0.4054	0.0300	2.86	0.0910
2005 G class 4dr 4WD	1	-0.1882	-17.2%	0.1105	-0.4048	0.0285	2.90	0.0887
2006 G class 4dr 4WD	1	-0.4460	-36.0%	0.1902	-0.8187	-0.0732	5.50	0.0190
2007 G class 4dr 4WD	1	-0.1291	-12.1%	0.1356	-0.3949	0.1368	0.91	0.3413
2008 G class 4dr 4WD	1	-0.1801	-16.5%	0.1348	-0.4443	0.0842	1.78	0.1817
2009 G class 4dr 4WD	1	-0.0605	-5.9%	0.1659	-0.3856	0.2647	0.13	0.7155
2010 G class 4dr 4WD	1	-0.5050	-39.6%	0.2400	-0.9754	-0.0347	4.43	0.0353
2007 GL class 4dr 4WD	1	-0.1979	-18.0%	0.1002	-0.3943	-0.0016	3.90	0.0482
2008 GL class 4dr 4WD	1	-0.1816	-16.6%	0.1012	-0.3801	0.0168	3.22	0.0728
2009 GL class 4dr 4WD	1	-0.1971	-17.9%	0.1038	-0.4006	0.0064	3.60	0.0577
2010 GL class 4dr 4WD	1	-0.0706	-6.8%	0.1042	-0.2749	0.1336	0.46	0.4981

Appendix : Illustrative regression results — collision frequency								
Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
2010 GLK class 4dr	1	-0.0953	-9.1%	0.1050	-0.3010	0.1105	0.82	0.3641
2010 GLK class 4dr 4WD	1	-0.1101	-10.4%	0.1014	-0.3088	0.0885	1.18	0.2772
2009 M class 4dr	1	-0.2298	-20.5%	0.1224	-0.4696	0.0100	3.53	0.0604
2010 M class 4dr	1	-0.2483	-22.0%	0.1112	-0.4663	-0.0303	4.99	0.0256
2002 M class 4dr 4WD	1	-0.1033	-9.8%	0.0994	-0.2980	0.0915	1.08	0.2988
2003 M class 4dr 4WD	1	-0.0779	-7.5%	0.0994	-0.2728	0.1170	0.61	0.4335
2004 M class 4dr 4WD	1	-0.1090	-10.3%	0.0998	-0.3046	0.0867	1.19	0.2751
2005 M class 4dr 4WD	1	-0.1195	-11.3%	0.0998	-0.3151	0.0762	1.43	0.2313
2006 M class 4dr 4WD	1	-0.2421	-21.5%	0.0995	-0.4372	-0.0470	5.92	0.0150
2007 M class 4dr 4WD	1	-0.3078	-26.5%	0.1002	-0.5043	-0.1113	9.43	0.0021
2008 M class 4dr 4WD	1	-0.2805	-24.5%	0.1007	-0.4780	-0.0831	7.76	0.0053
2009 M class 4dr 4WD	1	-0.2240	-20.1%	0.1017	-0.4232	-0.0247	4.85	0.0276
2010 M class 4dr 4WD	1	-0.2168	-19.5%	0.1037	-0.4200	-0.0135	4.37	0.0366
2010 M class hybrid 4dr 4WD	1	-0.0471	-4.6%	0.1698	-0.3798	0.2857	0.08	0.7816
2004 Maybach 57 4dr	1	-0.7385	-52.2%	0.2357	-1.2004	-0.2765	9.82	0.0017
2005 Maybach 57 4dr	1	-0.2121	-19.1%	0.2625	-0.7266	0.3025	0.65	0.4193
2006 Maybach 57 4dr	1	-0.3006	-26.0%	0.5862	-1.4495	0.8483	0.26	0.6081
2007 Maybach 57 4dr	1	-0.6473	-47.7%	0.5102	-1.6472	0.3526	1.61	0.2045
2008 Maybach 57 4dr	1	-0.2328	-20.8%	0.4586	-1.1315	0.6660	0.26	0.6117
2009 Maybach 57 4dr	1	-6.4240	-99.8%	16.1945	-38.1646	25.3166	0.16	0.6916
2010 Maybach 57 4dr	1	-5.6552	-99.7%	60.9864	-125.1860	113.8760	0.01	0.9261
2004 Maybach 62 4dr	1	-0.2180	-19.6%	0.3911	-0.9846	0.5485	0.31	0.5772
2005 Maybach 62 4dr	1	-0.1585	-14.7%	0.3911	-0.9250	0.6080	0.16	0.6853
2006 Maybach 62 4dr	1	0.4152	51.5%	0.5862	-0.7338	1.5642	0.50	0.4788
2007 Maybach 62 4dr	1	-0.5281	-41.0%	1.0051	-2.4981	1.4419	0.28	0.5993
2008 Maybach 62 4dr	1	-1.2628	-71.7%	1.0051	-3.2329	0.7072	1.58	0.2090
2009 Maybach 62 4dr	1	0.9019	146.4%	0.5862	-0.2470	2.0508	2.37	0.1239
2010 Maybach 62 4dr	1	-6.8639	-99.9%	172.6545	-345.2610	331.5328	0.00	0.9683
2008 R class 4dr	1	-0.0535	-5.2%	0.1106	-0.2703	0.1633	0.23	0.6287
2006 R class 4dr 4WD	1	0.0830	8.7%	0.0999	-0.1129	0.2788	0.69	0.4062
2007 R class 4dr 4WD	1	0.0888	9.3%	0.1007	-0.1086	0.2862	0.78	0.3780
2008 R class 4dr 4WD	1	0.0962	10.1%	0.1023	-0.1043	0.2967	0.88	0.3471
2009 R class 4dr 4WD	1	0.0295	3.0%	0.1112	-0.1884	0.2474	0.07	0.7906
2010 R class 4dr 4WD	1	0.1927	21.3%	0.1245	-0.0514	0.4367	2.39	0.1218
2010 S class hybrid 4dr	1	0.3038	35.5%	0.1441	0.0213	0.5863	4.44	0.0350
2000 S class 4dr	1	-0.1939	-17.6%	0.0995	-0.3890	0.0011	3.80	0.0513
2001 S class 4dr	1	-0.1358	-12.7%	0.0995	-0.3308	0.0592	1.86	0.1724
2002 S class 4dr	1	-0.0868	-8.3%	0.0995	-0.2819	0.1082	0.76	0.3829
2003 S class 4dr	1	-0.1558	-14.4%	0.1000	-0.3518	0.0403	2.42	0.1194
2004 S class 4dr	1	-0.2177	-19.6%	0.1007	-0.4150	-0.0203	4.67	0.0306
2005 S class 4dr	1	-0.1189	-11.2%	0.1016	-0.3181	0.0802	1.37	0.2419
2006 S class 4dr	1	-0.1769	-16.2%	0.1010	-0.3748	0.0209	3.07	0.0797
2007 S class 4dr	1	-0.0750	-7.2%	0.1003	-0.2715	0.1216	0.56	0.4546
2008 S class 4dr	1	-0.0279	-2.8%	0.1025	-0.2287	0.1729	0.07	0.7853
2009 S class 4dr	1	-0.0184	-1.8%	0.1099	-0.2338	0.1969	0.03	0.8667
2010 S class 4dr	1	-0.0029	-0.3%	0.1184	-0.2349	0.2291	0.00	0.9805

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	2003 S class 4dr 4WD	1	-0.1215	-11.4%	0.1014	-0.3202	0.0773	1.43	0.2311
	2004 S class 4dr 4WD	1	-0.1100	-10.4%	0.1019	-0.3098	0.0898	1.16	0.2805
	2005 S class 4dr 4WD	1	-0.0855	-8.2%	0.1031	-0.2877	0.1167	0.69	0.4072
	2006 S class 4dr 4WD	1	-0.1222	-11.5%	0.1035	-0.3251	0.0807	1.39	0.2377
	2007 S class 4dr 4WD	1	-0.0185	-1.8%	0.1026	-0.2196	0.1825	0.03	0.8565
	2008 S class 4dr 4WD	1	-0.0190	-1.9%	0.1031	-0.2210	0.1831	0.03	0.8539
	2009 S class 4dr 4WD	1	-0.0966	-9.2%	0.1102	-0.3125	0.1193	0.77	0.3804
	2010 S class 4dr 4WD	1	0.0138	1.4%	0.1190	-0.2195	0.2471	0.01	0.9077
	2003 SL class convertible	1	-0.4320	-35.1%	0.1001	-0.6282	-0.2359	18.64	<0.0001
	2004 SL class convertible	1	-0.4588	-36.8%	0.1010	-0.6567	-0.2608	20.63	<0.0001
	2005 SL class convertible	1	-0.4052	-33.3%	0.1011	-0.6035	-0.2070	16.06	<0.0001
	2006 SL class convertible	1	-0.4096	-33.6%	0.1033	-0.6121	-0.2072	15.73	<0.0001
	2007 SL class convertible	1	-0.4114	-33.7%	0.1030	-0.6133	-0.2095	15.95	<0.0001
	2008 SL class convertible	1	-0.3728	-31.1%	0.1100	-0.5884	-0.1573	11.49	0.0007
	2009 SL class convertible	1	-0.2895	-25.1%	0.1069	-0.4991	-0.0800	7.33	0.0068
	2005 SLK class convertible	1	-0.1992	-18.1%	0.1007	-0.3966	-0.0019	3.91	0.0479
	2006 SLK class convertible	1	-0.1994	-18.1%	0.1005	-0.3963	-0.0025	3.94	0.0472
	2007 SLK class convertible	1	-0.3028	-26.1%	0.1025	-0.5036	-0.1019	8.73	0.0031
	2008 SLK class convertible	1	-0.1735	-15.9%	0.1056	-0.3805	0.0334	2.70	0.1003
	2009 SLK class convertible	1	-0.1441	-13.4%	0.1082	-0.3562	0.0681	1.77	0.1832
	2010 SLK class convertible	0	0	0	0	0	0		
Rated driver age group	14-20	1	0.2769	31.9%	0.0122	0.2530	0.3008	514.69	<0.0001
	21-24	1	0.3350	39.8%	0.0098	0.3158	0.3543	1165.57	<0.0001
	25-39	1	0.1724	18.8%	0.0037	0.1652	0.1796	2195.02	<0.0001
	65+	1	0.0279	2.8%	0.0044	0.0194	0.0365	41.01	<0.0001
	Unknown	1	0.0479	4.9%	0.0060	0.0362	0.0597	63.77	<0.0001
	40-64	0	0	0	0	0	0		
Rated driver gender	Male	1	-0.0074	-0.7%	0.0035	-0.0143	-0.0005	4.41	0.0358
	Unknown	1	-0.2950	-25.5%	0.0064	-0.3074	-0.2825	2148.50	<0.0001
	Female	0	0	0	0	0	0		
Rated driver marital status	Single	1	0.2016	22.3%	0.0039	0.1939	0.2093	2633.09	<0.0001
	Unknown	1	0.3188	37.5%	0.0063	0.3064	0.3313	2527.50	<0.0001
	Married	0	0	0	0	0	0		
Risk	Nonstandard	1	0.2708	31.1%	0.0043	0.2623	0.2793	3885.77	<0.0001
	Standard	0	0	0	0	0	0		
State	Alabama	1	-0.1443	-13.4%	0.0401	-0.2230	-0.0657	12.95	0.0003
	Arizona	1	-0.1961	-17.8%	0.0390	-0.2726	-0.1197	25.31	<0.0001
	Arkansas	1	-0.1000	-9.5%	0.0465	-0.1911	-0.0090	4.64	0.0313
	California	1	-0.0091	-0.9%	0.0375	-0.0826	0.0644	0.06	0.8075
	Colorado	1	-0.1116	-10.6%	0.0398	-0.1896	-0.0336	7.86	0.0051

Appendix : Illustrative regression results — collision frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
					Appendix : Illustrative regression results — collision frequency			
Connecticut	1	-0.1679	-15.5%	0.0390	-0.2443	-0.0916	18.59	<0.0001
Delaware	1	-0.1435	-13.4%	0.0442	-0.2302	-0.0569	10.55	0.0012
District of Columbia	1	0.2158	24.1%	0.0412	0.1350	0.2965	27.41	<0.0001
Florida	1	-0.2475	-21.9%	0.0376	-0.3212	-0.1738	43.31	<0.0001
Georgia	1	-0.2408	-21.4%	0.0382	-0.3157	-0.1658	39.65	<0.0001
Hawaii	1	-0.1010	-9.6%	0.0421	-0.1834	-0.0185	5.76	0.0164
Idaho	1	-0.4664	-37.3%	0.0605	-0.5849	-0.3479	59.53	<0.0001
Illinois	1	-0.0718	-6.9%	0.0379	-0.1462	0.0025	3.59	0.0582
Indiana	1	-0.1829	-16.7%	0.0417	-0.2647	-0.1012	19.24	<0.0001
Iowa	1	-0.2438	-21.6%	0.0547	-0.3510	-0.1366	19.86	<0.0001
Kansas	1	-0.2702	-23.7%	0.0452	-0.3589	-0.1815	35.67	<0.0001
Kentucky	1	-0.3680	-30.8%	0.0432	-0.4527	-0.2832	72.43	<0.0001
Louisiana	1	0.0233	2.4%	0.0395	-0.0541	0.1006	0.35	0.5557
Maine	1	-0.1720	-15.8%	0.0592	-0.2881	-0.0559	8.44	0.0037
Maryland	1	-0.0722	-7.0%	0.0380	-0.1466	0.0023	3.61	0.0575
Massachusetts	1	0.0861	9.0%	0.0387	0.0103	0.1619	4.96	0.0259
Michigan	1	0.2983	34.8%	0.0391	0.2216	0.3750	58.12	<0.0001
Minnesota	1	-0.2108	-19.0%	0.0415	-0.2921	-0.1295	25.82	<0.0001
Mississippi	1	-0.1123	-10.6%	0.0434	-0.1973	-0.0272	6.69	0.0097
Missouri	1	-0.2387	-21.2%	0.0409	-0.3189	-0.1585	34.02	<0.0001
Montana	1	-0.2846	-24.8%	0.0838	-0.4489	-0.1203	11.53	0.0007
Nebraska	1	-0.3207	-27.4%	0.0563	-0.4310	-0.2104	32.47	<0.0001
Nevada	1	-0.0199	-2.0%	0.0396	-0.0974	0.0576	0.25	0.6151
New Hampshire	1	0.0353	3.6%	0.0452	-0.0533	0.1238	0.61	0.4350
New Jersey	1	-0.2126	-19.2%	0.0379	-0.2870	-0.1382	31.40	<0.0001
New Mexico	1	-0.2045	-18.5%	0.0500	-0.3025	-0.1066	16.75	<0.0001
New York	1	-0.0342	-3.4%	0.0376	-0.1079	0.0396	0.83	0.3635
North Carolina	1	-0.4755	-37.8%	0.0390	-0.5518	-0.3991	148.91	<0.0001
North Dakota	1	-0.0444	-4.3%	0.1073	-0.2547	0.1659	0.17	0.6790
Ohio	1	-0.2985	-25.8%	0.0394	-0.3756	-0.2213	57.49	<0.0001
Oklahoma	1	-0.2840	-24.7%	0.0426	-0.3676	-0.2005	44.36	<0.0001
Oregon	1	-0.2471	-21.9%	0.0411	-0.3276	-0.1665	36.12	<0.0001
Pennsylvania	1	-0.0377	-3.7%	0.0380	-0.1122	0.0368	0.98	0.3211
Rhode Island	1	0.0035	0.4%	0.0443	-0.0833	0.0902	0.01	0.9378
South Carolina	1	-0.3387	-28.7%	0.0402	-0.4176	-0.2598	70.82	<0.0001
South Dakota	1	-0.3615	-30.3%	0.0876	-0.5332	-0.1897	17.01	<0.0001
Tennessee	1	-0.2957	-25.6%	0.0399	-0.3739	-0.2176	54.97	<0.0001
Texas	1	-0.2105	-19.0%	0.0378	-0.2845	-0.1366	31.10	<0.0001
Utah	1	-0.3018	-26.1%	0.0462	-0.3924	-0.2112	42.64	<0.0001
Vermont	1	-0.0823	-7.9%	0.0698	-0.2192	0.0545	1.39	0.2384
Virginia	1	-0.1375	-12.8%	0.0380	-0.2121	-0.0630	13.07	0.0003
Washington	1	-0.1986	-18.0%	0.0390	-0.2751	-0.1221	25.88	<0.0001
West Virginia	1	-0.3357	-28.5%	0.0500	-0.4337	-0.2377	45.09	<0.0001
Wisconsin	1	-0.1763	-16.2%	0.0433	-0.2613	-0.0914	16.57	<0.0001
Wyoming	1	-0.1304	-12.2%	0.0991	-0.3246	0.0637	1.73	0.1879
Alaska	0	0	0	0	0	0		

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Deductible range	0-250	1	0.4434	55.8%	0.0047	0.4343	0.4526	9024.26	<0.0001
	1001+	1	-0.3756	-31.3%	0.0184	-0.4117	-0.3394	414.63	<0.0001
	251-500	1	0.2793	32.2%	0.0039	0.2717	0.2869	5208.15	<0.0001
	501-1000	0	0	0	0	0	0		
Registered vehicle density	0-99	1	-0.2190	-19.7%	0.0061	-0.2309	-0.2071	1300.26	<0.0001
	100-499	1	-0.1569	-14.5%	0.0036	-0.1640	-0.1498	1858.26	<0.0001
	500+	0	0	0	0	0	0		
Distronic		1	-0.0311	-3.1%	0.0161	-0.0626	0.0005	3.73	0.0535
Distronic Plus		1	-0.0732	-7.1%	0.0324	-0.1366	-0.0097	5.11	0.0238
Parktronic		1	0.0075	0.8%	0.0063	-0.0048	0.0198	1.43	0.2310
Parking Guidance		1	0.0613	6.3%	0.0407	-0.0185	0.1412	2.27	0.1321
Backup camera		1	0.0046	0.5%	0.0121	-0.0192	0.0284	0.14	0.7068
Active Curve Illumination		1	-0.0085	-0.8%	0.0098	-0.0277	0.0107	0.76	0.3843
Adaptive High Beam Assist		1	-0.0070	-0.7%	0.0347	-0.0749	0.0610	0.04	0.8404
Blind Spot Assist		1	-0.0015	-0.1%	0.0667	-0.1321	0.1292	0.00	0.9826
Lane Keeping Assist		1	0.0549	5.6%	0.0736	-0.0893	0.1991	0.56	0.4554
Night View Assist/ Plus		1	-0.0423	-4.1%	0.0212	-0.0840	-0.0007	3.97	0.0463
Active Cornering Lights		1	-0.0276	-2.7%	0.0094	-0.0461	-0.0091	8.52	0.0035
High Intensity Discharge Headlights		1	0.0079	0.8%	0.0058	-0.0035	0.0192	1.85	0.1735

Appendix : Illustrative regression results — collision frequency