



Insurance Institute for Highway Safety
Highway Loss Data Institute



Banking & Insurance Group®

MORE INFORMATION. BETTER DECISIONS.

WHAT YOU ARE MISSING

Vehicle History in Auto Insurance Rating and Underwriting

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The power of segmentation

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



A collage of documents. On the right is a Texas Department of Public Safety license record for a driver with a license class of C, issued on 12/31/1990 and expiring on 12/31/2010. On the left is a CARFAX report for a vehicle with VIN 1G0011194010, showing a 738 ICOP score (Good), a 762 FICO score (Very Good), and a 733 FICO score (Good). The report also lists reported claim history and negative factors.

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)

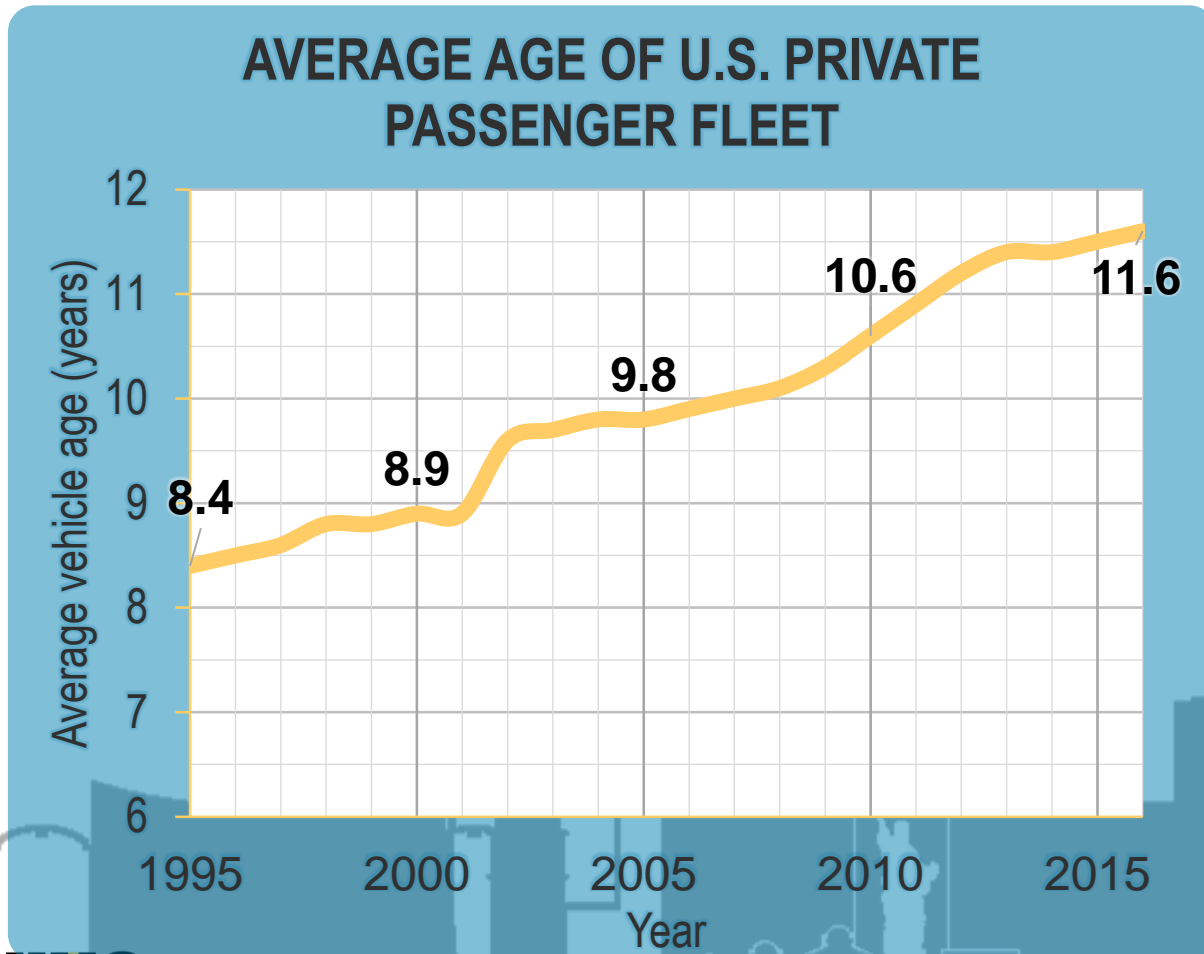
Location-Specific Data

- Weather models
- Commute and traffic data

Vehicle-Specific Data

- Advanced safety features
- Vehicle history

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



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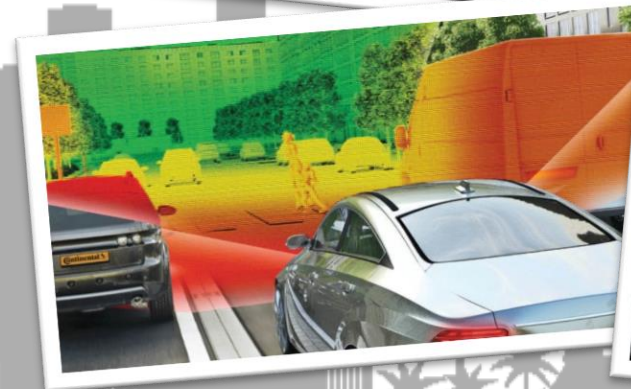


MANUFACTURED ATTRIBUTES

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.



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

Automatic Seat Belts

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



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:



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



Vehicle Safety Features – Prior to 2006

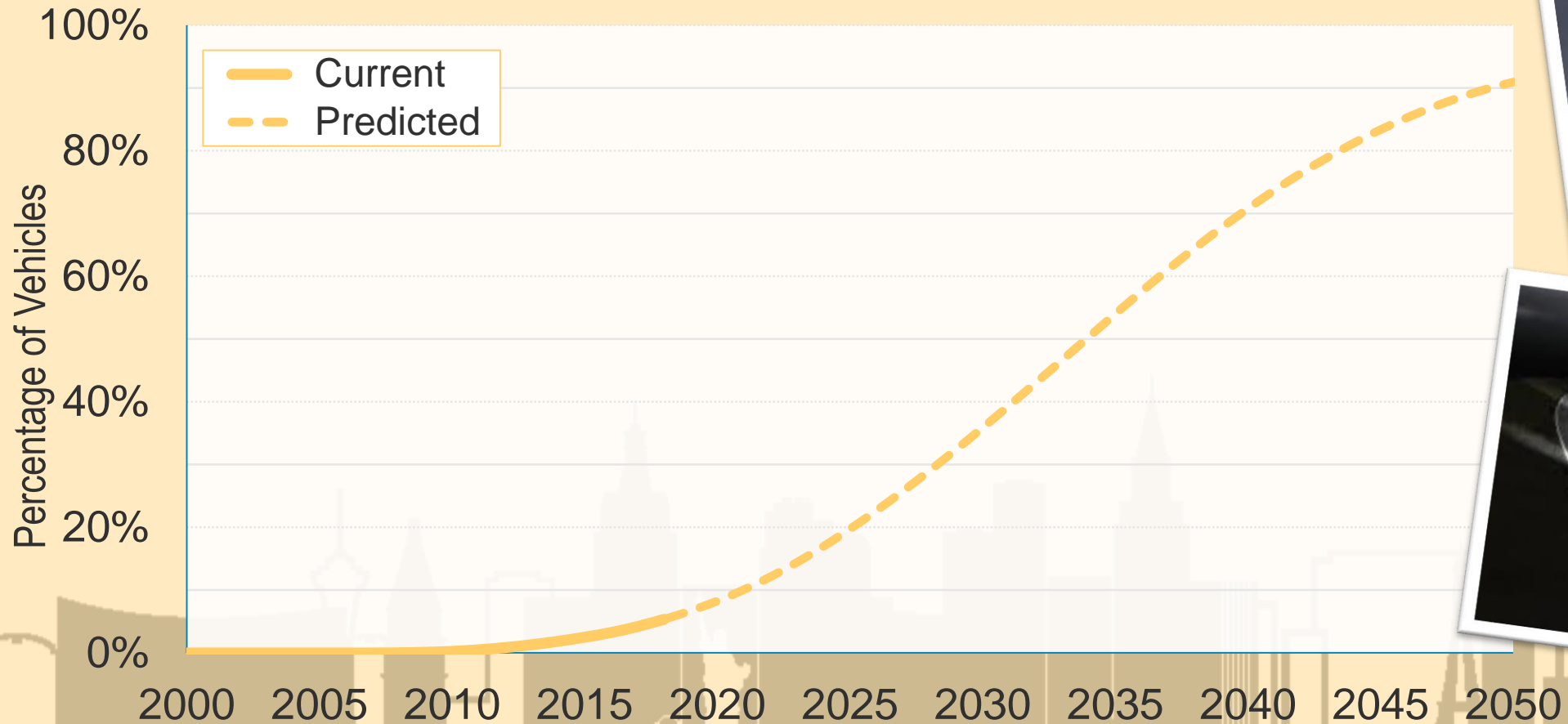
- All-wheel drive systems
- Safety belt pretensioners
- Safety belt load limiters
- Active head restraints
- Advanced airbag deployment systems
- Tire pressure monitoring systems
- Side-impact airbags
- Electronic brake assist
- Electronic stability control
- Traction control
- Sturdy Body Cell
- Crumple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

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

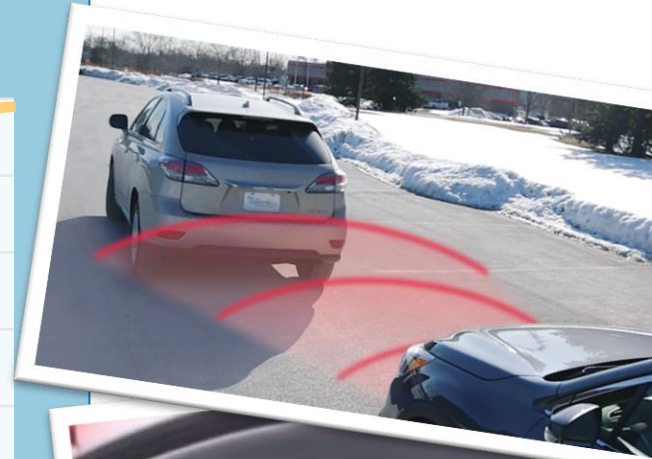
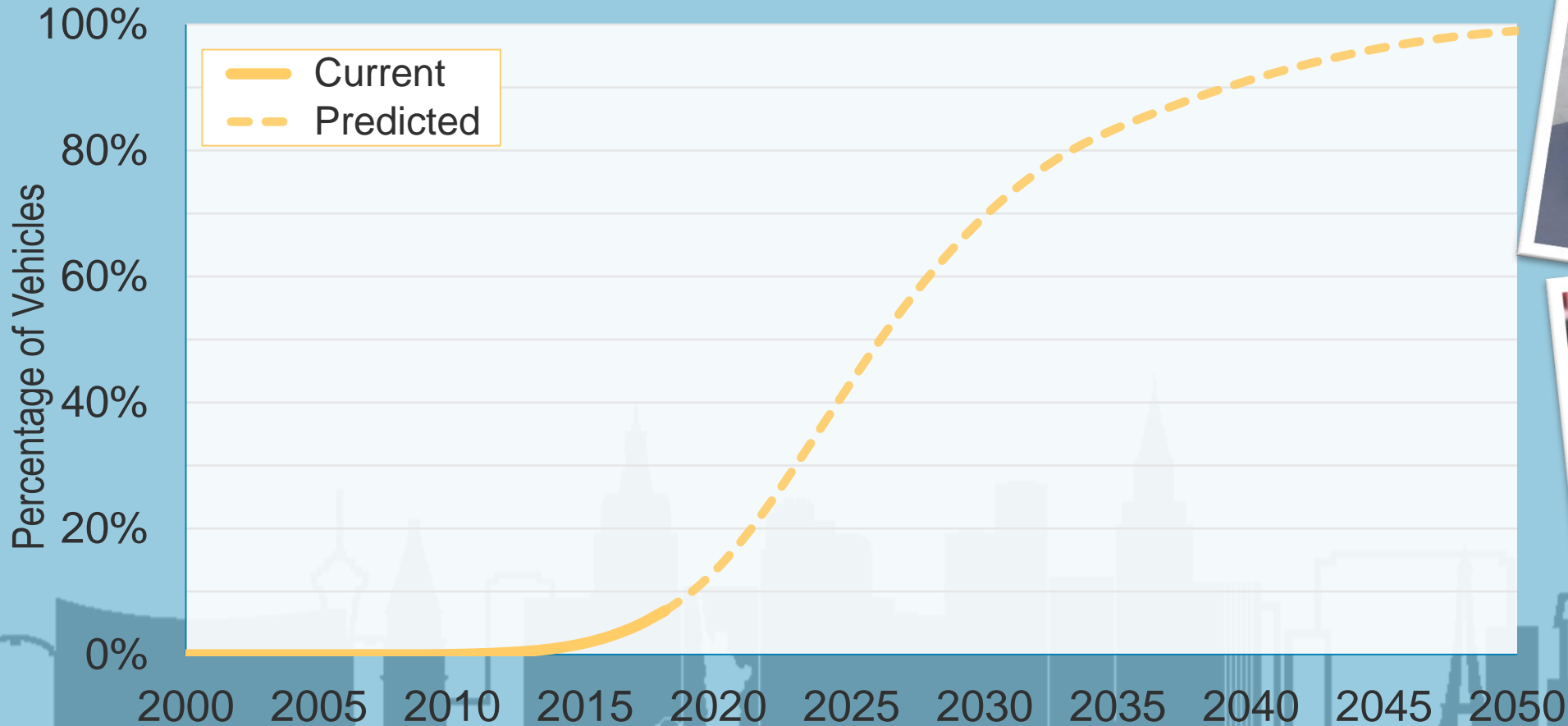
Adaptive Headlights

Predicted percentage of registered vehicles with adaptive headlights



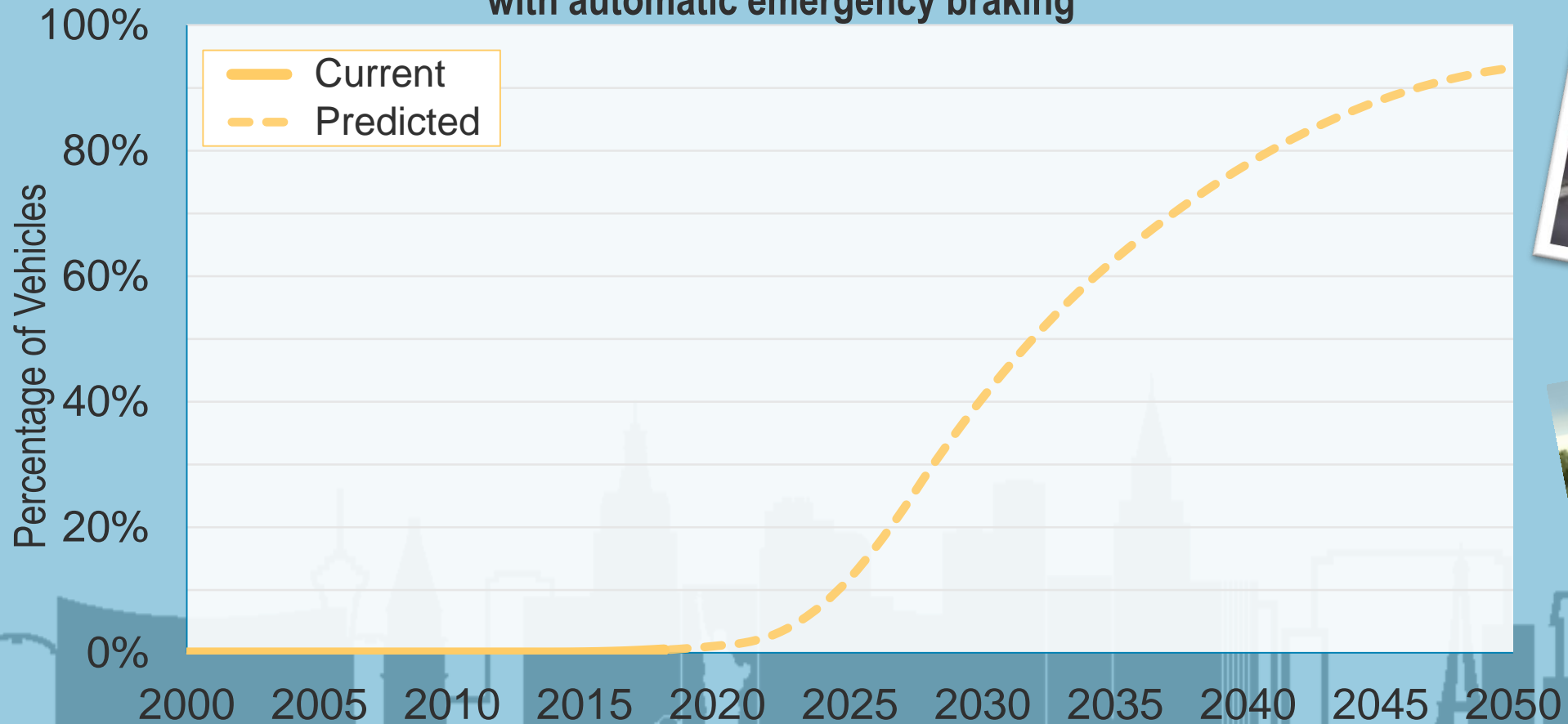
Front Crash Prevention

Predicted percentage of registered vehicles with front crash prevention



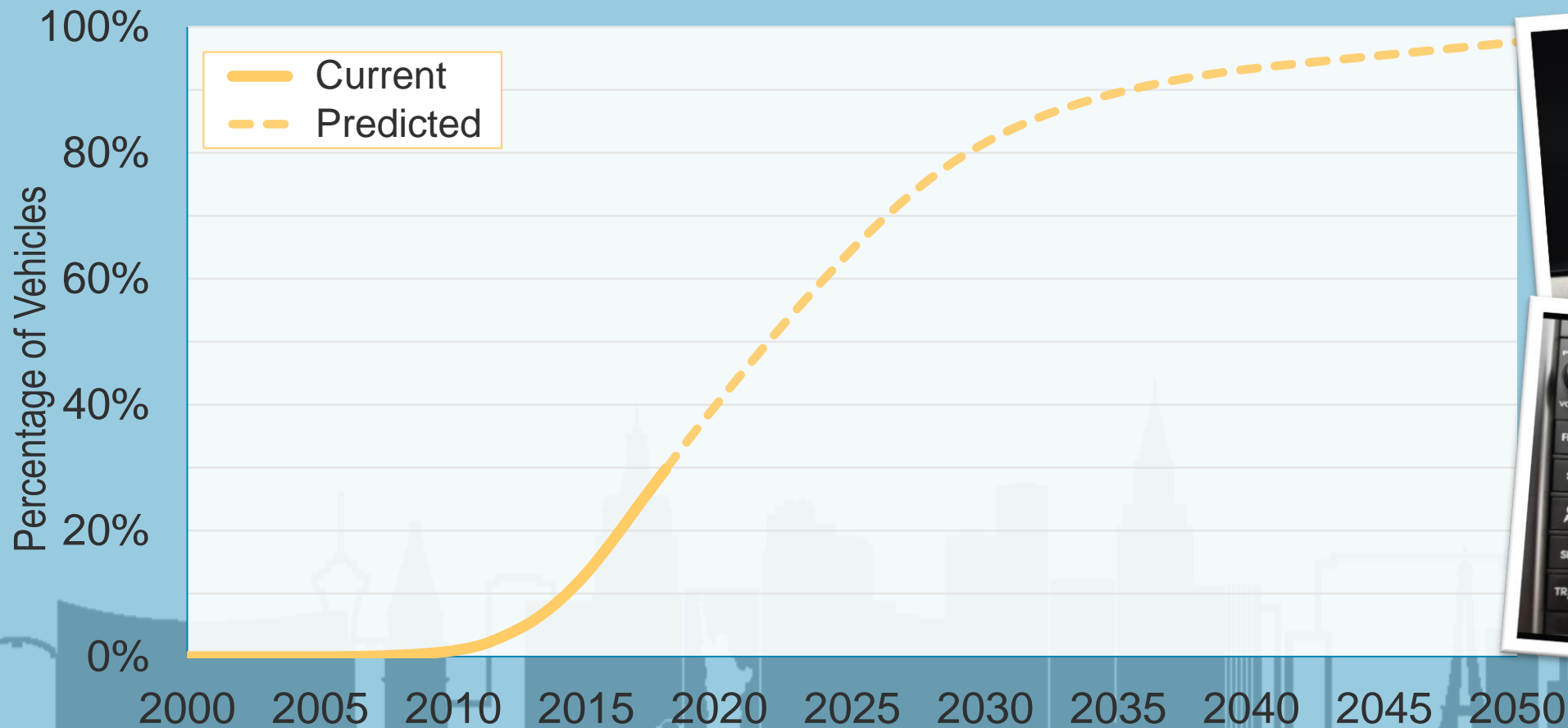
Auto Emergency Braking

Predicted percentage of registered vehicles with automatic emergency braking



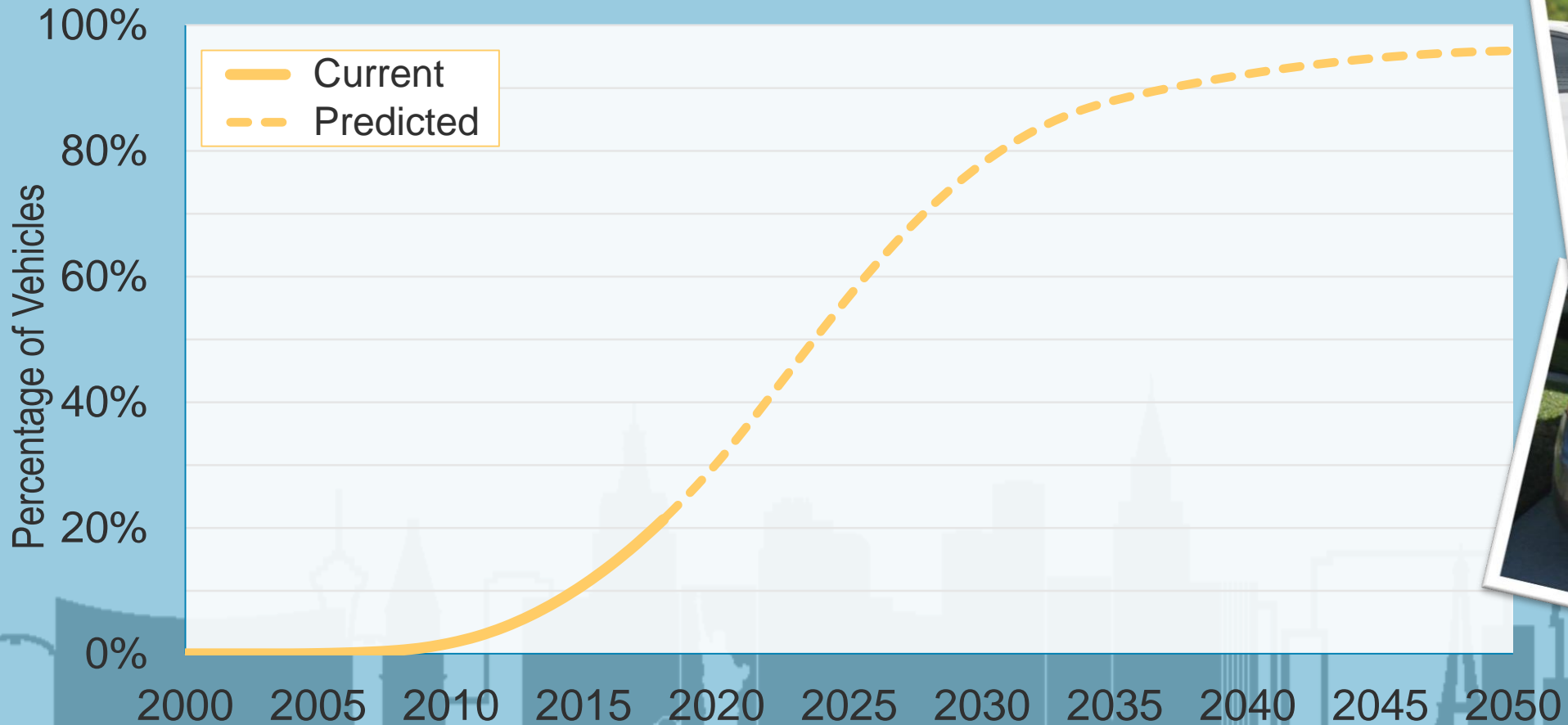
Back-up Camera

Predicted percentage of registered vehicles with rear camera



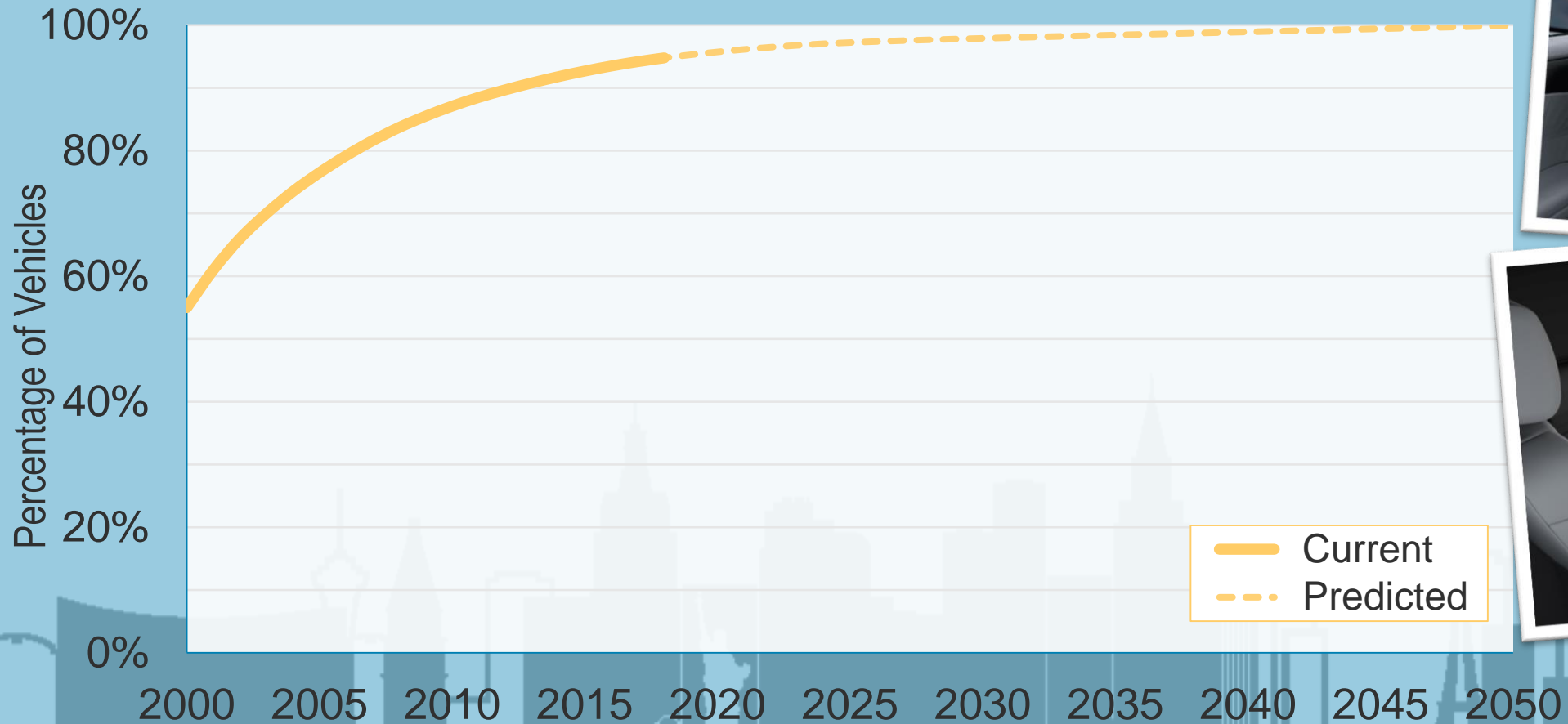
Rear Parking Sensors

Predicted percentage of registered vehicles with rear parking sensors



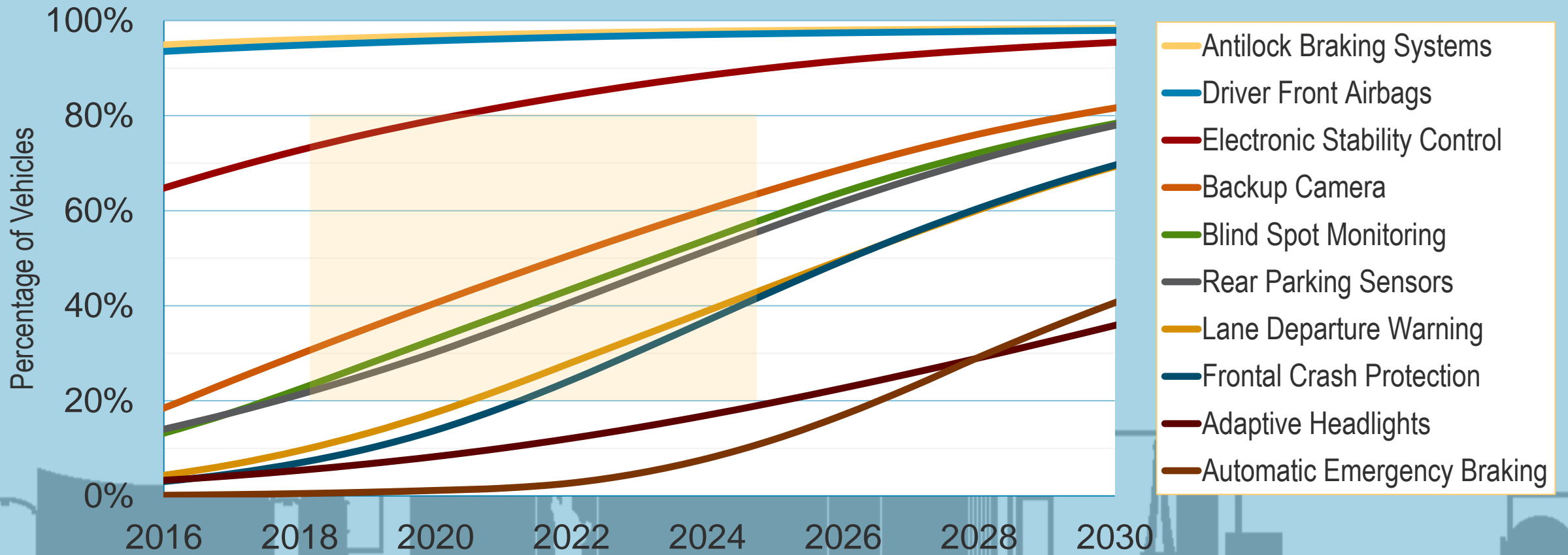
Driver Front Airbags

Predicted percentage of registered vehicles with Driver Front Airbags



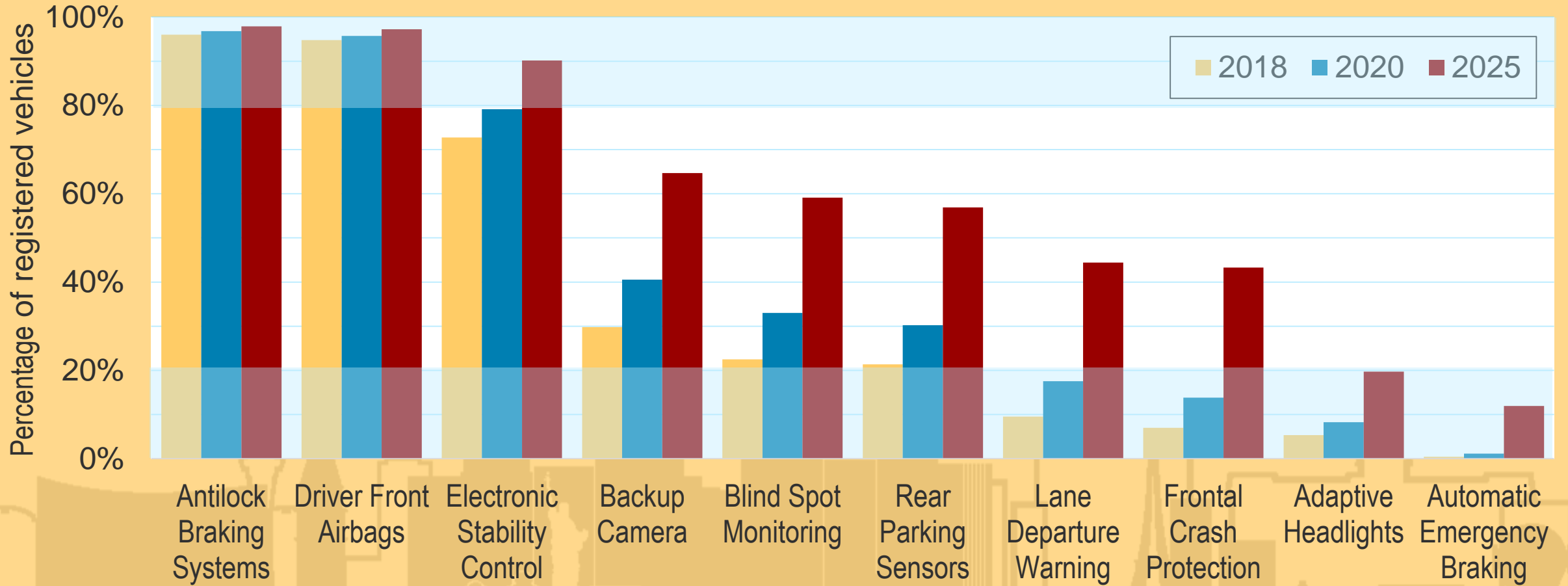
Safety Equipment - Looking into the Future

Predicted percentage of registered vehicles fitted with safety equipment



Safety Equipment – Next 5 Years

Predicted percentage of registered vehicles fitted with safety equipment



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

**IHS
HLDI**

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MORE INFORMATION. BETTER DECISIONS.

VEHICLE HISTORY

Insurance scoring for your car

Quiz Question:

Which of the following vehicles would you rather insure?

A

2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$15,592

B

2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$14,951

C

2012 Ford Explorer
280HP V-6 FWD

Symbol 18
Value: \$7,247

D

2012 Ford Explorer XLT
290HP V-6 FWD

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!



2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$15,592



2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$14,951



2012 Ford Explorer
280HP V-6 FWD

Symbol 18
Value: \$7,247



2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$5,190

Which of the following vehicles would you rather insure?

A

2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$15,592

- Odometer: 75,284
- 1 owner
- Personal Use
- Complete service history
- Clean CARFAX report

B

2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$14,951

- Odometer: 62,863
- 2 owners
- Registered for commercial use
- Some service records
- 1 minor accident

C

2012 Ford Explorer
280HP V-6 FWD

Symbol 18
Value: \$7,247

- Odometer: 192,926
- 2 owners
- Formerly registered for police use
- No service records
- Body damage reported

D

2012 Ford Explorer XLT
290HP V-6 FWD

Symbol 18
Value: \$5,190

- Odometer: 261,336
- 4 owners
- 2 severe accidents
- Frame damage reported
- Stolen
- Salvage title

What is *vehicle history*?

CARFAX CARFAX® Vehicle History Report™ US \$39.99
An independent company established in 1986

Vehicle Information:
2012 NISSAN ALTIMA 2.5/2.5 S
VIN: 1N4AL2AP0CC152436
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

	Owners 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 the information in this section

	Owners 1-2	Owner 3	Owner 4
Salvage Junk Rebuilt Fire Flood Hail Lemon ALERT!	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	Purchased:	Type:	Where:	Est. miles/year:	Est. length owned:	Tranid:	Load Date:	Date:	Mileage:	Source:	Comments:
Owner 1	2011	Personal lease	New Jersey, New York	6,330/yr	11/15/11 - 1/25/13 (1 yr. 2 mo.)	CV20DM	05/03/2013	09/22/2011	10	NICB	and shipped to New Jersey Vehicle manufactured
Owner 2	2013	Personal	New York, New Jersey	5/2/13 - 9/9/13 (4 months)		CV2NBNJ	05/09/2013	05/02/2013	14,085	New York Motor Vehicle Dept. Valley Stream, NY	New owner reported SALVAGE TITLE/CERTIFICATE ISSUED REBUILT TITLE ISSUED
Owner 3	2013	Taxi	New Jersey, New York	9/9/13 - 9/25/14 (1 year)		CV2NBNJ	10/09/2013	09/09/2013	14,085	New Jersey Motor Vehicle Dept. Bayonne, NJ	Registration issued or renewed Vehicle color noted as Black
Owner 4	2014	Taxi	New York	49,011/yr	9/25/14 - present (2 yrs. 4 mo.)	CV20MR	08/22/2015	10/24/2014	42,575	New York Motor Vehicle Dept. Brooklyn, NY	New owner reported SALVAGE TITLE/CERTIFICATE ISSUED REBUILT TITLE ISSUED Titled or registered as taxi
						CV20MQ	02/03/2015	12/01/2014	60,541	New York Inspection Station	Accident reported with another motor vehicle Passed safety inspection Passed emissions inspection View what was inspected
						CV20MQ	05/05/2015	04/14/2015	73,857	New York Inspection Station	Passed safety inspection Passed emissions inspection View what was inspected
						CV2NYFNY	07/05/2015	06/29/2015	80,747	New York Motor Vehicle Dept. Brooklyn, NY	Registration issued or renewed Titled or registered as taxi Passed safety inspection
						CV20MQ	08/28/2015	08/04/2015	100,101	New York Inspection Station	Passed safety inspection Passed emissions inspection View what was inspected
						CV20MQ	10/12/2015	10/08/2015	119,489	New York Inspection Station	Passed safety inspection Passed emissions inspection View what was inspected
						CV20MQ	03/07/2016	03/02/2016	140,732	New York Inspection Station	Registration issued or renewed Titled or registered as taxi Passed safety inspection Passed emissions inspection View what was inspected
						CV2NYFNY	07/04/2016	06/27/2016		New York Motor Vehicle Dept. Brooklyn, NY	Failed safety inspection Passed emissions inspection View what was inspected
						CV20MQ	07/18/2016	07/05/2016		New York Inspection Station	Passed safety inspection Passed emissions inspection View what was inspected
						CV20MQ	12/08/2016	12/01/2016		New York Inspection Station	Passed safety inspection Passed emissions inspection View what was inspected



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

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

Ownership History

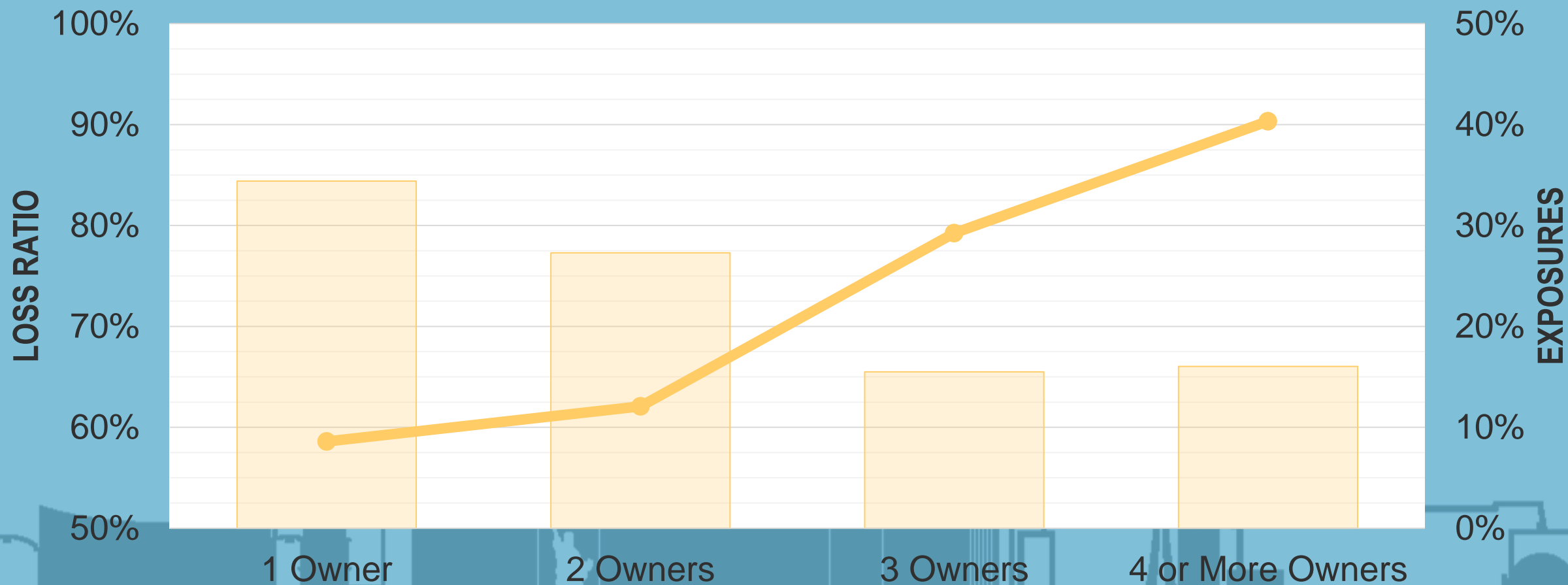
Number of Owners

- 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.



Lift from Number of Owners

Univariate Analysis



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

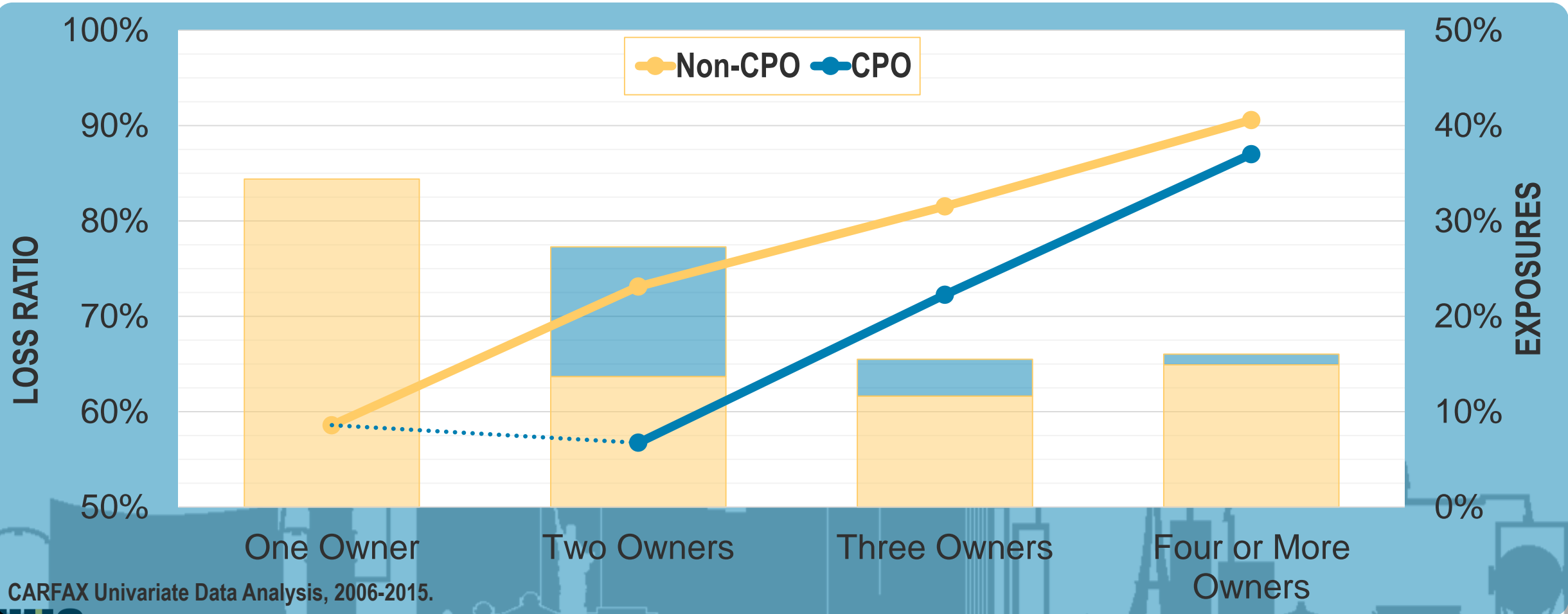
Certified
Pre-Owned



Certified Pre-Owned
by BMW

Lift from Number of Owners with CPO

Univariate Analysis



CARFAX Univariate Data Analysis, 2006-2015.



CARFAX Univariate Data Analysis, 2006-2015.



Ownership History

Current Owner Length of Ownership

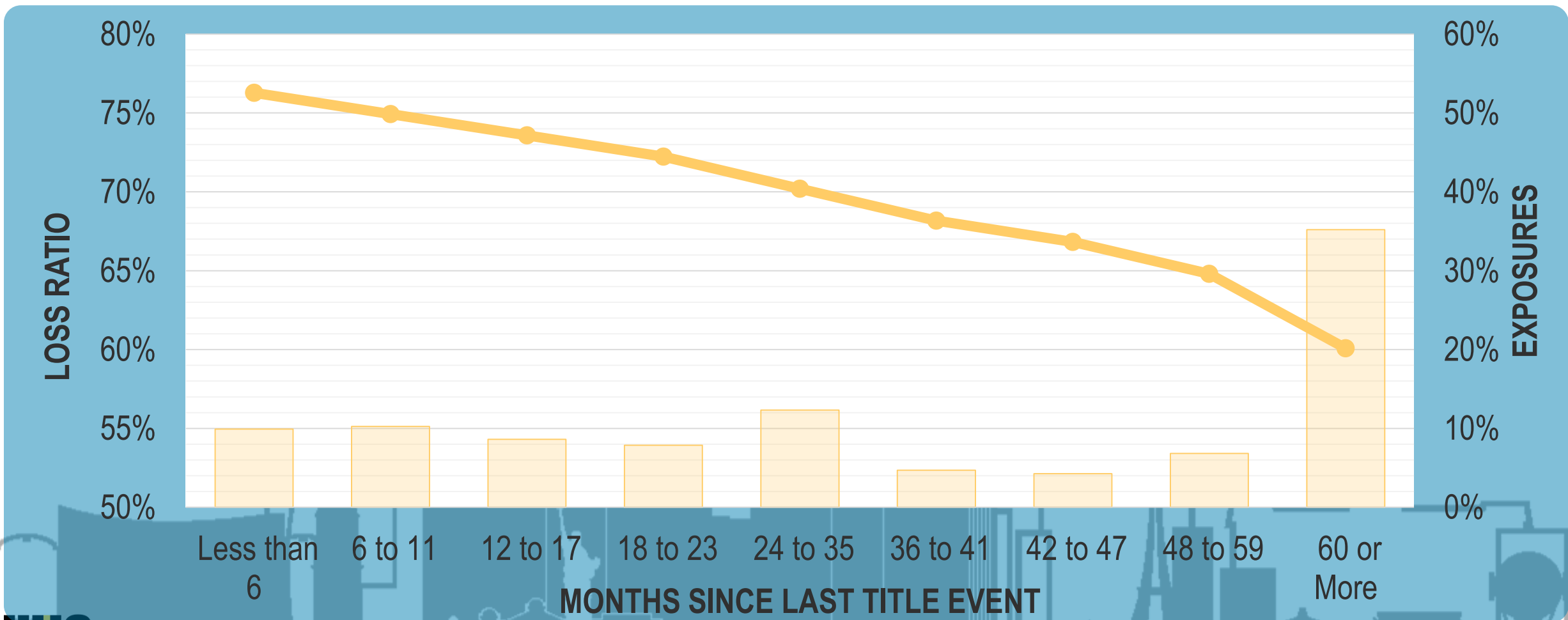
CARFAX studies show that the longer a car is owned, the better the risk becomes.

- 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.



Lift from Length of Ownership

Univariate Analysis



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



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

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

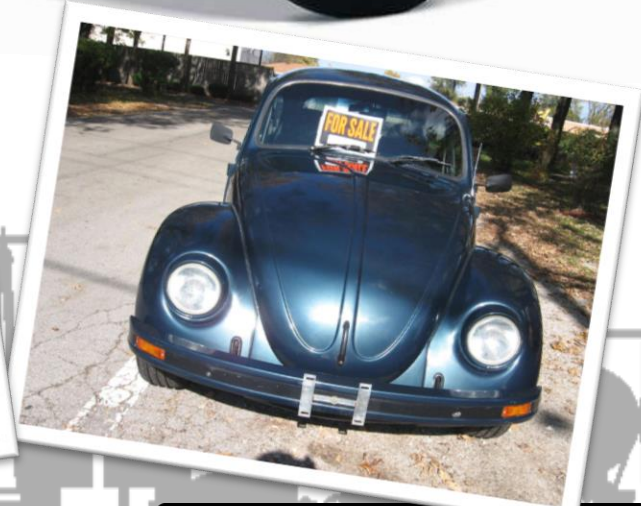
- Comprehensive Only for part of year
 - Tend to be well-maintained
 - Usually lower mileage
 - Check driver-to-vehicle ratio
- Gaps in Liability coverage
 - Liability only coverage
 - Low liability limits



Vehicle Use

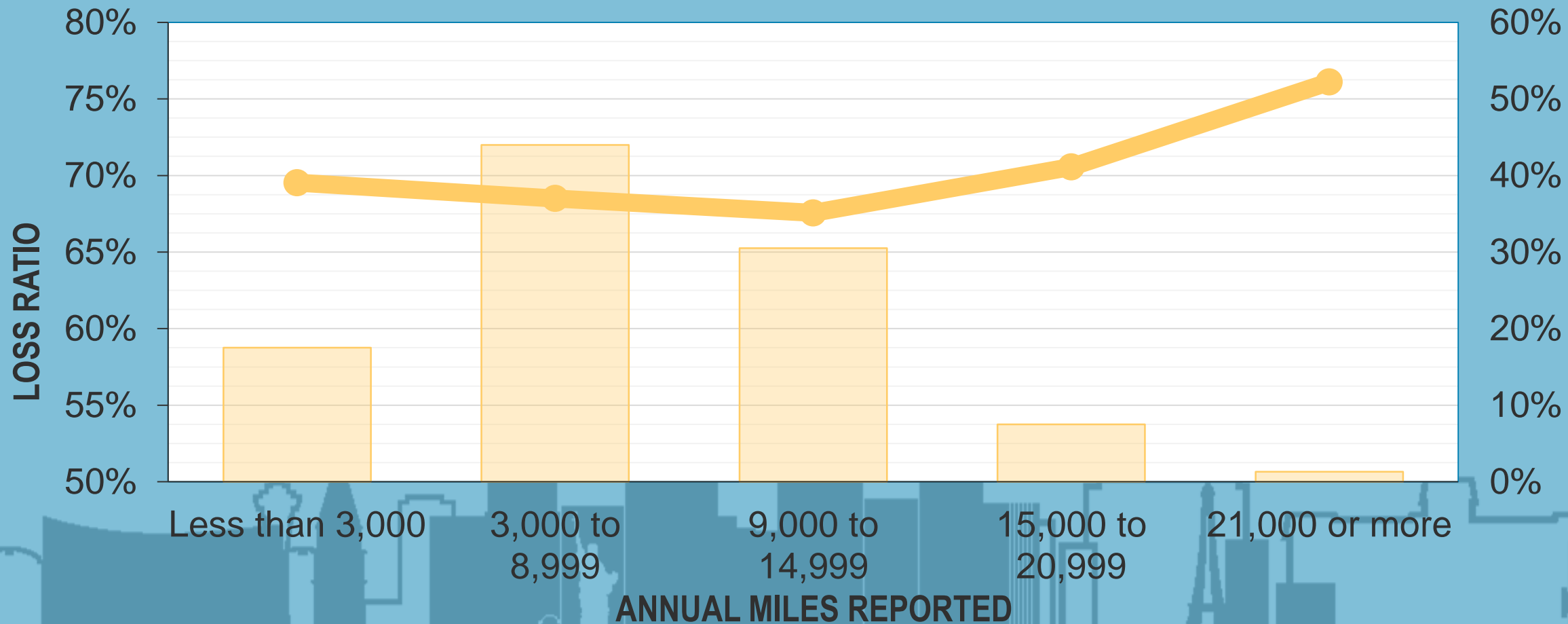
Grey Market Vehicles

- 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



Vehicle Use

Lift from Self-Reported Mileage



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.

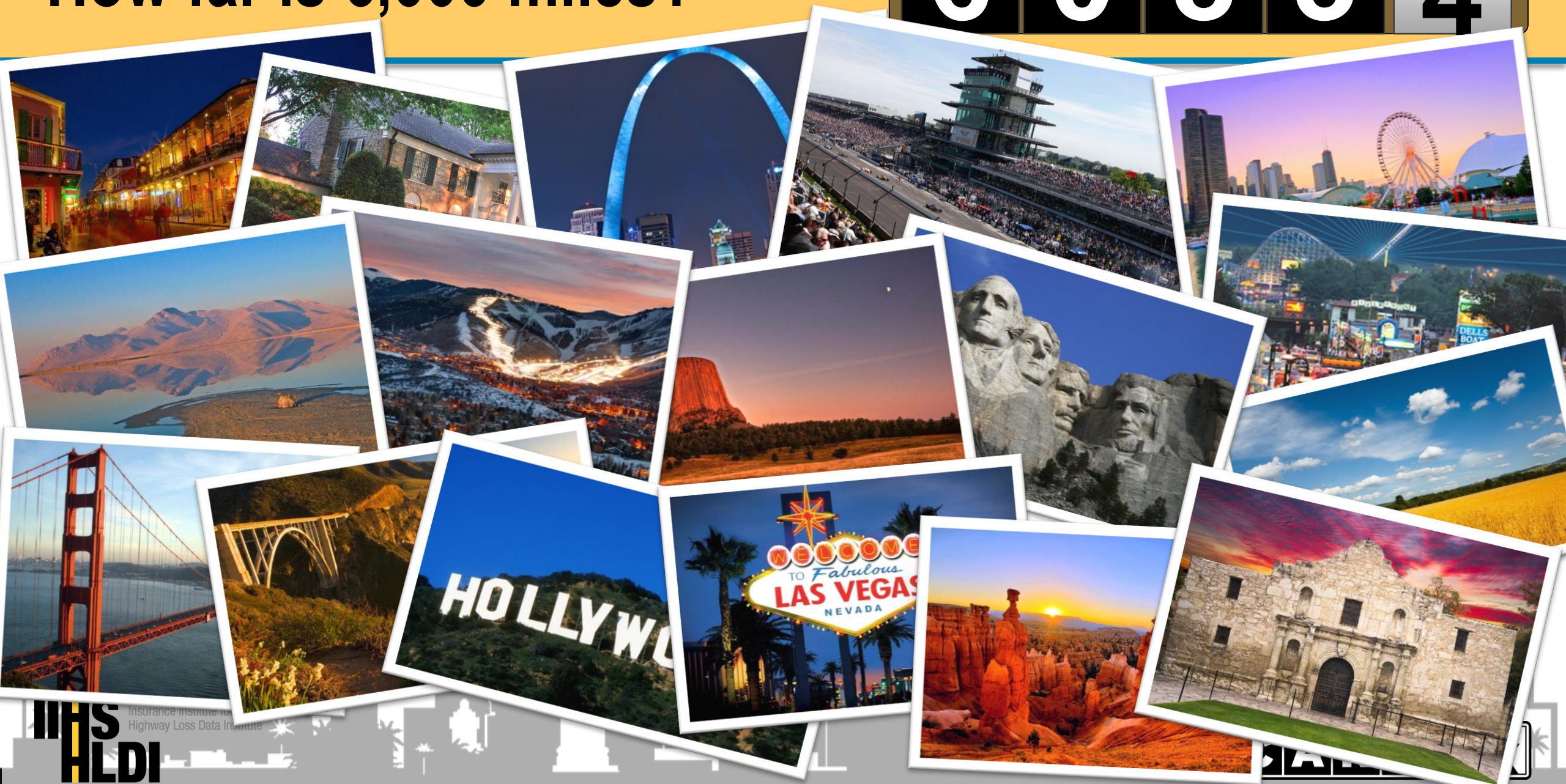
Self-Reported Mileage

- 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



How far is 6,000 miles?

6 0 8 3 4



Vehicle Use

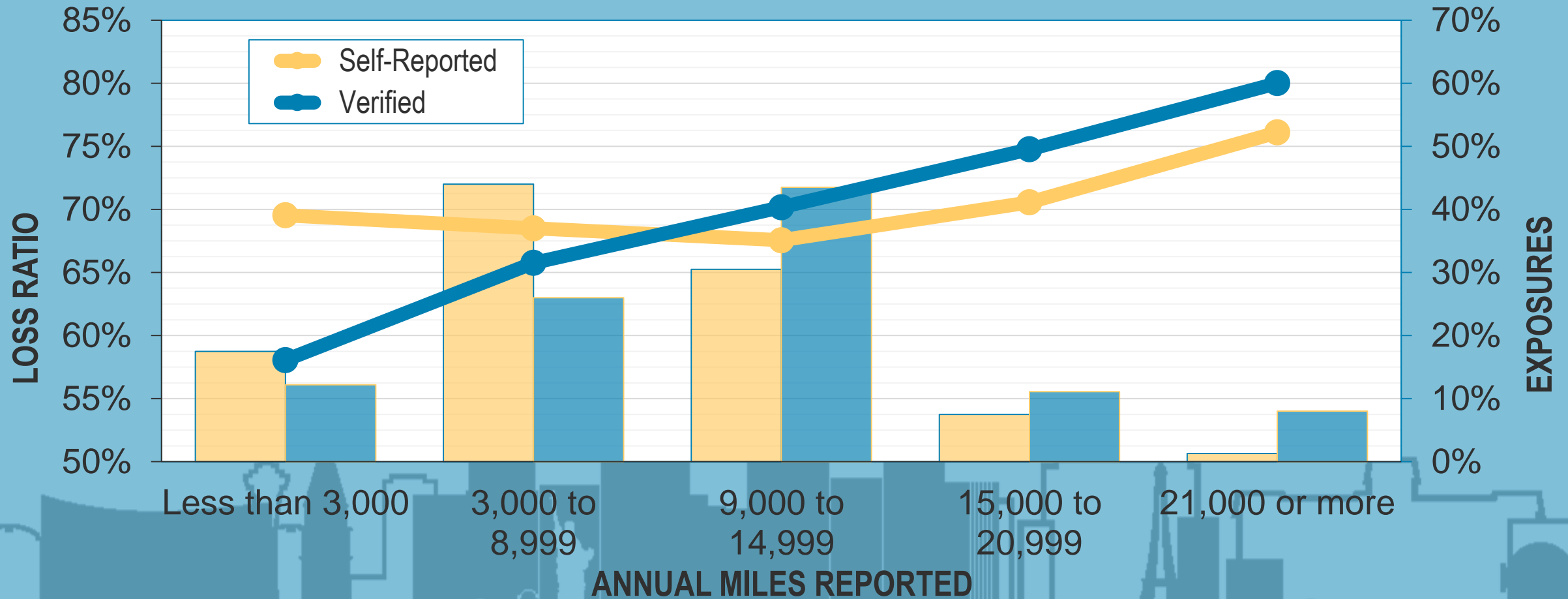
Verified Average Mileage

- 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.



Lift from Annual Mileage

Univariate Analysis



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

Vehicle Condition

Severe Accidents

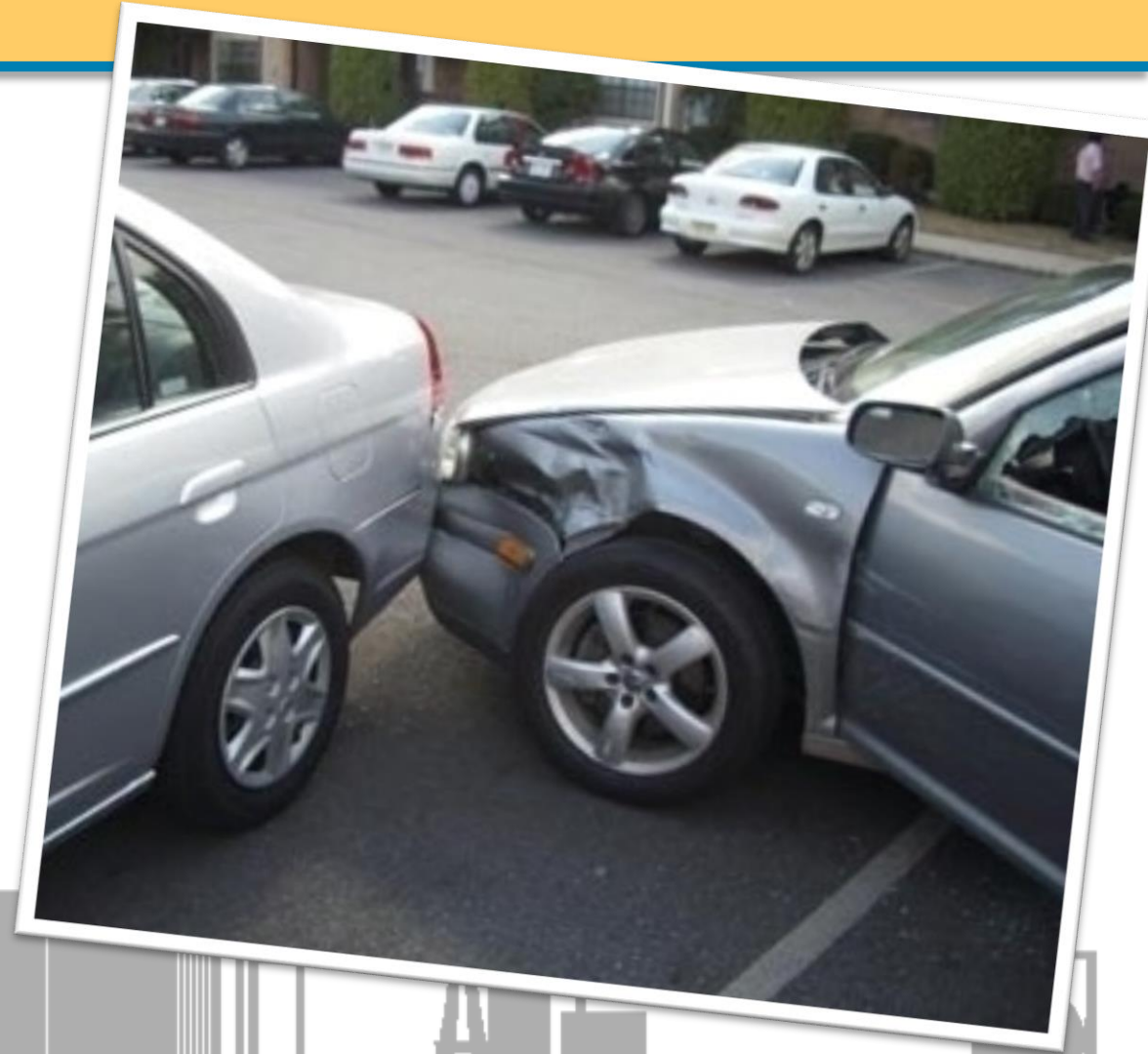


- Structural integrity is compromised
- Many sensitive parts may be improperly installed or remain unrepaired
- Low-quality aftermarket parts are prone to failure

Vehicle Condition

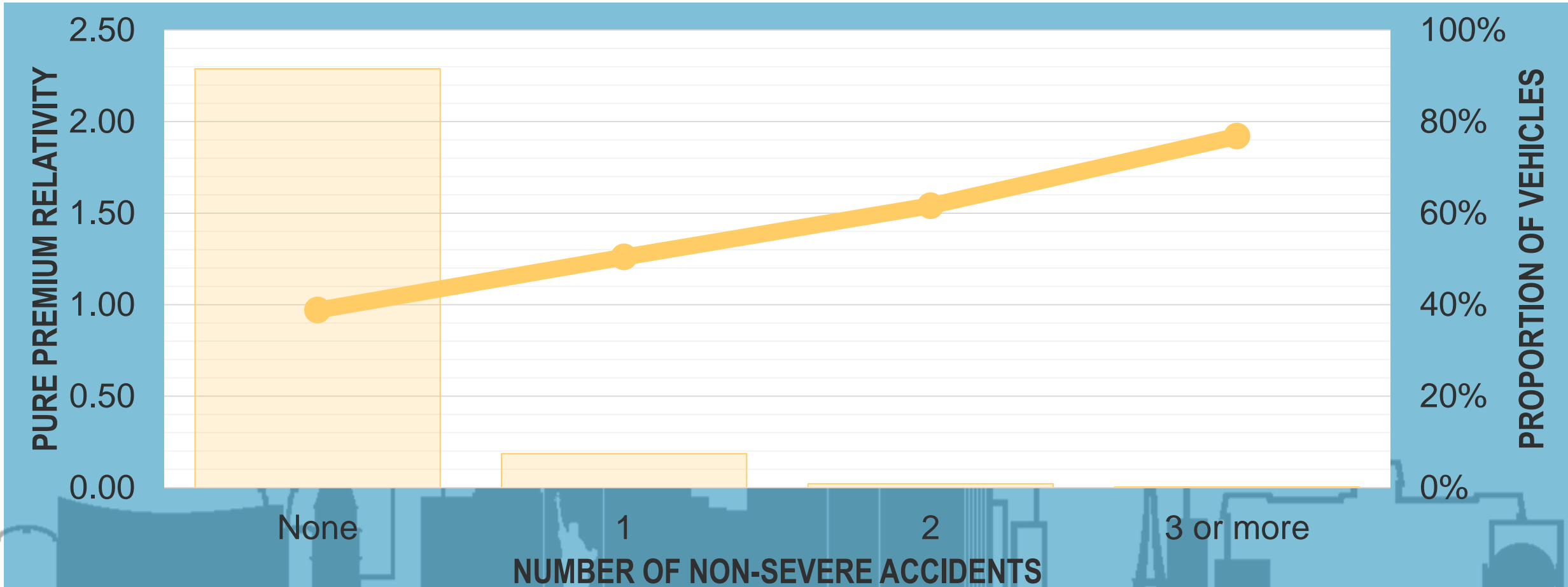
Minor Accidents

- 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



Lift from Non-Severe Accidents

Univariate Analysis



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

Flood Vehicles Hurricane Harvey



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



Vehicle Condition Branded Titles

Salvage Titles

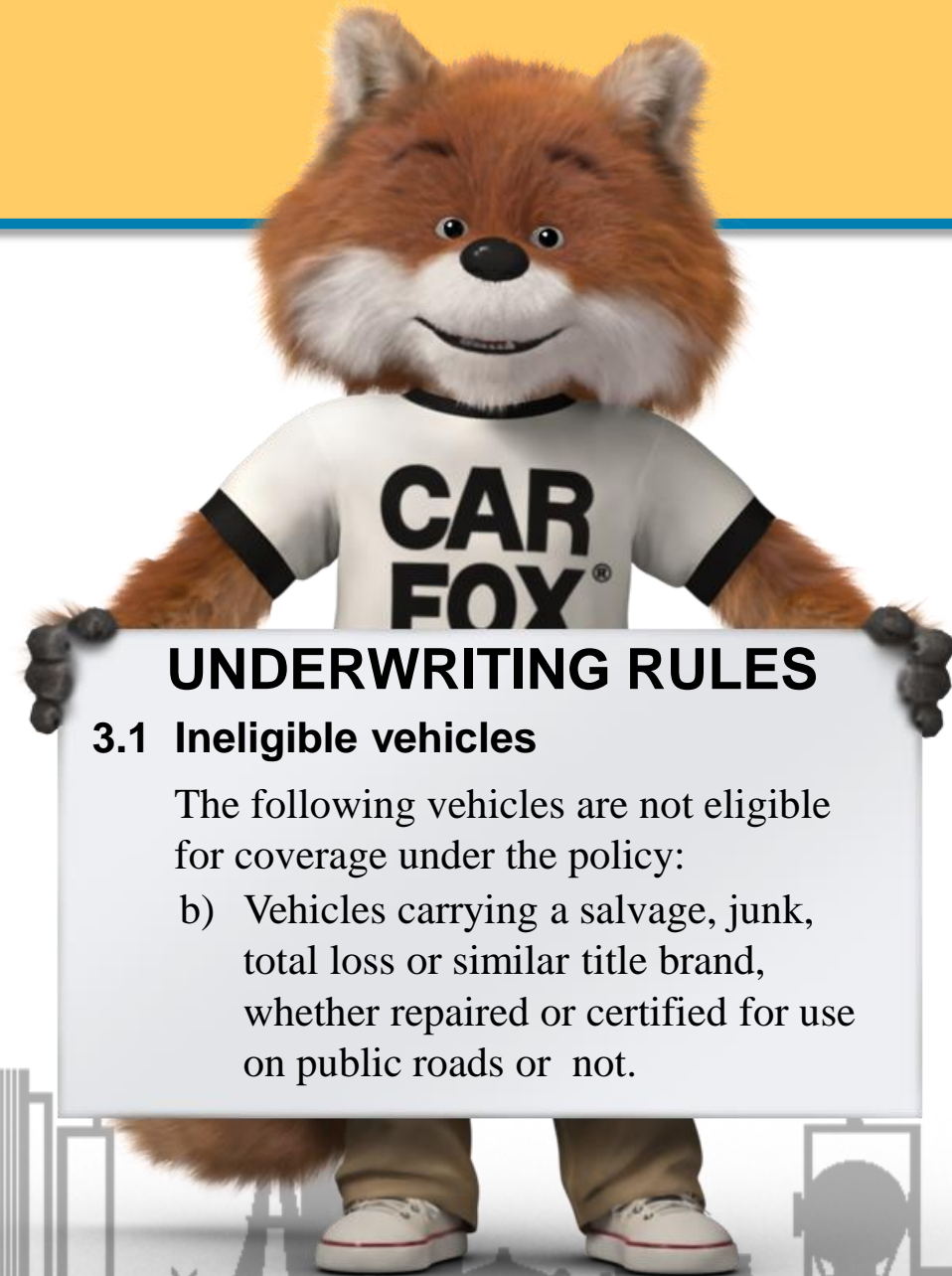
- Precluded by many underwriting plans
- Need copy of title

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



UNDERWRITING RULES

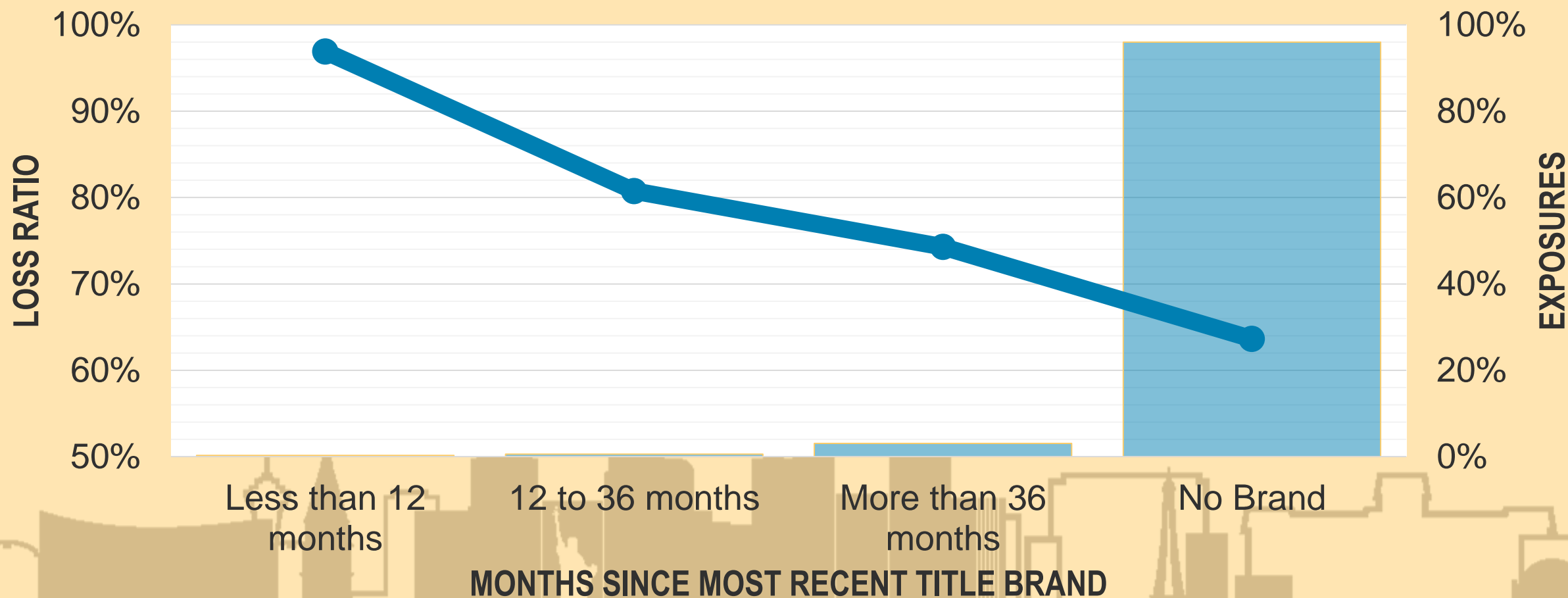
3.1 Ineligible vehicles

The following vehicles are not eligible for coverage under the policy:

- b) Vehicles carrying a salvage, junk, total loss or similar title brand, whether repaired or certified for use on public roads or not.

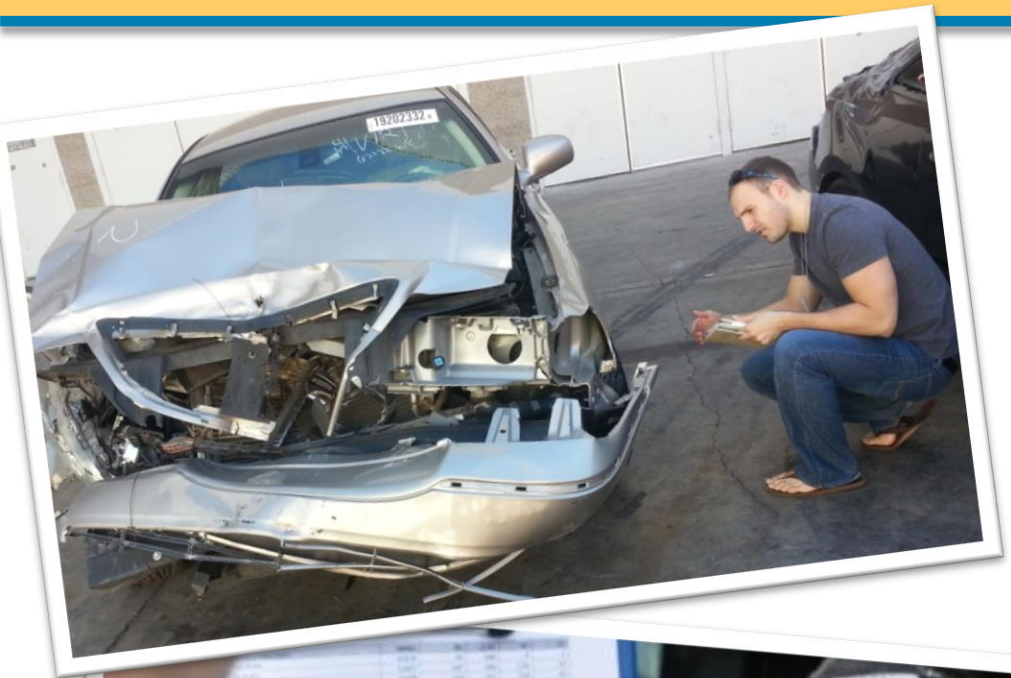
Lift from Branded Titles over Time

Univariate Analysis



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

Vehicle Condition

Potential Damage

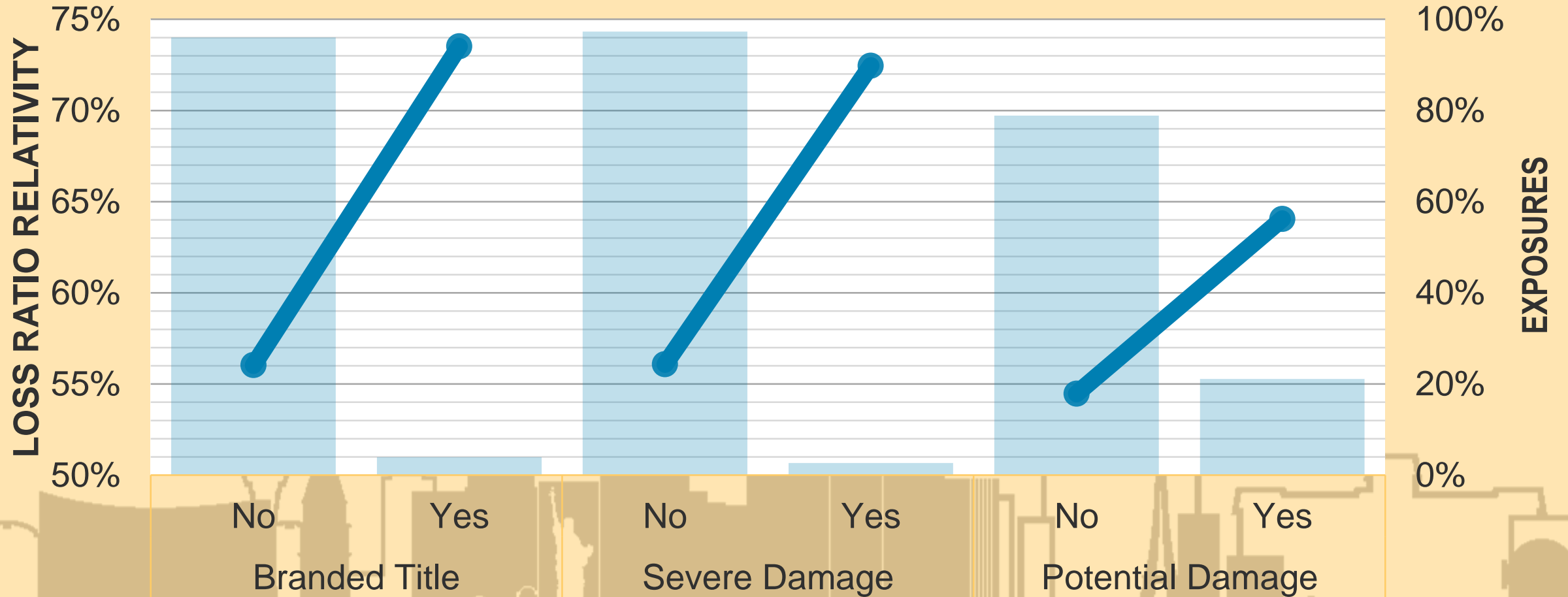
Indications of damage that is likely to affect insurability

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



Lift from Vehicle Damage

Univariate Analysis



Vehicle Condition

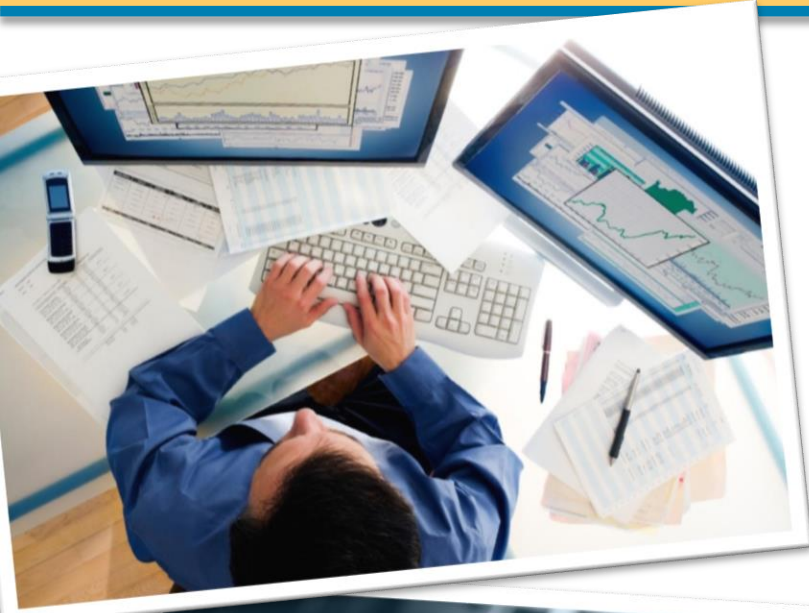
Service History

- 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

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



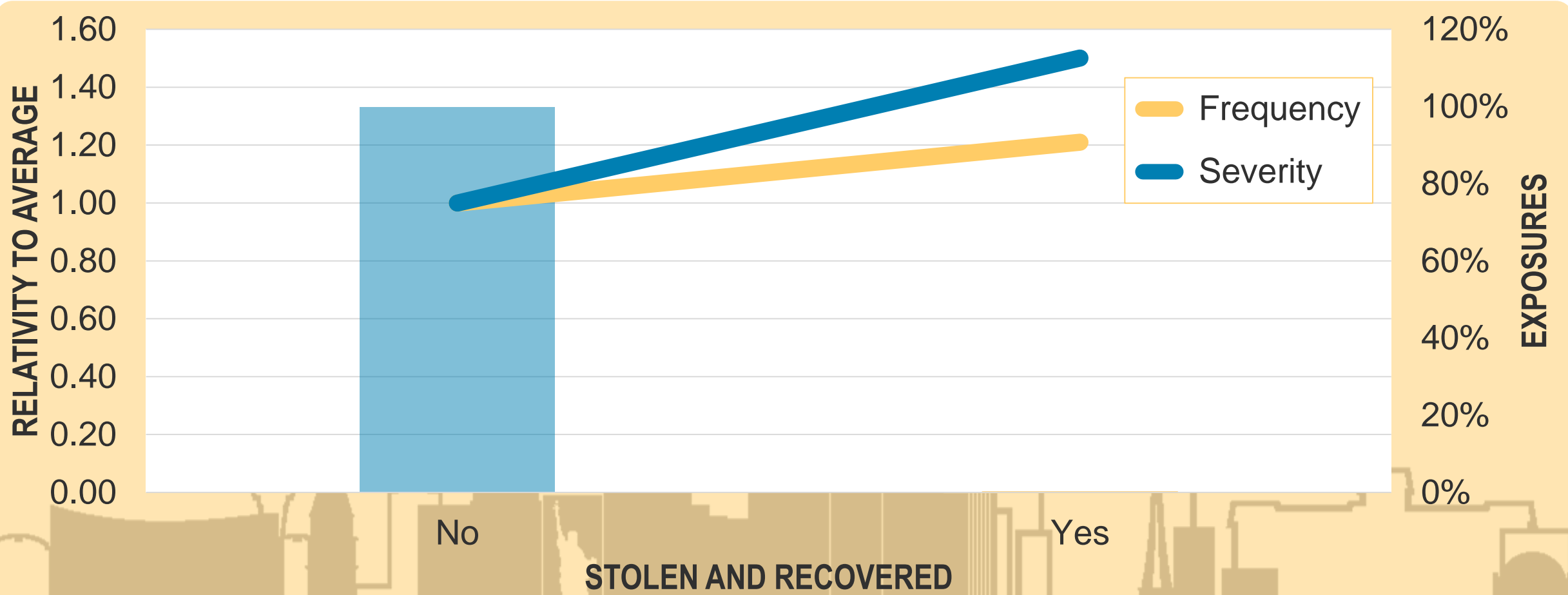
Vehicle Condition Stolen and Recovered

- 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

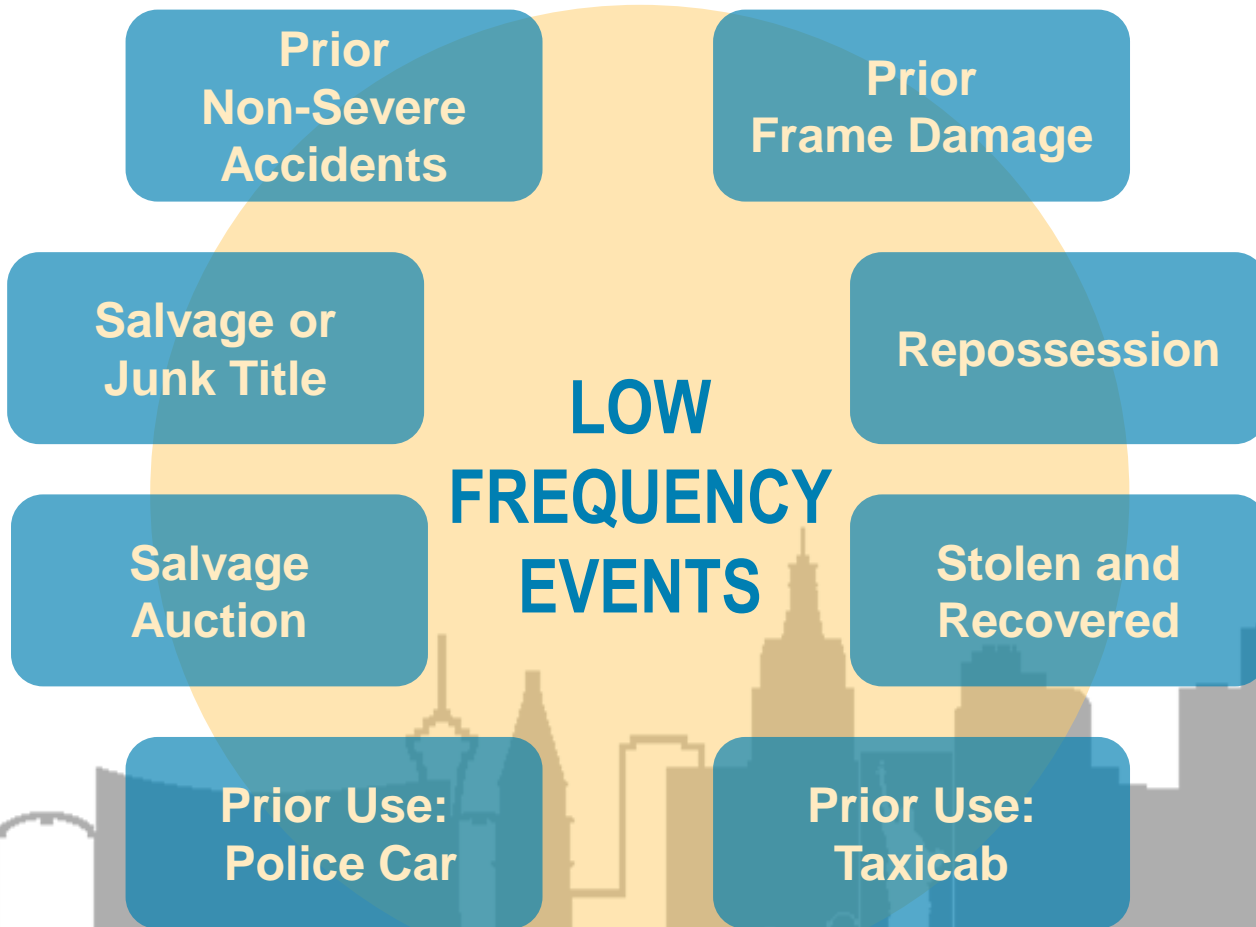


Lift from Stolen and Recovered Indicator

Univariate Results



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

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

**IHS
HLDI**

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MORE INFORMATION. BETTER DECISIONS.

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



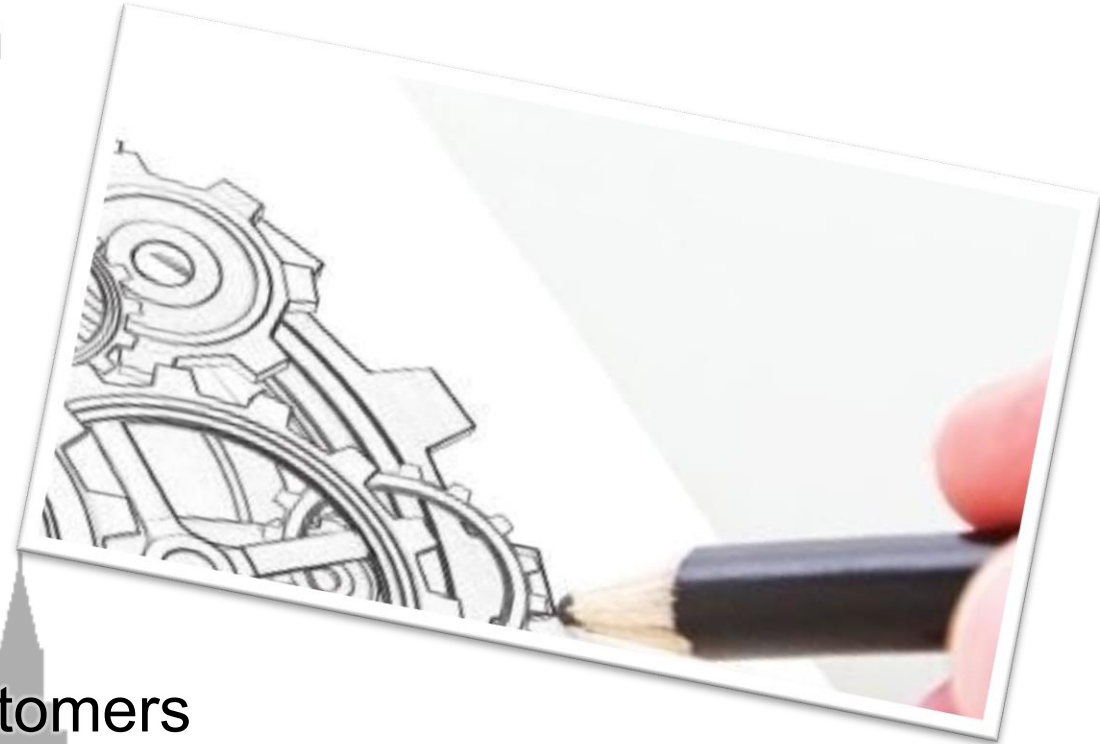
Use in Rating



- 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

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