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WHAT YOU ARE MISSING

Vehicle History in Auto Insurance Rating and Underwriting

Don Hendriks, ACAS, ASA, MAAA
Actuary and Data Scientist

June 29, 2018

Antitrust Notice

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The power of segmentation

- Insurers discriminate between risks to determine the costs associated with providing insurance coverage.

The collage illustrates risk segmentation through various factors: vehicle type (SUV, sports car, pickup truck), driver demographics (age, gender), and property type (townhouse, suburban house, rural house). The CARFAX report shows credit scores of 738, 762, and 733, which are used by insurers to determine risk levels and associated costs.

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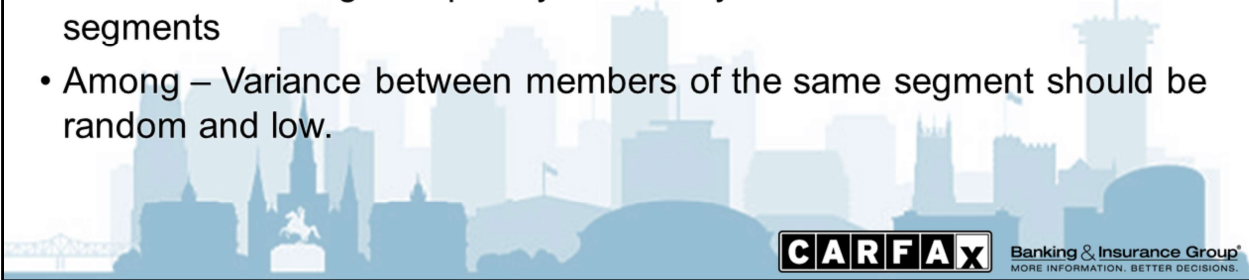
Effective segmentation

Lift

- Members of segments must be effectively identified.
- There must significant differences between the segments

Performance

- Between – Average frequency or severity must be different for different segments
- Among – Variance between members of the same segment should be random and low.



Increasing Segmentation

LESS SEGMENTED

Driver Classification

- Age, gender, marital status
- Driving records

Territory Classification

- Urbanity
- Population density

Vehicle Classification

- Year, make and model
- Cost new (Symbol)

MORE SEGMENTED

Driver-Specific Data

- Credit history
- Driving behavior (UBI)

Location-Specific Data

- Weather models
- Commute and traffic data

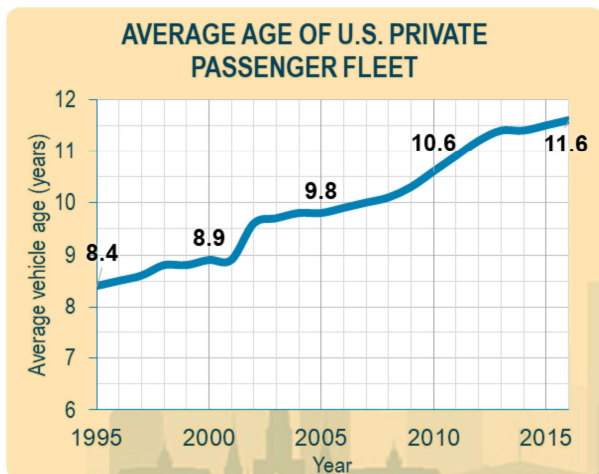
Vehicle-Specific Data

- Advanced safety features
- Vehicle history



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Vehicle-based underwriting matters more than ever



- Vehicles are lasting longer
 - Average age in 2016: 11.6 years
 - More differences as new technologies come to the road
 - More variance in drivability among vehicles of similar ages
 - More history per vehicle
- Age and symbol don't describe older vehicles well

IHS Automotive. Nov 2016. *Vehicles getting older: Average age of light cars and trucks in U.S. rises again in 2016 to 11.6 Years.* IHS Online Newsroom. Southfield, MI



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MANUFACTURED ATTRIBUTES

The low-hanging fruit of auto segmentation

Manufactured Attributes in Underwriting

- Companies are offering discounts on safety features that provide very little effective segmentation.
- Many advancements in vehicle safety are ignored in underwriting and rating.
- Safety features are evolving at a breakneck pace.



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Vehicle-level discounts

MORE COMMON

- Passive Restraint Systems
 - Automatic seat belts.
 - Driver-side and passenger-side airbags.
- Anti-Lock Brakes
- Daytime Running Lights
- Anti-Theft Systems
- Stolen Vehicle Recovery Systems

LESS COMMON

- Rearview Cameras
- Front Collision Avoidance
- Blind Spot Detection
- Lane-Departure Warning Systems
- Tire-Pressure Monitoring Systems
- Emergency Response Systems



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Automatic Seat Belts

Raise your hand if you have ever ridden in a car with one of these:



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Automatic Seat Belts

Raise your hand if you have ever ridden in a car with one of these:



Now put it down if you have ever watched a broadcast of this show:



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Vehicle Safety Features



2016 Buick Envision
MSRP \$42,380

Forward-Collision Warning
Low Speed Auto-braking
High Speed Auto-braking
Lane Departure Warning
Lane Keeping Assist
Blind-Spot Warning
Rear Cross Traffic Warning
Rearview Camera



2016 BMW X3
MSRP \$39,650

Forward-Collision Warning
Low Speed Auto-braking
High Speed Auto-braking

Blind-Spot Warning
Rearview Camera



2016 Ford Escape
MSRP \$31,745

Blind-Spot Warning
Rear Cross Traffic Warning
Rearview Camera



2016 VW Tiguan
MSRP \$30,645

Rearview Camera



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Vehicle Safety Features – Prior to 2006

- All-wheel drive systems
- Safety belt pretensioners
- Safety belt load limiters
- Active head restraints
- Advanced airbag deployment systems
- Tire pressure monitoring systems
- Side-impact airbags
- Electronic brake assist
- Electronic stability control
- Traction control
- Sturdy Body Cell
- Crumple zones
- Cargo barriers
- LATCH



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Vehicle Safety Features – Since 2006

- Visualization and augmented reality
 - Rear-view camera
 - Heads-up display
 - Infrared night vision
 - 360° Overhead View
 - Adaptive headlamps
 - Automatic high beams
 - HID, LED and matrix headlights
 - Traffic monitoring and warning
 - Congestion avoidance GPS
- Adaptive cruise control
- Collision avoidance and mitigation systems
 - Forward automatic emergency braking
 - Rear automatic emergency braking
 - Lane-keeping assist
 - Lane-centering assist
 - Automatic parking
- Collision warning systems
 - Forward-collision warning
 - Blind-spot warning
 - Rear cross-traffic warning
 - Lane-departure warning
 - Driver alertness detection



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Safety Equipment Fitment



Insurance Institute for Highway Safety
Highway Loss Data Institute

INSURANCE INSTITUTE FOR HIGHWAY SAFETY
HDLI

Bulletin | Vol. 28, No. 26 | April 2012

Predicted availability of safety features on registered vehicles

Introduction

In 2011, the Insurance Institute for Highway Safety (IIHS) estimated the potential benefits of several advanced vehicle safety features. Research conducted from 2010 to 2011 took into account the effectiveness of the features and the percentage of registered vehicles that had each feature. The IIHS estimates that the potential benefits of these features are as follows:

- **Electronic Stability Control (ESC):** 1.4 million lives saved over the next 20 years.
- **Blind Spot Monitoring (BSM):** 1.4 million lives saved over the next 20 years.
- **Forward Collision Warning (FCW):** 1.4 million lives saved over the next 20 years.
- **Adaptive Cruise Control (ACC):** 1.4 million lives saved over the next 20 years.
- **Automatic Emergency Braking (AEB):** 1.4 million lives saved over the next 20 years.
- **Head-Up Display (HUD):** 1.4 million lives saved over the next 20 years.
- **Daytime Running Lamps (DRL):** 1.4 million lives saved over the next 20 years.
- **Crash-avoidance steering (CAS):** 1.4 million lives saved over the next 20 years.
- **Advanced Driver Assistance Systems (ADAS):** 1.4 million lives saved over the next 20 years.

Methods

The IIHS estimates the percentage of new vehicles with each feature based on the IIHS New Vehicle Sales Report. The IIHS estimates the percentage of registered vehicles with each feature based on the IIHS New Vehicle Sales Report. The IIHS estimates the percentage of registered vehicles with each feature based on the IIHS New Vehicle Sales Report.

The following features are included in this bulletin: vehicle safety (VSA), electronic stability control (ESC), blind spot monitoring (BSM), forward collision warning (FCW), adaptive cruise control (ACC), automatic emergency braking (AEB), head-up display (HUD), daytime running lamps (DRL), crash-avoidance steering (CAS), and advanced driver assistance systems (ADAS).

INSURANCE INSTITUTE FOR HIGHWAY SAFETY
HDLI

Bulletin | Vol. 31, No. 15 | September 2014

Predicted availability of safety features on registered vehicles

Introduction

Our Highway Loss Data Institute (HLDI) studies have indicated that some vehicle safety features, such as electronic stability control (ESC), blind spot monitoring (BSM), forward collision warning (FCW), adaptive cruise control (ACC), automatic emergency braking (AEB), head-up display (HUD), daytime running lamps (DRL), crash-avoidance steering (CAS), and advanced driver assistance systems (ADAS), are becoming more widely available on registered vehicles. The IIHS estimates that the potential benefits of these features are as follows:

- **ESC:** 1.4 million lives saved over the next 20 years.
- **BSM:** 1.4 million lives saved over the next 20 years.
- **FCW:** 1.4 million lives saved over the next 20 years.
- **ACC:** 1.4 million lives saved over the next 20 years.
- **AEB:** 1.4 million lives saved over the next 20 years.
- **HUD:** 1.4 million lives saved over the next 20 years.
- **DRL:** 1.4 million lives saved over the next 20 years.
- **CAS:** 1.4 million lives saved over the next 20 years.
- **ADAS:** 1.4 million lives saved over the next 20 years.

Methods

The IIHS estimates the percentage of new vehicles with each feature based on the IIHS New Vehicle Sales Report. The IIHS estimates the percentage of registered vehicles with each feature based on the IIHS New Vehicle Sales Report.

Estimated percentage of registered vehicles with each feature:

Feature	Estimated Percentage
ESC	80%
BSM	70%
FCW	60%
ACC	50%
AEB	40%
HUD	30%
DRL	20%
CAS	10%
ADAS	5%

HLDI

Bulletin | Vol. 32, No. 16 | September 2015

Predicted availability of safety features on registered vehicles a 2015 update

Introduction

Our Highway Loss Data Institute (HLDI) studies have indicated that some vehicle safety features, such as electronic stability control (ESC), blind spot monitoring (BSM), forward collision warning (FCW), adaptive cruise control (ACC), automatic emergency braking (AEB), head-up display (HUD), daytime running lamps (DRL), crash-avoidance steering (CAS), and advanced driver assistance systems (ADAS), are becoming more widely available on registered vehicles. The IIHS estimates that the potential benefits of these features are as follows:

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- **AEB:** 1.4 million lives saved over the next 20 years.
- **HUD:** 1.4 million lives saved over the next 20 years.
- **DRL:** 1.4 million lives saved over the next 20 years.
- **CAS:** 1.4 million lives saved over the next 20 years.
- **ADAS:** 1.4 million lives saved over the next 20 years.

Methods

The IIHS estimates the percentage of new vehicles with each feature based on the IIHS New Vehicle Sales Report. The IIHS estimates the percentage of registered vehicles with each feature based on the IIHS New Vehicle Sales Report.

Estimated percentage of registered vehicles with each feature:

Feature	Estimated Percentage
ESC	85%
BSM	75%
FCW	65%
ACC	55%
AEB	45%
HUD	35%
DRL	25%
CAS	15%
ADAS	10%

HLDI

Bulletin | Vol. 34, No. 20 | September 2017

Predicted availability and fitment of safety features on registered vehicles

Introduction

Our Highway Loss Data Institute (HLDI) studies have indicated that some vehicle safety features, such as electronic stability control (ESC), blind spot monitoring (BSM), forward collision warning (FCW), adaptive cruise control (ACC), automatic emergency braking (AEB), head-up display (HUD), daytime running lamps (DRL), crash-avoidance steering (CAS), and advanced driver assistance systems (ADAS), are becoming more widely available on registered vehicles. The IIHS estimates that the potential benefits of these features are as follows:

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- **CAS:** 1.4 million lives saved over the next 20 years.
- **ADAS:** 1.4 million lives saved over the next 20 years.

Methods

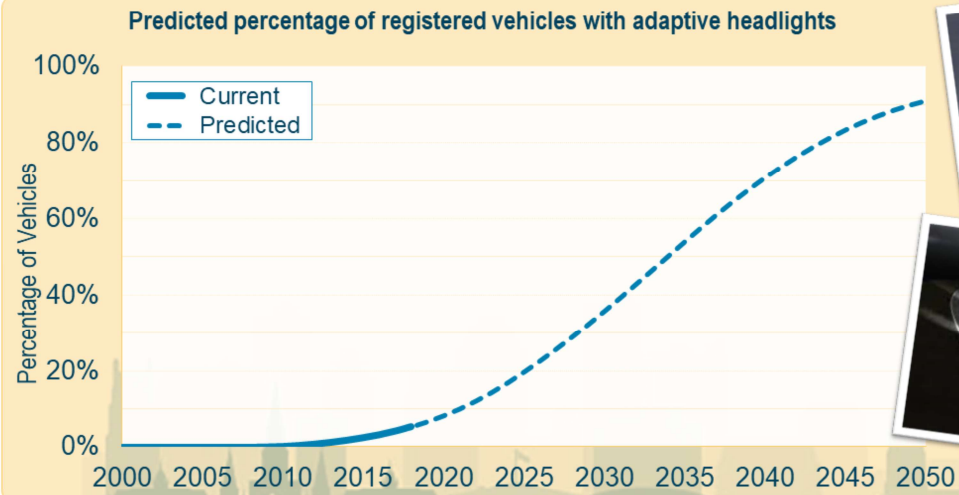
The IIHS estimates the percentage of new vehicles with each feature based on the IIHS New Vehicle Sales Report. The IIHS estimates the percentage of registered vehicles with each feature based on the IIHS New Vehicle Sales Report.

Estimated percentage of registered vehicles with each feature:

Feature	Estimated Percentage
ESC	90%
BSM	80%
FCW	70%
ACC	60%
AEB	50%
HUD	40%
DRL	30%
CAS	20%
ADAS	15%



Adaptive Headlights

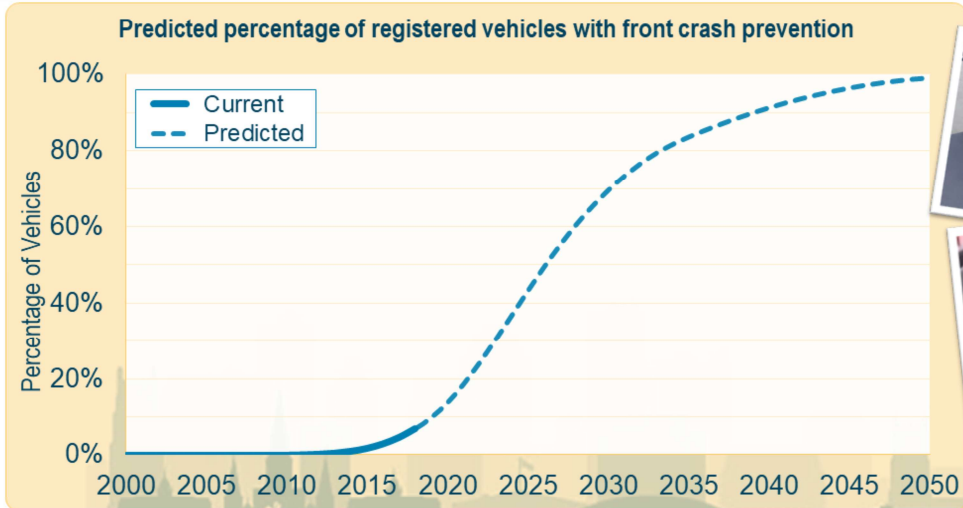


Highway Loss Data Institute, Sep 2017. Predicted availability and fitment of safety features on registered vehicles. *Loss Bulletin*. Vol. 34, No. 28. Arlington, Virginia.



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Front Crash Prevention

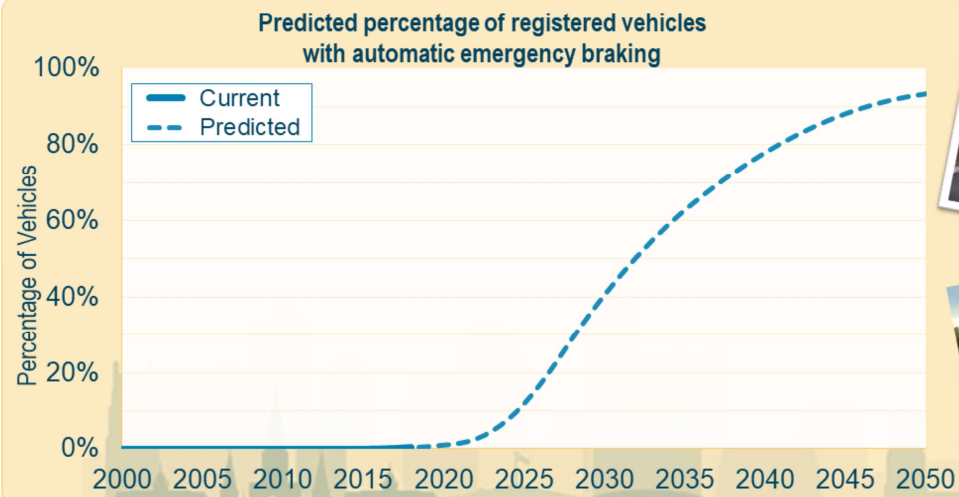


Highway Loss Data Institute, Sep 2017. Predicted availability and fitment of safety features on registered vehicles. *Loss Bulletin*. Vol. 34, No. 28. Arlington, Virginia.



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Auto Emergency Braking

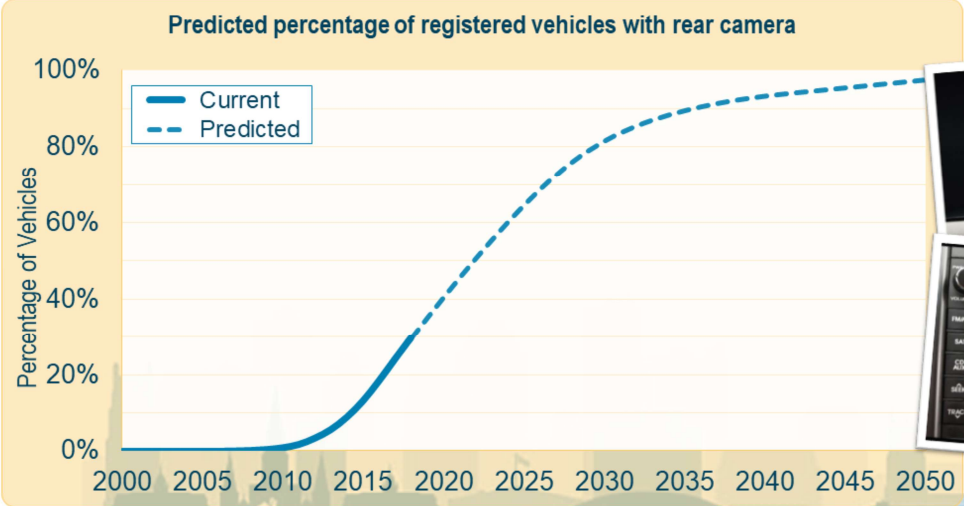


Highway Loss Data Institute, Sep 2017. Predicted availability and fitment of safety features on registered vehicles. *Loss Bulletin*. Vol. 34, No. 28. Arlington, Virginia.



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Back-up Camera

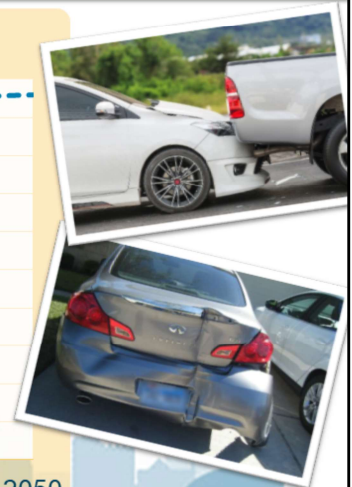
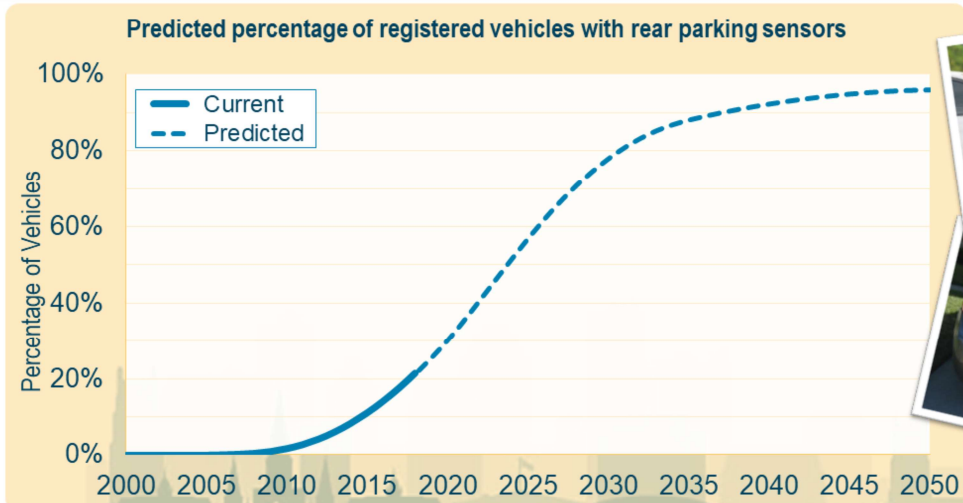


Highway Loss Data Institute, Sep 2017. Predicted availability and fitment of safety features on registered vehicles. *Loss Bulletin*. Vol. 34, No. 28. Arlington, Virginia.



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Rear Parking Sensors

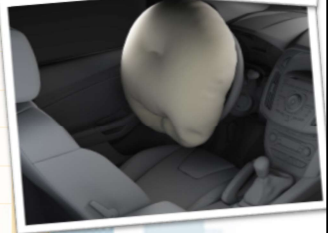
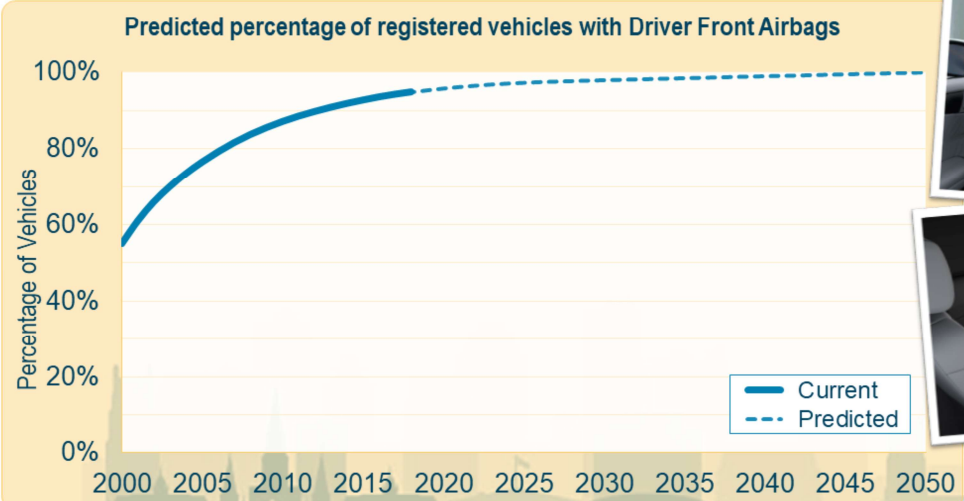


Highway Loss Data Institute, Sep 2017. Predicted availability and fitment of safety features on registered vehicles. *Loss Bulletin*. Vol. 34, No. 28. Arlington, Virginia.



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Driver Front Airbags

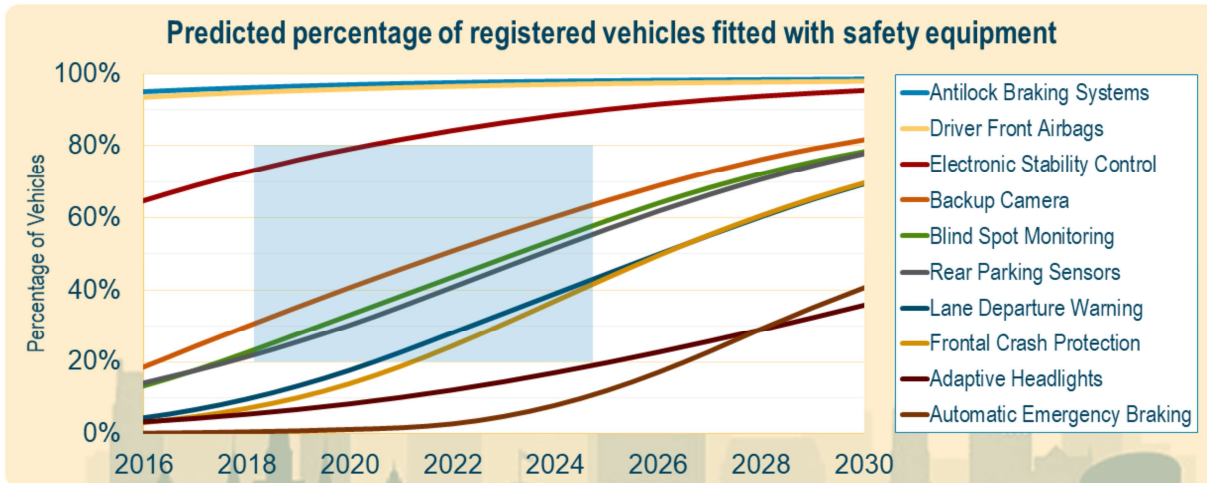


Highway Loss Data Institute, 2012. Predicted availability of safety features on registered vehicles. *Loss bulletin*. Vol. 28, No 26. Arlington, VA.



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Safety Equipment - Looking into the Future



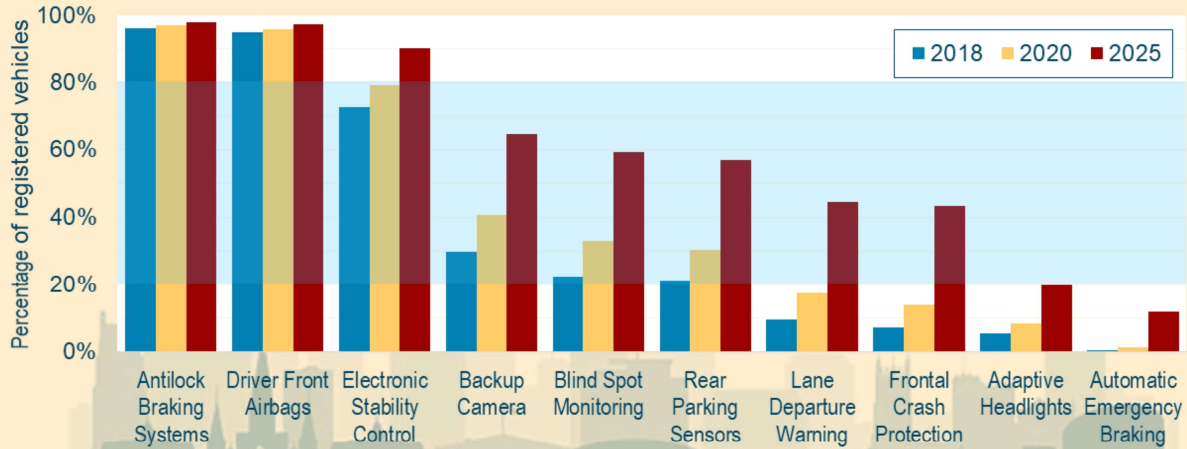
Highway Loss Data Institute, 2012, 2015, and 2017. Data compiled from various reports. *Loss Bulletin*. Vol. 28, No 26; Vol 32.16; Vol. 34, No. 28. Arlington, Virginia.



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Safety Equipment – Next 5 Years

Predicted percentage of registered vehicles fitted with safety equipment



Highway Loss Data Institute, 2012, 2015, and 2017. Data compiled from various reports. *Loss Bulletin*. Vol. 28, No 26; Vol 32.16; Vol. 34, No. 28. Arlington, Virginia.



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Vehicle-Level Rating and Underwriting

- More revolution than evolution
- Low-hanging fruit for auto risk segmentation
 - Information is relatively easy to get and verify
 - Offers segmentation for the short term
 - May be difficult to keep ahead of in highly competitive auto market
- Value will increase over time
 - Safety
 - Theft deterrence and recovery
 - Connectivity
 - Autonomy



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VEHICLE HISTORY

Insurance scoring for your car

Quiz Question:
Which of the following vehicles would you rather insure?

A	B	C	D
2012 Ford Explorer XLT 290HP V-6 FWD	2012 Ford Explorer XLT 290HP V-6 FWD	2012 Ford Explorer 280HP V-6 FWD	2012 Ford Explorer XLT 290HP V-6 FWD
Symbol 18 Value: \$15,592	Symbol 18 Value: \$14,951	Symbol 18 Value: \$7,247	Symbol 18 Value: \$5,190

E It doesn't matter – they are all the same from an underwriting standpoint.



Which of the following vehicles would you rather insure?

A picture is worth a thousand rating variables!

			
<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$15,592</p>	<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$14,951</p>	<p>2012 Ford Explorer 280HP V-6 FWD</p> <p>Symbol 18 Value: \$7,247</p>	<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$5,190</p>



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Which of the following vehicles would you rather insure?

A	B	C	D
<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$15,592</p> <ul style="list-style-type: none"> • Odometer: 75,284 • 1 owner • Personal Use • Complete service history • Clean CARFAX report 	<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$14,951</p> <ul style="list-style-type: none"> • Odometer: 62,863 • 2 owners • Registered for commercial use • Some service records • 1 minor accident 	<p>2012 Ford Explorer 280HP V-6 FWD</p> <p>Symbol 18 Value: \$7,247</p> <ul style="list-style-type: none"> • Odometer: 192,926 • 2 owners • Formerly registered for police use • No service records • Body damage reported 	<p>2012 Ford Explorer XLT 290HP V-6 FWD</p> <p>Symbol 18 Value: \$5,190</p> <ul style="list-style-type: none"> • Odometer: 261,336 • 4 owners • 2 severe accidents • Frame damage reported • Stolen • Salvage title



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What is vehicle history?

CARFAX Vehicle History Report™
VIN: 1NAAL2AP0CC152436
2012 NISSAN ALTIMA 2.5I S 5 S
SEDAN 4 DR
2.5L I4 FI DOHC 16V
GASOLINE
FRONT WHEEL DRIVE
Standard Equipment | Safety Options

Branded Titles: Rebuilt, Reconstructed, Salvage

4 Previous owners
4 Service history records
Types of owners: Personal lease, Personal, Taxi
Last owned in New York
140,732 Last reported odometer reading

CARFAX Ownership History
The number of owners is estimated

	Owner 1-2	Owner 3	Owner 4
Year purchased	2011	2013	2014
Type of owner	See Details	Taxi	Taxi
Estimated length of ownership	1 yr. 9 mo.	1 year	2 yrs. 4 mo.
Owned in the following states/provinces	See Details	New Jersey, New York	New York
Estimated miles driven per year	See Details	---	49,011/yr
Last reported odometer reading	8,615	22,377	140,732

CARFAX Title History
CARFAX guarantees this information in this section

	Owner 1-2	Owner 3	Owner 4
Salvage Junk Rebuilt Fire Flood Hall Lemon	ALERT! Problem Found	ALERT! Problem Found	ALERT! Problem Found
Not Actual Mileage Exceeds Mechanical Limits	No Problem	No Problem	No Problem

Alert! Severe problems were reported by a state Department of Motor Vehicles (DMV). This vehicle does not qualify for the CARFAX Buyback Guarantee.

- Damage information
- Mileage data
- Ownership data
- Title information
- Detailed service history

CARFAX Detailed History

Owner	Year	Last Date	Date	Mileage	Source	Comments
Owner 1	2011	05/02/2011	05/02/2011	10	State of New York	Vehicle title issued for sale
Owner 2	2013	05/02/2013	05/02/2013	10	State of New York	Vehicle title issued for sale
Owner 3	2014	05/02/2014	05/02/2014	10	State of New York	Vehicle title issued for sale
Owner 4	2014	05/02/2014	05/02/2014	10	State of New York	Vehicle title issued for sale



What is *vehicle history*?

OWNERSHIP

- Number of owners
- Current length of ownership
- Average length of ownership
- Leased vs. owned
- Lien
- Repossession

USE

- Total miles
- Average annual miles
- Registration type
- Historical use
- Gaps in Coverage

CONDITION

- Maintenance
 - Scheduled
 - Unscheduled repairs
- Damage
 - Accidents
 - Minor damage
 - Flood, Fire
 - Thefts
- Open recalls



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Ownership History Components

CURRENT OWNER

- Original Owner
- Certified Pre-owned
- Length of Ownership
- Current Registration Type
- Leased, Financed or Owned

PRIOR OWNERS

- Number of Owners
- Average Length of Ownership
- Historical Registration Type
- Repossession
- Grey Market Vehicles



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Ownership History Number of Owners

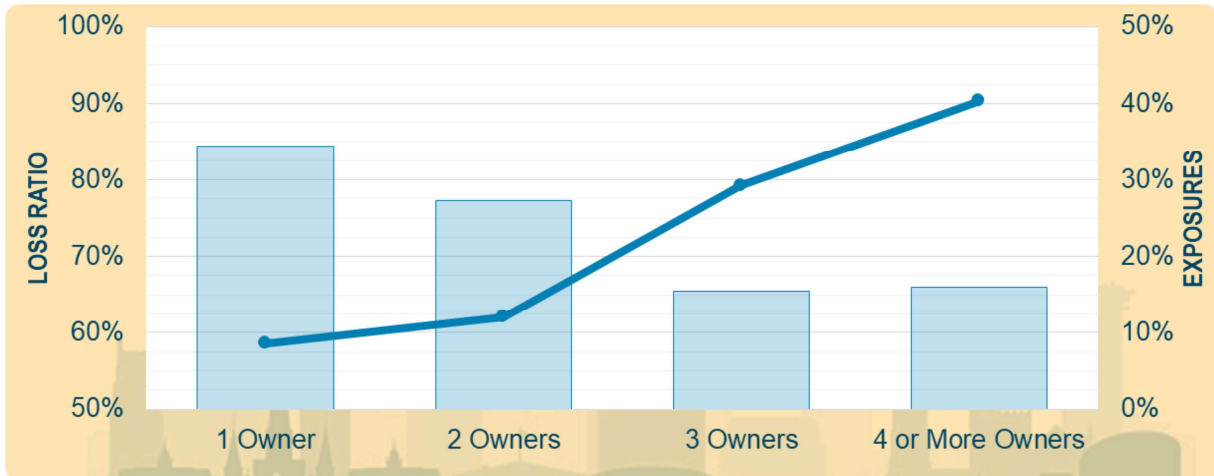
- One-owner cars are more valuable in the used-car marketplace.
- Fewer owners means fewer opportunities for neglect.
- Earlier owners tend to have to follow maintenance schedules more closely.
- Cars needing frequent or major repairs may be replaced rather than repaired
- Lemons tend to change hands more often.



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Lift from Number of Owners

Univariate Analysis



CARFAX Univariate Data Analysis, 2006-2015.



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Ownership History Certified Pre-Owned Vehicles

- Tend to be newer, lower-mileage, second-owner vehicles
- Undergo thorough inspection from manufacturer
 - Meet strict criteria for condition
 - Consistent maintenance history
- Vehicles reconditioned by factory-trained technicians
- Covered under extended warranties
 - Minor repairs are not skipped
 - Repairs done at dealerships

**CERTIFIED
PRE-OWNED**



HONDA

**Certified
Pre-Owned**



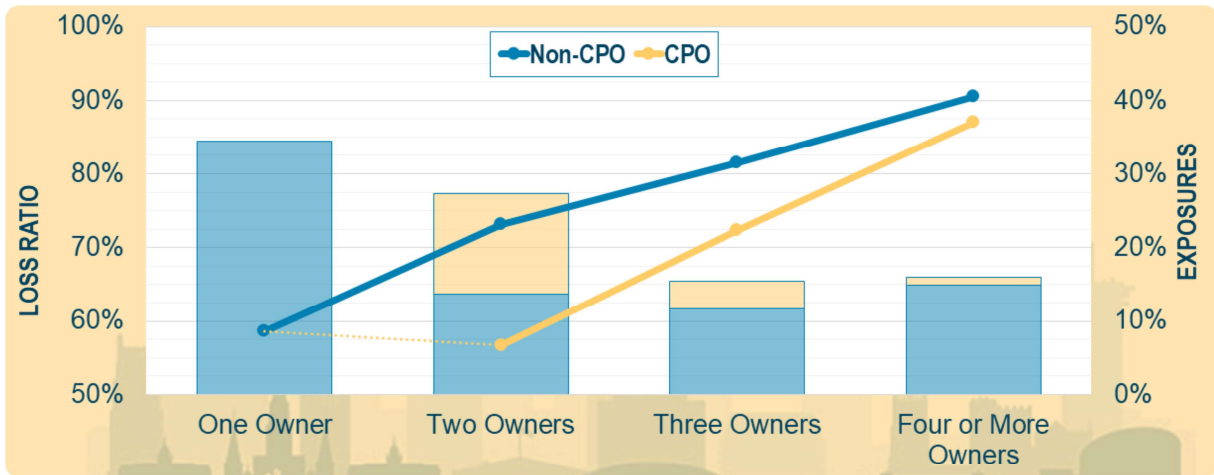
Certified Pre-Owned
by BMW



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Lift from Number of Owners with CPO

Univariate Analysis



CARFAX Univariate Data Analysis, 2006-2015.



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Ownership History

Current Owner Length of Ownership

CARFAX studies show that the longer a car is owned, the better the risk becomes.

- Newer cars are less familiar.
- Newer cars are used on longer drives.
- Minor damage is more likely to be reported on newer cars.
- Lemons get moved on to new owners.

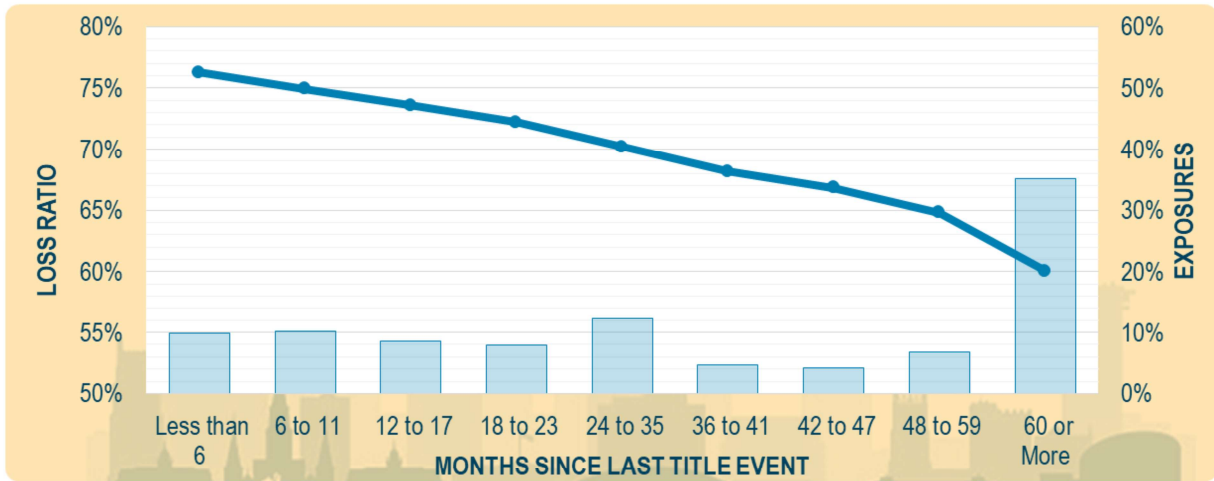


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Lift from Length of Ownership

Univariate Analysis



CARFAX Univariate Data Analysis, 2006-2015.



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Ownership History Average Length of Ownership



Owners tend to hold on to “good” vehicles

- Repair savings outweigh replacement costs, even when opportunity cost of driving older vehicle is considered
- Problem vehicles change hands often

PROBLEM VEHICLES ARE MORE LIKELY TO HAVE SAFETY ISSUES

CARFAX

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Vehicle Use Components

TYPE OF USE

- Personal
- Commercial
- Government
- Police
- Farm
- Seasonal
- Show cars

FREQUENCY AND AREA OF USE

- Mileage
- Registration vs garage ZIP
- Out-of-area service





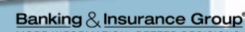
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Vehicle Use

Current Registration Type

- Less likely to be fraudulently reported than self-reported use
 - Tax incentives for commercial registrations
 - Significant penalties for misreporting
- Used in underwriting to match customers to most appropriate coverage



Vehicle Use Coverage Gaps

Insurers already have this data

- Comprehensive Only for part of year
 - Tend to be well-maintained
 - Usually lower mileage
 - Check driver-to-vehicle ratio
- Gaps in Liability coverage
 - Liability only coverage
 - Low liability limits



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Vehicle Use Grey Market Vehicles

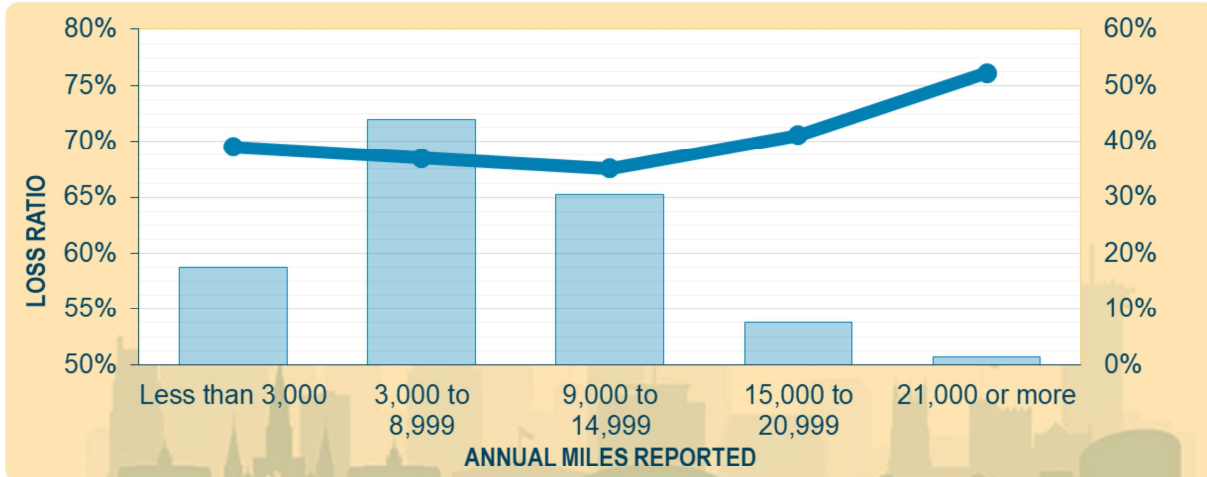
- Manufactured for sale outside U.S.
 - Less rigorous safety and emissions standards.
 - Subject to jerry-rigged repairs
- May be illegal to possess
- Must meet certain guidelines
 - Modified to meet U.S. safety and emissions standards, or
 - Only used for show and display



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Vehicle Use Lift from Self-Reported Mileage



TransUnion Performance Analytics Database, 2006-2010



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Quiz Question:

What is the average difference between rated and actual miles?

- A 2,500 miles per year
- B 3,000 miles per year
- C 4,500 miles per year
- D 6,000 miles per year
- E 7,500 miles per year

HINT

Average Annual Miles Driven
2015 U.S. Light-Duty Vehicles

1 1 4 4 3 0

U.S. Department of Transportation, Federal Highway
Administration. *2015 National Household Travel Survey*. Table
VM-1.

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Self-Reported Mileage

- Often Inaccurate
 - Customers may not know how much they drive
 - Significant cost incentive to underreport
 - Agents underreport to save time
- Can change over time
- Difficult for insurers to verify

Source: TransUnion Performance Analytics Database, 2006-2010



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How far is 6,000 miles?

6 0 8 3 4



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Vehicle Use Verified Average Mileage

- Can be calculated easily from vehicle odometer readings.
- Direct measure of exposure to loss.
 - Extremely predictive
 - May be the most powerful rating variable for liability and collision.
 - Can account for performance differences in gender.

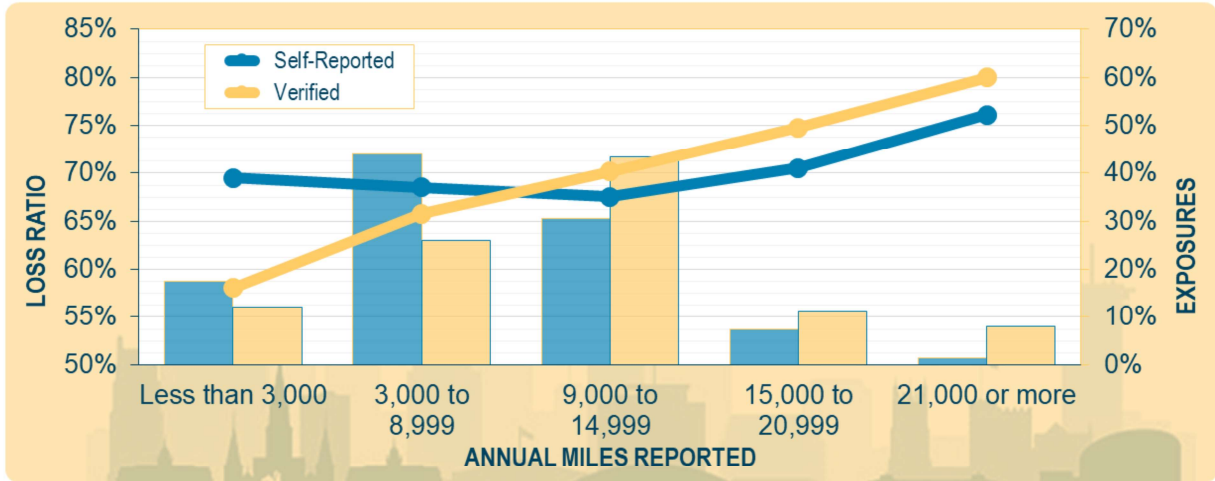


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Lift from Annual Mileage

Univariate Analysis



TransUnion Performance Analytics Database, 2006-2010



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Vehicle Condition Components

KNOWN DAMAGE

- Severe accidents
- Minor accidents
- Title brands
- Flood and water damage
- Fire damage

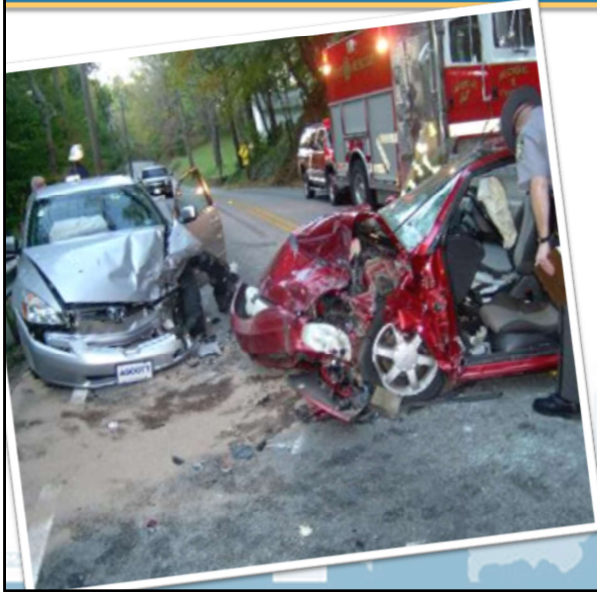
PROBLEM CONDITIONS

- Service history
- Claims history
- Open recall
- Stolen and recovered
- Repossessed vehicles



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Vehicle Condition Severe Accidents



- Structural integrity is compromised
- Many sensitive parts may be improperly installed or remain unrepaired
- Low-quality aftermarket parts are prone to failure



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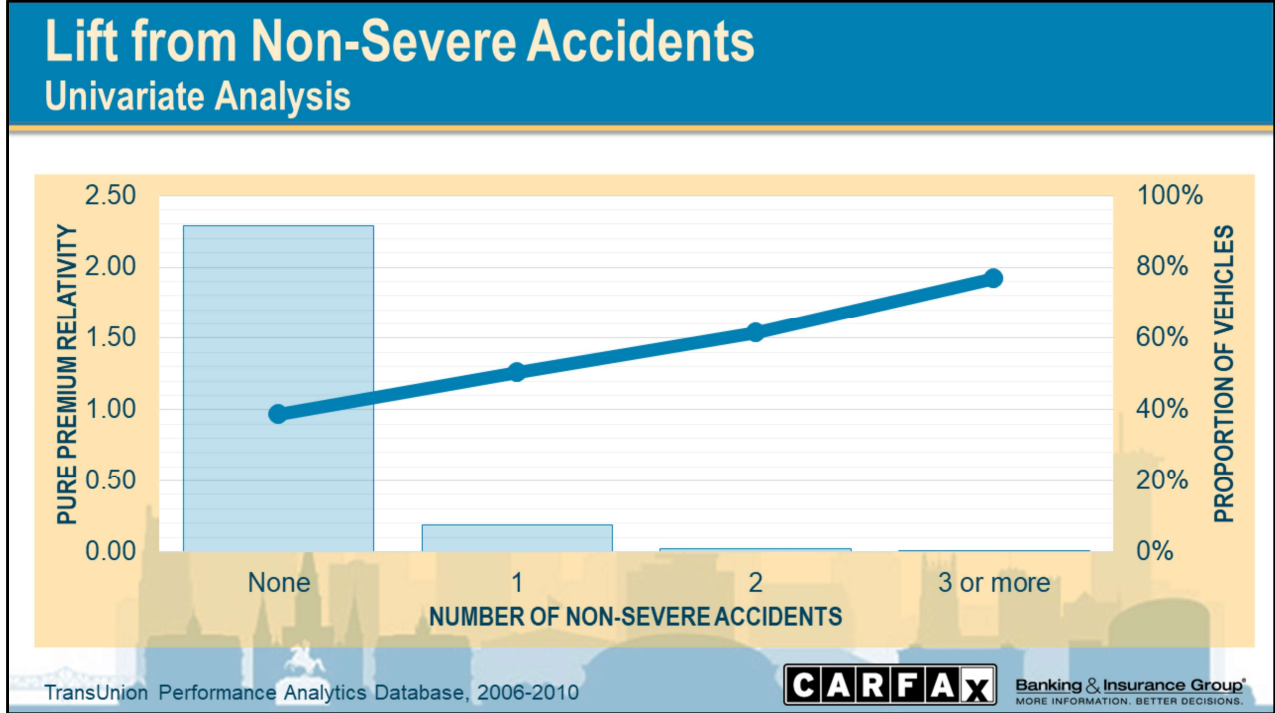
Vehicle Condition Minor Accidents

- Repairs may be improperly or incompletely done
 - May cause sensitive electronics to fail
 - Damage to critical structural components may be missed
- Low-quality aftermarket safety components may fail



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Vehicle Condition Flood Vehicles

Flood water can damage several components of vehicle

- Antilock braking systems.
- Electronic safety system sensors.
- Passive and active restraint systems.
- Rusted structural components.
- Water damage inside engine, transmission and other components.

“When a car’s electrical systems have been compromised, it may no longer be safe or roadworthy.”

- U.S. Department of Justice

U.S. Department of Justice Bureau of Justice Affairs. "Buyer Beware: Safety Hazards of Flood-Damaged Vehicles" Web. www.bja.gov/programs/flooddamagedvehicles_nmvts.pdf



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Flood Vehicles Hurricane Harvey

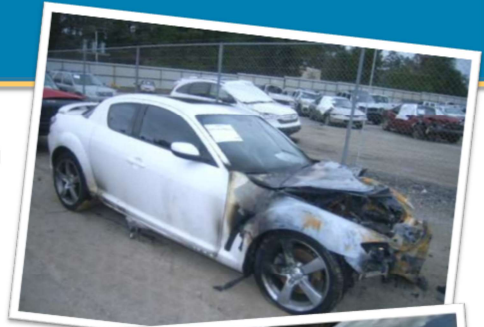


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Vehicle Condition Fire Damage

- Changes brittleness of steel and aluminum structural components
- Heat expansion causes problems in hydraulic systems, especially braking systems
- Damages wiring and electronics
- Completely destroys many important sensors
- Less common and more expensive to repair than flood damage



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Vehicle Condition Branded Titles

Salvage Titles

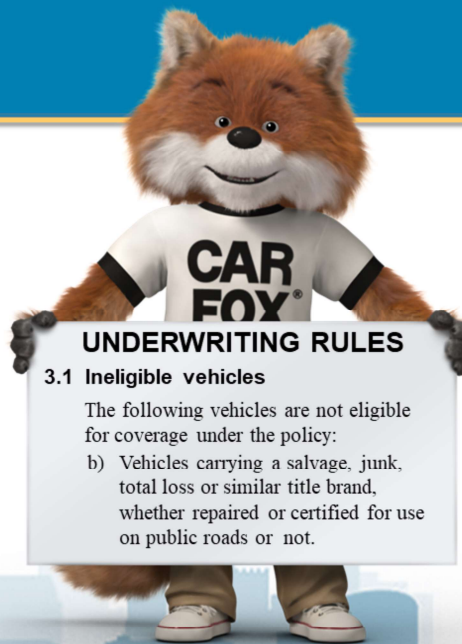
- Precluded by many underwriting plans
- Need copy of title

Rebuilt Titles

- Repairs may not meet standards
- Often incomplete or improper repair

Fire and Flood Titles

- Possible damage to sensitive electronic or critical structural components

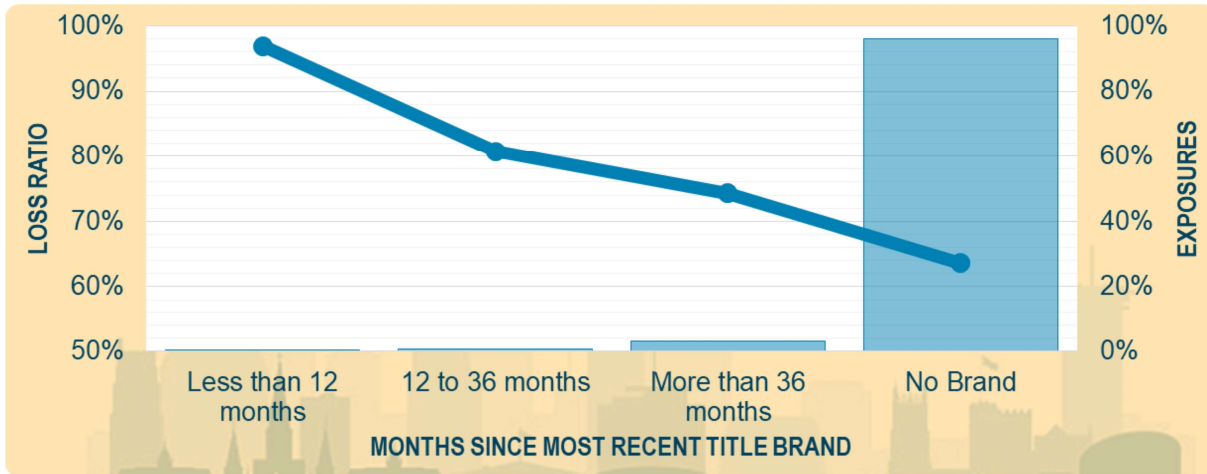


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Lift from Branded Titles over Time

Univariate Analysis

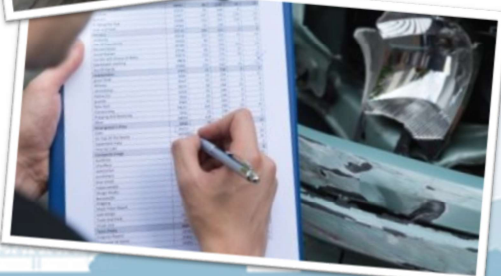
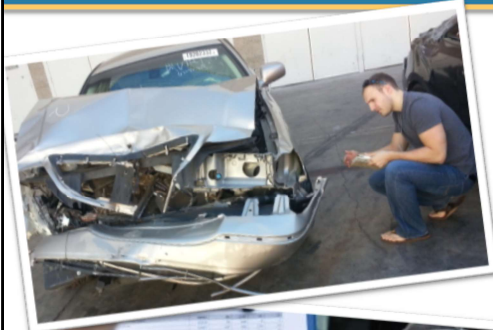


TransUnion Performance Analytics Database, 2006-2010



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Vehicle Condition Insurance Total Loss



- May or may not have branded title
 - Requirements vary by state
 - Reporting to national databases is inconsistent
- Damage is severe enough that the insurer doesn't think the vehicle is worth repairing
 - Cost of repairs is too high
 - Vehicle is not safe for use



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Vehicle Condition Potential Damage

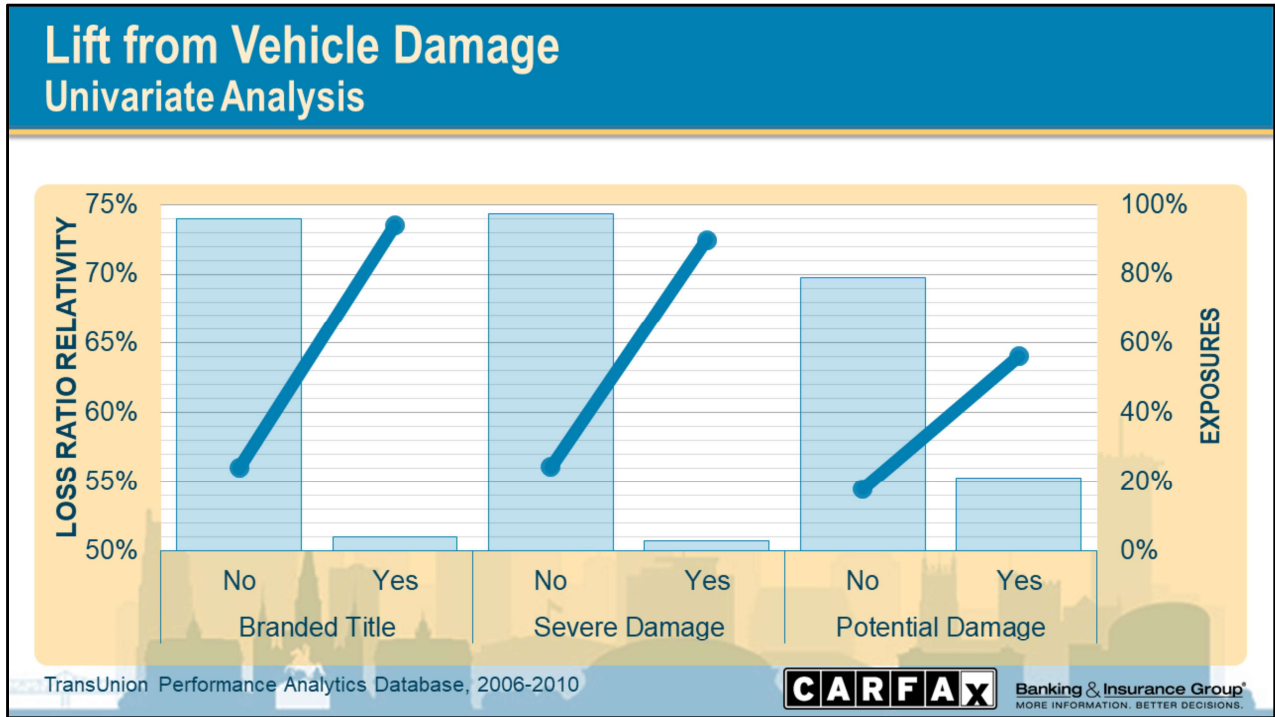
Indications of damage that is likely to affect insurability

- Frame inspected
- Police accident report
- Collision repair facility records
- Failed inspections
- Auction damage disclosure



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Vehicle Condition Service History

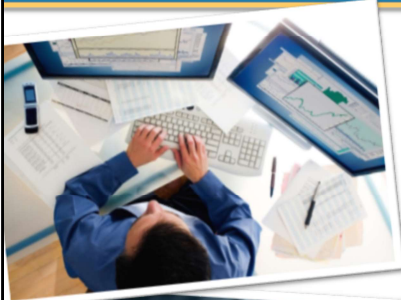
- Well maintained vehicles tend to be safer on the road
- Lack of service records
 - Could indicate service performed by owner
 - Doesn't necessarily indicate a problem
- Service record patterns
 - Changes in patterns can signal larger problems
 - Look for increase in service records after damage events
 - Look for major service events immediately before title events
- Good source to identify odometer fraud



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Vehicle Condition Claims History



Look at your existing claims data

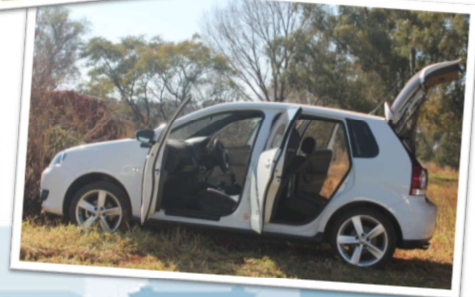
- Analyze performance of your book after claims
- After a claim, frequency and severity tend to increase
- Watch out for correlation with other variables
- Analyze liability as well as physical damage



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Vehicle Condition Stolen and Recovered

- Insured has no idea what happened to the vehicle while in possession of thieves
- Often dismantled for parts
 - May not be reassembled to original standards
 - Repairs may have used lower-quality parts
- Airbags and electronic sensors
 - High-value items
 - Difficult to get in the current market

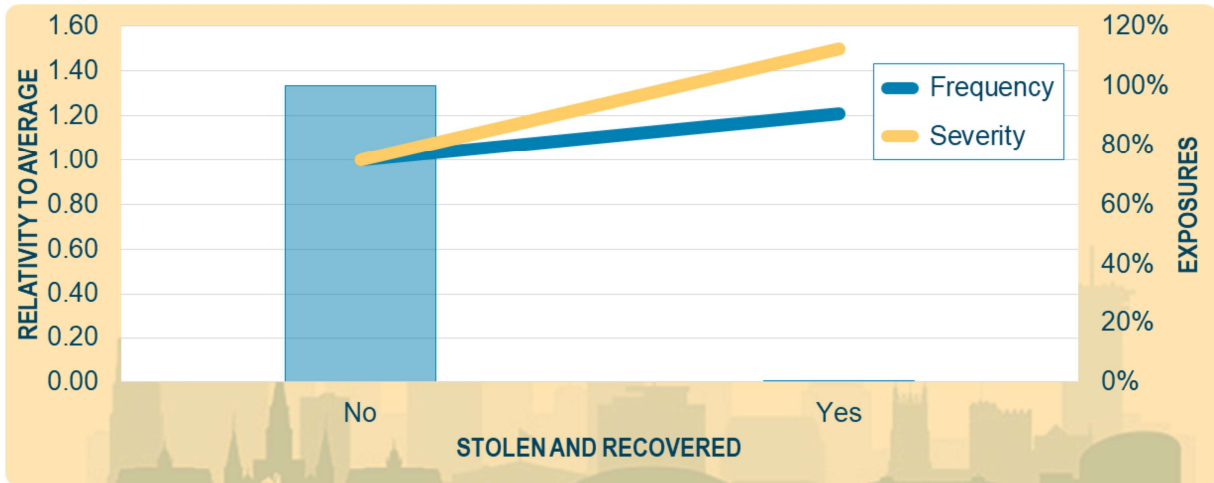


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Lift from Stolen and Recovered Indicator

Univariate Results

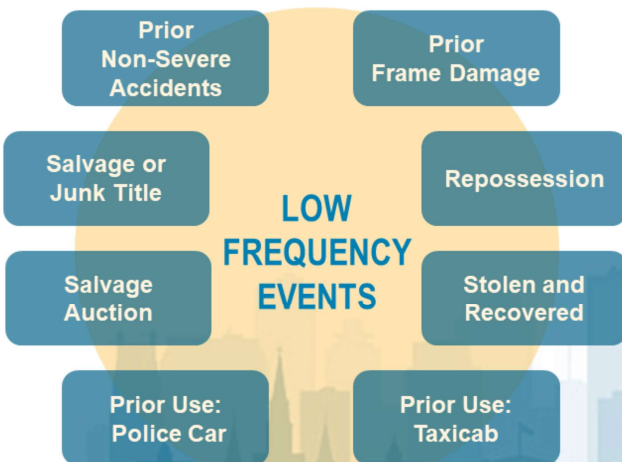


Independent carrier analysis of CARFAX Vehicle History Data, 2000 – 2005.



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Low-Frequency Events



- Occur on low percentage of vehicles
- Difficult to identify in small books of business
- Remarkably consistent across carriers
 - Consistency indicates a lower acceptable threshold for statistical credibility
 - Should be considered in model



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Fraud Detection

- VIN cloning
 - Vehicle has a VIN plate identifying it as a different vehicle
 - Used to hide title problems
- Title washing
 - Vehicle with branded title is re-titled in state with different branding requirements
 - Common after floods, hurricanes, and other natural disasters
 - Exposure varied by state
- Odometer rollbacks
- Double-dipping first party repairs



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IMPLEMENTATION

Pulling it all together

Use in Underwriting

- Some attributes are already in use
 - Salvage titles not eligible for coverage
 - Mileage
 - Commercial Use
 - Government or Non-Profit Use
- Customer service
 - Establishes a touch-point
 - Helps find the best coverage for hard-to-cover risks
- Front-end flags for fraud detection



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Use in Rating



- Many interactions between variables
 - Carefully consider impact on other variables
 - Multivariate analysis is needed to get the most out of the data
 - May result in replacement of some proxy variables
- Good candidate for a scoring or tiering model
- Fits well as a modification to symbols
- Can be “averaged” across the policy



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Use in Product Development

- Opportunities for new product innovation
 - Advanced safety feature discounts
 - Product enhancements for older one-owner cars or CPO cars
- Can be used as a lead-in for usage based insurance
 - Identify low mileage personal use vehicles
 - Combine with policy information to 'slot' customers into appropriate UBI tiers
- Product differentiator in a commodity market



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QUESTIONS

Vehicle History in Auto Insurance Rating and Underwriting