HIGHWAY LOSS DATA INSTITUTE

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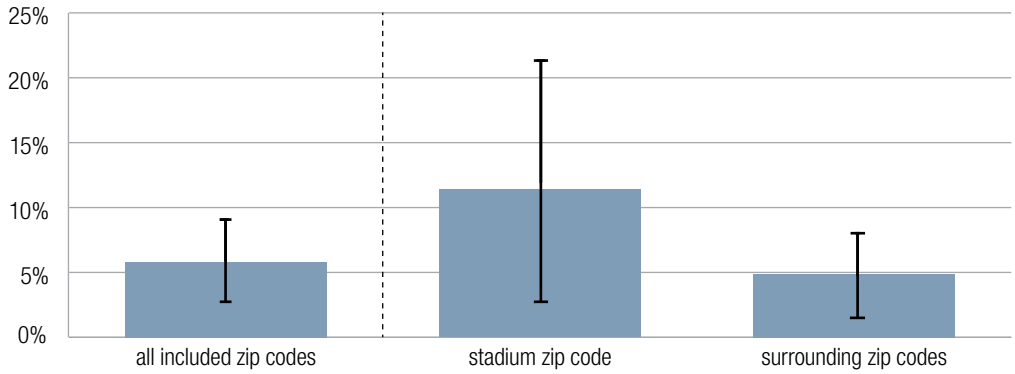
Collision claim frequencies and NFL games

Most HLDI studies use insurance data to evaluate highway safety outcomes. Occasionally, HLDI studies quantify the insurance costs associated with major weather events such as Hurricane Katrina, Super Storm Sandy, or the hail storms of 2011. Studies of the cost of weather events serve as public information but also are a quality control tool. The geographic reach of the events is known and, consequently, analysts can examine the reported loss experience, relative to what is known about the events, to make certain there are no gaps in the HLDI data feed. Major sporting events such as National Football League (NFL) games represent significant changes to local traffic patterns. Of the 31 NFL stadiums, 15 can accommodate more than 70,000 spectators. Additionally, on game days thousands of people are employed at those stadiums. The purpose of this study was to evaluate the relationship between NFL games and collision claims in the zip codes where stadiums are located and the zip codes that surround them. The study found that collision claim frequencies in and around the stadium zip codes increased on game days (5.8 percent). Collision claims frequencies were even higher if the home team lost.

Estimated change in collision claim frequencies of NFL game by stadium proximity



Introduction

Major sporting events such as National Football League (NFL) games represent significant changes to local traffic patterns. Of the 31 NFL stadiums, 15 can accommodate more than 70,000 spectators. Even the smallest NFL stadiums can accomodate 50,000 spectators. Additionally, on game days thousands of people are employed at those stadiums. The purpose of this study was to evaluate the relationship between NFL games and collision claims in the zip codes where stadiums are located and the zip codes that surround them.

Methods

Insurance data

Automobile insurance covers damage 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 collision coverage. 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. Data are supplied to HLDI by its member companies.

NFL data

A total of 995 NFL games were played during the 2011, 2012, and 2013 seasons. The seven games played outside the United States were excluded from the analysis, yielding a total of 988 games. The games were played on 206 different dates. The total number of participating teams equaled 32. Of these, two shared the same stadium. For each game, information on the day of the week and whether the home team won or lost was recorded.

The zip code for each of the 31 stadiums was identified as well as the surrounding zip codes. Surrounding zip codes consisted of bordering areas with significant residential land mass. The total number of surrounding zip codes equaled 180, bringing the total number of zip codes in this analysis to 211.

Analysis method

Collision claim and exposure data were obtained for the 206 game dates and 211 zip codes for a total of 43,466 zip code and date combinations. That is, loss data in all zip codes where a game was played were compard to other zip codes in the analysis on that same date. This design allowed the analysis to separate the effect of the game while controlling for zip code and date-related information. Claim and exposure data were stratified by calendar year, vehicle model year, driver age group, gender, marital status, risk, state, deductible, and density. Results were based on 595,342 insured vehicle years and 42,797 claims for 2003-15 model year vehicles during the 2011-13 NFL seasons.

Of the 988 games, 685 (69.3 percent) were played on Sundays. No games were played on Tuesday, and only four games (0.4 percent) were played on Wednesday. The remaining 4 days of the week shared the remaining 299 games. Day of the week is a very important variable, not only because the games were not evenly distributed across the days of the week, but also because prior HLDI studies have shown that claim frequency varies by day of the week and, in particular, that weekdays differ from the weekend (HLDI, 2009, 2013). Therefore, in order to assess the effect of the game, frequencies were examined separately for each day of the week.

Regression analysis was used to quantify the effect of an NFL game on collision claim frequency while controlling for various covariates. Claim frequency was modeled using a Poisson distribution and used a logarithmic link function. The independent variables in this analysis included venue, calendar year, model year, rated driver age group (youthful, prime, senior), rated driver gender, marital status, risk, deductible range, vehicle density (number of registered vehicles per square mile), venue proximity, day of the week, and game day.

Game day was a key variable in the regression analysis; it equaled "1" if there was a game on a given day in that or a nearby zip code and "0" otherwise. The corresponding effect in the model output indicates the percentage change in collision claim frequency associated with a game.

A second model was run to assess the separate effects of the game for zip codes where stadiums are located versus zip codes that surround the zip codes where stadiums are located. The model term for the zip codes was named proximity, and it had two possible values: zip codes with a stadium and zip codes that surround stadiums. The interaction of proximity and game day was added as an independent variable. In this model, the main effect for "game day" represents the change in collision claim frequency associated with game days for indirect proximity of the stadium (surrounding zip codes), while the interaction will be an additive effect, i.e., summation of "game day" effect and interaction effect will estimate the effect of game day for the direct proximity (stadium zip).

To alternatively assess and confirm the effect variability with proximity, two more simple models with no interaction were conducted, restricting the data to direct proximity for the first model and indirect proximity for the second model.

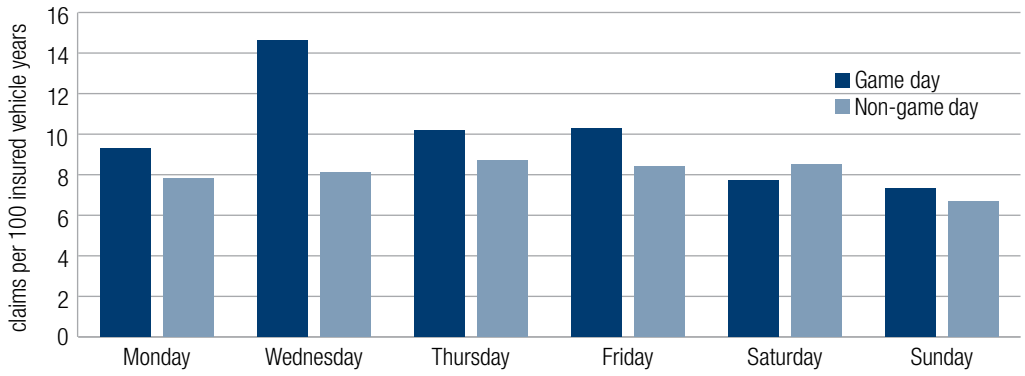
Additional analysis was conducted to differentiate the effect of game day, based on game outcome. For that purpose, a new variable called gameday2 was introduced based on three possible outcomes (home team win, home team not winning, no game). This variable was included in the model instead of the game day variable. Two models with gameday2 were run, restricting the data first to zip codes in direct proximity of the venue and then in indirect proximity of the venue.

The equations obtained in the regressions were used to estimate the number of additional claims that occurred due to games. This number was first obtained for the data as a whole, then stratified by stadium proximity, and finally by venue.

Results

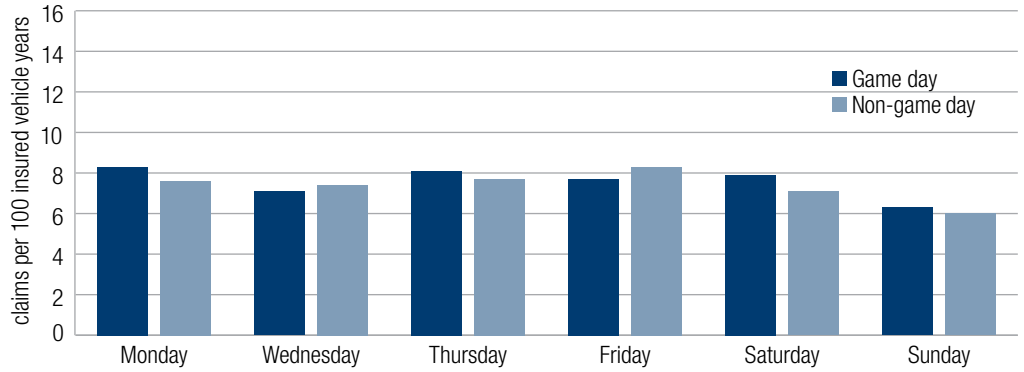
Acutal collision claim frequencies by day of the week are presented in Figures 1-2. With the exception of Saturday, collision claim frequencies for the stadium zip code were higher on game days than on days with no games (Figure 1). The claim frequency increases on game days ranged from 8.2 percent on Sunday to 79.7 percent on Wednesday (however, Wednesday had very limited exposure).

Figure 1: Actual collision claim frequency for stadium zip code, by day of the week



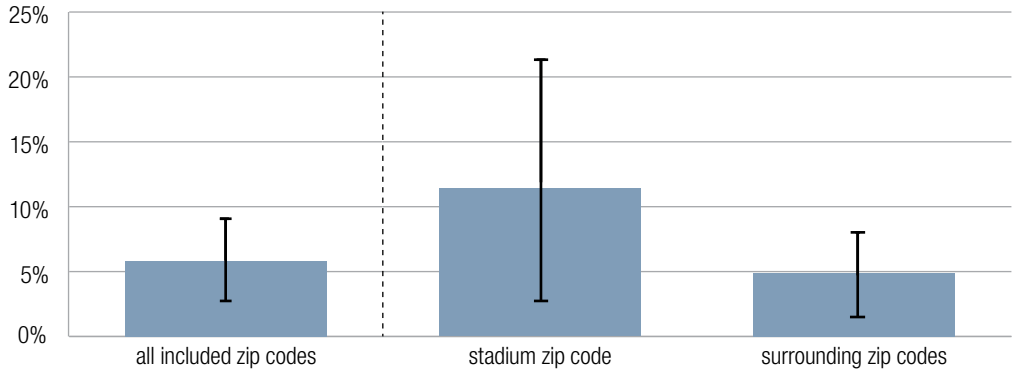
With the exception of Wednesday (limited exposure day) and Friday, actual collision claim frequencies for the zip codes surrounding the stadium were higher on game days than on non-game days (Figure 2). The claim frequency increases on game days were smaller than those seen in Figure 1 and ranged from 5.5 percent on Sunday to 11 percent on Saturday.

Figure 2: Actual collision claim frequency for surrounding zip codes, by day of the week



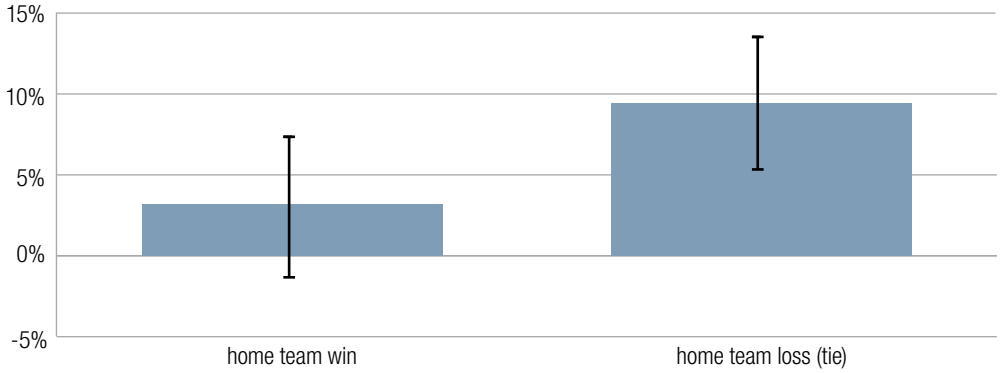
Collision claim frequencies increased significantly in the immediate area of an NFL game. A 5.8 percent increase in collision claims was seen for the stadium and surrounding zip codes combined. The effect was even larger when only the direct stadium zip code was examined (11.4 percent). An alternative analysis based on two different models yielded similar results.

Figure 3: Estimated change in collision claim frequencies of NFL game by stadium proximity



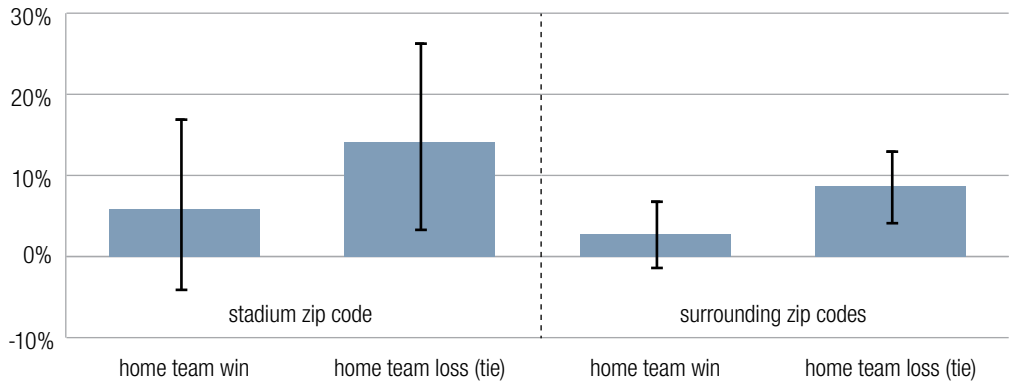
When stratified according to the game results, games with a home team win were associated with a 3.2 percent increase in collision claim frequency (Figure 4). When the home team lost or tied (only one tie game), collision claim frequency increased 9.4 percent.

Figure 4: Estimated change in collision claim frequencies by game outcome



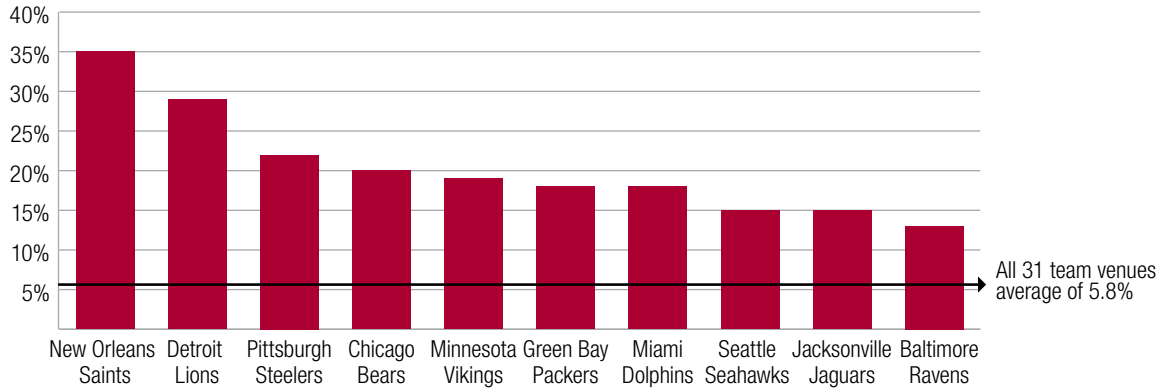
A home team loss or tie led to larger increases in collision claim frequency than if the team won. These increases in frequency were higher for zip codes in closer proximity to the stadium (Figure 5). Only the increases for a loss or tie were significant.

Figure 5: Estimated change in collision claim frequencies by game outcome and proximity



The equations obtained in the regressions were used to estimate the number of additional claims that occurred due to games. This number was first obtained for the data as a whole, then stratified by stadium proximity, and finally by venue. Results were stratified by venue and the percentage increases were compared. For 17 of the 31 venues, the estimated percentage was higher than the 5.8 percent average. The top 10 game day venues are shown in **Figure 6**. The effect was highest for the New Orleans Saints stadium (35.3 percent) followed by the Detroit Lions (28.5 percent), Pittsburgh Steelers (22 percent), and Chicago Bears (19.6 percent). It should be noted that due to limited data for individual stadiums, these numbers are subject to chance variation and should be treated with caution.

Figure 6: Ten game day venues with largest estimated effects



Results of the simple (no interaction) regression model are presented in the **Appendix**. All variables were statistically significant. The estimates for regular covariates are generally in line with the prior HLDI findings. Higher claim frequency was associated with earlier calendar years, earlier model years, higher density, lower deductible, younger driver age, known driver gender, driver singlehood, and non-standard risk. Among the venues, the frequencies were highest at the zip codes in proximity of the San Francisco 49ers, Philadelphia Eagles, and New Orleans Saints stadiums. Note that this effect is irrespective of the games and only reflects geographical and other area-specific differences.

Discussion

The purpose of this study was to evaluate the relationship between NFL games and collision claims in the zip codes where stadiums are located and the zip codes that surround them. These results provide an interesting look at large crowd events and found that collision claim frequencies in and around the stadium zip codes increased significantly on game days. Collision claim frequencies were even higher if the home team lost. A major sporting event such as an NFL game draws additional drivers to a given area, and motorists should exercise caution when traveling through areas during a major sporting event.

A limitation of the HLDI database is that the location of the crashes that cause claims is not known. The HLDI database contains the zip code of the "garaging location." The garaging location typically indicates the primary residence of the insurance customer. This analysis was based on the garaging location. Consequently, the results indicate the impact of NFL games on vehicles garaged in zip codes that include stadiums or in the zip codes surrounding them. Crashes that occurred in and around stadiums on game days that involved vehicle garaged in other zip codes could not be included in this analysis.

References

Highway Loss Data Institute. 2013. Seasonal variation in driver deaths and collision claims for motorcycles and automobiles – an update. Loss bulletin Vol. 30, No. 23. Arlington, VA.

Highway Loss Data Institute. 2009. Seasonal Variation in Crash Deaths and Collision Claims for Motorcycles and Automobiles. Loss bulletin Vol. 26, No. 6. Arlington, VA.

Appendix: Regression results

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Intercept		1	-12.2335		0.1308	-12.4898	-11.9772	8753.92	<0.0001
Calendar year	2011	1	0.0701	7.3%	0.0335	0.0045	0.1357	4.38	0.0363
	2012	1	0.0024	0.2%	0.0329	-0.0622	0.0669	0.01	0.9425
	2013	1	0.0532	5.5%	0.0326	-0.0107	0.1171	2.66	0.1026
	2014	0	0	0	0	0	0		
Model year	2003	1	-0.2806	-24.5%	0.0759	-0.4294	-0.1317	13.65	0.0002
	2004	1	-0.2379	-21.2%	0.0721	-0.3793	-0.0965	10.87	0.0010
	2005	1	-0.1671	-15.4%	0.0706	-0.3055	-0.0287	5.60	0.0179
	2006	1	-0.1153	-10.9%	0.0704	-0.2532	0.0227	2.68	0.1014
	2007	1	-0.0460	-4.5%	0.0702	-0.1836	0.0917	0.43	0.5127
	2008	1	-0.0469	-4.6%	0.0703	-0.1847	0.0910	0.44	0.5052
	2009	1	-0.0161	-1.6%	0.0708	-0.1549	0.1228	0.05	0.8203
	2010	1	0.0176	1.8%	0.0705	-0.1207	0.1558	0.06	0.8033
	2011	1	0.0451	4.6%	0.0705	-0.0931	0.1834	0.41	0.5224
	2012	1	0.0699	7.2%	0.0708	-0.0688	0.2086	0.98	0.3230
	2013	1	0.1017	10.7%	0.0721	-0.0396	0.2430	1.99	0.1585
	2015	1	-1.3414	-73.9%	20.3343	-41.1960	38.5131	0.00	0.9474
	2014	0	0	0	0	0	0		
Rated driver age group	<25	1	0.3183	37.5%	0.0202	0.2787	0.3579	248.60	<0.0001
	25-64	1	0.0364	3.7%	0.0156	0.0057	0.0670	5.41	0.0200
	65+	0	0	0	0	0	0		
Rated driver gender	Female	1	0.3607	43.4%	0.0273	0.3072	0.4142	174.44	<0.0001
	Male	1	0.3134	36.8%	0.0276	0.2592	0.3675	128.71	<0.0001
	Unknown	0	0	0	0	0	0		
Rated driver marital status	Married	1	-0.2879	-25.0%	0.0275	-0.3417	-0.2341	110.00	<0.0001
	Single	1	-0.0658	-6.4%	0.0273	-0.1192	-0.0124	5.82	0.0158
	Unknown	0	0	0	0	0	0		
Risk	Nonstandard	1	0.1437	15.5%	0.0138	0.1166	0.1708	108.34	<0.0001
	Standard	0	0	0	0	0	0		
Team/venue	Arizona Cardinals	1	-0.2359	-21.0%	0.0839	-0.4004	-0.0713	7.90	0.0050
	Atlanta Falcons	1	-0.1649	-15.2%	0.0337	-0.2310	-0.0988	23.92	<0.0001
	Baltimore Ravens	1	-0.1195	-11.3%	0.0260	-0.1704	-0.0686	21.15	<0.0001
	Buffalo Bills	1	-0.6936	-50.0%	0.0293	-0.7511	-0.6361	558.63	<0.0001
	Carolina Panthers	1	-0.3932	-32.5%	0.0371	-0.4659	-0.3206	112.46	<0.0001
	Chicago Bears	1	-0.0346	-3.4%	0.0363	-0.1058	0.0366	0.91	0.3407
	Cincinnati Bengals	1	-0.2475	-21.9%	0.0388	-0.3235	-0.1715	40.74	<0.0001
	Cleveland Browns	1	-0.2508	-22.2%	0.0622	-0.3728	-0.1288	16.23	<0.0001
	Dallas Cowboys	1	-0.3091	-26.6%	0.0299	-0.3677	-0.2505	106.89	<0.0001
	Denver Broncos	1	-0.1892	-17.2%	0.0291	-0.2463	-0.1321	42.16	<0.0001
	Detroit Lions	1	-0.0850	-8.1%	0.0855	-0.2526	0.0826	0.99	0.3202
	Giants / Jets	1	-0.1982	-18.0%	0.0365	-0.2697	-0.1268	29.57	<0.0001
	Green Bay Packers	1	-0.4924	-38.9%	0.0838	-0.6566	-0.3283	34.56	<0.0001
	Houston Texans	1	-0.2616	-23.0%	0.0348	-0.3297	-0.1935	56.67	<0.0001

Appendix: Regression results

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	Indianapolis Colts	1	-0.3379	-28.7%	0.0342	-0.4048	-0.2709	97.83	<0.0001
	Jacksonville Jaguars	1	-0.3653	-30.6%	0.0396	-0.4429	-0.2878	85.25	<0.0001
	Kansas City Chiefs	1	-0.4228	-34.5%	0.0452	-0.5114	-0.3342	87.52	<0.0001
	Miami Dolphins	1	-0.3088	-26.6%	0.0294	-0.3663	-0.2512	110.54	<0.0001
	Minnesota Vikings	1	-0.0776	-7.5%	0.0622	-0.1995	0.0443	1.56	0.2122
	New England Patriots	1	-0.7241	-51.5%	0.0348	-0.7923	-0.6560	434.14	<0.0001
	New Orleans Saints	1	0.1326	14.2%	0.0450	0.0443	0.2208	8.67	0.0032
	Oakland Raiders	1	0.0840	8.8%	0.0279	0.0293	0.1387	9.06	0.0026
	Philadelphia Eagles	1	0.1731	18.9%	0.0289	0.1166	0.2297	35.97	<0.0001
	Pittsburgh Steelers	1	-0.1100	-10.4%	0.0300	-0.1688	-0.0513	13.47	0.0002
	San Diego Chargers	1	-0.2089	-18.9%	0.0260	-0.2599	-0.1579	64.44	<0.0001
	San Francisco 49ers	1	0.2864	33.2%	0.0299	0.2278	0.3449	91.86	<0.0001
	Seattle Seahawks	1	-0.1878	-17.1%	0.0386	-0.2635	-0.1120	23.60	<0.0001
	St. Louis Rams	1	-0.1128	-10.7%	0.0918	-0.2927	0.0671	1.51	0.2190
	Tampa Bay Buccaneers	1	-0.4407	-35.6%	0.0334	-0.5061	-0.3753	174.28	<0.0001
	Tennessee Titans	1	-0.2385	-21.2%	0.0440	-0.3247	-0.1524	29.44	<0.0001
	Washington Redskins	0	0	0	0	0	0		
Deductible range	0	1	0.4660	59.4%	0.2050	0.0641	0.8679	5.16	0.0231
	1-50	1	1.5082	351.9%	0.1167	1.2794	1.7370	166.94	<0.0001
	51-100	1	0.8212	127.3%	0.0945	0.6361	1.0064	75.59	<0.0001
	101-200	1	0.8622	136.8%	0.0972	0.6717	1.0528	78.64	<0.0001
	201-250	1	0.9384	155.6%	0.0924	0.7574	1.1195	103.19	<0.0001
	251-500	1	0.6908	99.5%	0.0916	0.5114	0.8702	56.94	<0.0001
	501-1,000	1	0.3640	43.9%	0.0925	0.1827	0.5452	15.48	<0.0001
	1,001+	0	0	0	0	0	0		
Registered vehicle density	100-499	1	-0.1364	-12.8%	0.0771	-0.2876	0.0147	3.13	0.0769
	500+	0	0	0	0	0	0		
Proximity	stadium zip code	1	0.0721	7.5%	0.0148	0.0431	0.1011	23.77	<0.0001
	surrounding zip codes	0	0	0	0	0	0		
Game day	No game	1	-0.0560	-5.4%	0.0144	-0.0841	-0.0278	15.16	<0.0001
	Game	0	0	0	0	0	0		
Day of the week	Friday	1	0.0756	7.9%	0.0532	-0.0287	0.1798	2.02	0.1554
	Monday	1	-0.0157	-1.6%	0.0499	-0.1135	0.0821	0.10	0.7531
	Saturday	1	-0.0364	-3.6%	0.0517	-0.1378	0.0650	0.49	0.4821
	Sunday	1	-0.2352	-21.0%	0.0499	-0.3329	-0.1374	22.22	<0.0001
	Thursday	1	0.0121	1.2%	0.0499	-0.0857	0.1099	0.06	0.8080
	Wednesday	0	0	0	0	0	0		

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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.