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# Model Year and Vehicle Rating

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CAS RPM Seminar  
Las Vegas, NV

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# Discussion Topics

- Model Year Rating
- Vehicle Rating
- Liability Vehicle Rating
- GLM applications
- Crash simulation and Telematics

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# Distant Yesterday

- Based upon MSRP.
- Applied only to 1<sup>st</sup> party property coverages.
- Same Symbol for both Comprehensive and Collision.
- Combined with “Age” as opposed to “Model Year” Rating.

# Yesterday

- Late 70's 2 significant changes
  - Introduction of Model Year Rating
  - Introduction of Damageability/Repairability into Symbol

# Model Year Rating

Age	Factor	Model Year	Factor
		$X + 2$	$(1.05)(1.05)$
		$X + 1$	1.05
1	1.00	X	1.00
2,3	0.85	$X - 1$	0.95
4,5	0.75	$X - 2$	0.90
6 & over	0.65	$X - 3$	0.85

# Model Year Rating

- Typically uses constant multiplicative relationship between model years
- Typically 5% for Comprehensive and Collision
- Limited to X model years with catch all for older vehicles

# Model Year Rating

- Created a mechanism by which individual vehicle model years could be recognized – ***not really utilized except by several innovators.***
- Some companies are using for Liability coverages –inconsistent - some positive, some negative – overlaps with mileage

# Model Year

- The ability to use Model Year effectively together with specific models has not been realized.
  - **E.G. If the 1995 Honda Civic or 2003 Dodge Ram Pickup has the highest theft rate as recently published – shouldn't it have a higher rate than the later models?**

# Stolen Cars Vary By Model Year



**2005 HOT WHEELS**  
NICB'S LIST OF AMERICA'S MOST STOLEN VEHICLES

**TOP 10 STOLEN VEHICLES**

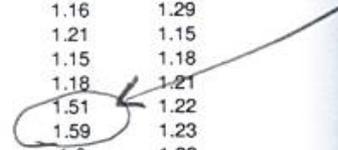
1. 1995 Honda Civic
2. 1989 Toyota Camry
3. 1991 Honda Accord
4. 1994 Dodge Caravan
5. 1994 Chevrolet Full Size C/K 1500 Pickup
6. 1997 Ford F150 Series
7. 2003 Dodge Ram Pickup
8. 1990 Acura Integra
9. 1988 Toyota Pickup
10. 1991 Nissan Sentra

# Progressive Rating

	Class	MM	Symbol	
1995 Honda Civic	HC1	0.99	5	
1989 Toyota Camry	TC1	0.96	8	
1991 Honda Accord	HA1	1.23	11	92-93 factor, 1.33 for '94-98, drops to .75 in 98
1994 Dodge Caravan	DG1	0.99	8	
1990 Acura Integra	AI1	0.99	14	
1991 Nissan Sentra	NS1	0.9	5	

Year	Make	Model	BEPS	Coll	Comp	PIP
2004	GMC	YUKON/DENALI XL 1500	1.26	1.01	1.91	0.99
2005	GMC	YUKON/DENALI XL 1500	1.28	1.23	1.97	0.95
2006	GMC	YUKON/DENALI XL 1500	1.32	1.3	2.18	0.93
2007	GMC	YUKON/DENALI XL 1500	1.32	1.3	2.18	0.9
2000	GMC	YUKON/DENALI XL 2500	1.41	0.98	1.85	1.03
1981	HONDA	ACCORD	0.91	0.58	0.81	1.18
1982	HONDA	ACCORD	0.86	0.6	0.73	1.08
1983	HONDA	ACCORD	0.88	0.63	0.69	1.12
1984	HONDA	ACCORD	0.92	0.78	0.86	1.11
1985	HONDA	ACCORD	0.87	0.79	0.84	1.14
1986	HONDA	ACCORD	0.97	0.86	0.96	1.12
1987	HONDA	ACCORD	1	1.04	0.97	1.19
1988	HONDA	ACCORD	0.93	0.97	0.99	1.21
1989	HONDA	ACCORD	0.92	1.07	0.99	1.13
1990	HONDA	ACCORD	1.04	1.11	1.16	1.29
1991	HONDA	ACCORD	1.02	1.11	1.21	1.15
1992	HONDA	ACCORD	0.99	1.04	1.15	1.18
1993	HONDA	ACCORD	1.02	1.11	1.18	1.21
1994	HONDA	ACCORD	1.07	1.18	1.51	1.22
1995	HONDA	ACCORD	0.99	1.22	1.59	1.23
1996	HONDA	ACCORD	0.97	1.16	1.6	1.22
1997	HONDA	ACCORD	1.04	1.12	1.52	1.21
1998	HONDA	ACCORD	0.99	0.98	1.07	1.23
1999	HONDA	ACCORD	1.13	0.99	1.07	1.25
2000	HONDA	ACCORD	1.04	0.96	0.98	1.22
2001	HONDA	ACCORD	1.02	1.04	1	1.19
2002	HONDA	ACCORD	1.05	1.09	0.98	1.21
2003	HONDA	ACCORD	1.07	1.27	1.21	1.24
2004	HONDA	ACCORD	1.04	1.3	1.07	1.15
2005	HONDA	ACCORD	1.02	1.41	1.16	1.12
2005	HONDA	ACCORD HYBRID	1.02	1.41	1.16	1.12
2006	HONDA	ACCORD	0.96	1.47	1.27	1.03
2006	HONDA	ACCORD HYBRID	0.96	1.47	1.27	1.03
2007	HONDA	ACCORD	0.95	1.43	1.28	1.05
1981	HONDA	CIVIC	0.89	0.44	0.64	1.18
1982	HONDA	CIVIC	0.87	0.47	0.57	1.14
1983	HONDA	CIVIC	0.86	0.58	0.56	1.23
1984	HONDA	CIVIC	0.83	0.53	0.62	1.02

BEPS Coll Comp PIP



# Luxury vehicle tops insurance claims list

The Cadillac Escalade had the highest rate of insurance theft claims for the fourth straight year, according to a study released Wednesday by the Insurance Institute for Highway Safety.

Highest losses	Claim frequency, per 1,000 insured vehicles	Average payment per claim
Cadillac Escalade	13.2	\$17,913
Mitsubishi Lancer Evolution*	11.9	\$10,326
Dodge Ram 1500 quad cab	11.1	\$10,088
Ford F-250/350 supercrew* **	8.9	\$17,702
Chrysler Sebring***	8.5	\$5,077
<b>Lowest losses</b>		
Toyota Sienna* ***	0.6	\$8,777
Buick LeSabre	0.5	\$4,905
Buick Park Avenue	0.5	\$3,270
Pontiac Vibe*	0.4	\$3,872
Ford Taurus	0.3	\$3,872

\*4WD \*\*2005s only \*\*\*2004-05s

SOURCE: Insurance Institute for Highway Safety

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# Reasons Why Cars Most Stolen

- Parts - Xenon headlights, hubcaps, spoilers
- Street Racing – light cars with big engines
- Desirability - sports and luxury

# Forbes – Luxury Cars only

- **Top 10 Most Stolen Vehicles**
- **Cadillac Escalade**
- **Hummer H2**
- **BMW 7L Series**
- **Honda S2000 Convertible**
- **Lincoln Navigator**
- **Chevrolet Avalanche**
- **Mercedes-Benz S-Class**
- **Chevrolet Corvette**
- **Mercedes-Benz SL-Class Convertible**
- **BMW X5**

# Immobilizer

- 1999 and 2000 Honda Civics do not come with an electronic immobilizer, however all Hondas from 2001 and onward are equipped with an immobilizer. Immobilizers will be mandatory on all new cars sold beginning September 2007. The devices enable an engine computer to recognize an electronic code in the key. If the code in the key and the engine don't match exactly, the vehicle can't be started.

State of Florida  
 Progressive Select Insurance Company  
 Private Passenger Automobile  
 Year Make Model Vehicle Rating Factors

Model Year	Make	Model	SubModel	BIPD	COLL	COMP	PIP
1995	HONDA	CIVIC		0.88	0.93	1.21	1.06
1996	HONDA	CIVIC		0.91	0.97	1.13	1.09
1997	HONDA	CIVIC		0.88	0.96	1.16	1.12
1998	HONDA	CIVIC		0.84	0.91	1.1	1.15
1999	HONDA	CIVIC		0.89	0.98	1.12	1.2
1999	HONDA	CIVIC	SI/SIR	1.05	1.34	4.24	1.16
2000	HONDA	CIVIC		0.92	1.01	1.14	1.15
2000	HONDA	CIVIC	SI/SIR	1.03	1.29	5.28	1.21
2001	HONDA	CIVIC		1.01	1.1	0.95	1.19
2002	HONDA	CIVIC		1.04	1.22	0.99	1.17
2003	HONDA	CIVIC		0.99	1.16	0.94	1.17
2003	HONDA	CIVIC	HYBRID	0.99	1.16	0.94	1.17
2004	HONDA	CIVIC		0.98	1.09	0.8	1.12
2004	HONDA	CIVIC	HYBRID	0.98	1.09	0.8	1.12
2005	HONDA	CIVIC		0.97	1.18	0.78	1.09
2005	HONDA	CIVIC	HYBRID	0.97	1.18	0.78	1.09
2006	HONDA	CIVIC		0.96	1.44	1.07	1.02
2006	HONDA	CIVIC	HYBRID	0.96	1.44	1.07	1.02
2007	HONDA	CIVIC		0.96	1.44	1.07	1.02

# Vehicle Rating

- New Vehicles are usually rated by “comparison to similar” existing vehicle – **becoming less accurate as new, different vehicle type are being introduced.**

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# 2009 Car and Driver

- IN AN EVER-SHRINKING MARKET AND AS GAS PRICES SURGE PAST \$4, THE AUTO INDUSTRY SCRAMBLES TO THINK SMALL.
- 2009 IS SHAPING UP TO BE A CRITICAL YEAR FOR AUTOMAKERS AS THEY RUSH TO REACT TO THE SPECTER OF HIGH FUEL PRICES

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# 2007 Car and Driver

- Every year, it seems, is a banner year for car and truck introductions. And 2007 is no exception. There are now well over 300 models on sale in the U.S., covering every area from mainstream sedans and sport-utes to increasingly popular segments such as crossover SUVs and subcompacts.

# Car and Driver

- The 2006 model year will see the usual sort of turnover, with 50 or so new models arriving and about 30 departing
- “Of the 324 models out there for 2005—by our reckoning—64 qualify as “all-new.”

# Electronic Stability Control

- **Electronic stability control could prevent nearly one-third of all fatal crashes and reduce rollover risk by as much as 80%; effect is found on single- and multiple-vehicle crashes**

# ESC - availability

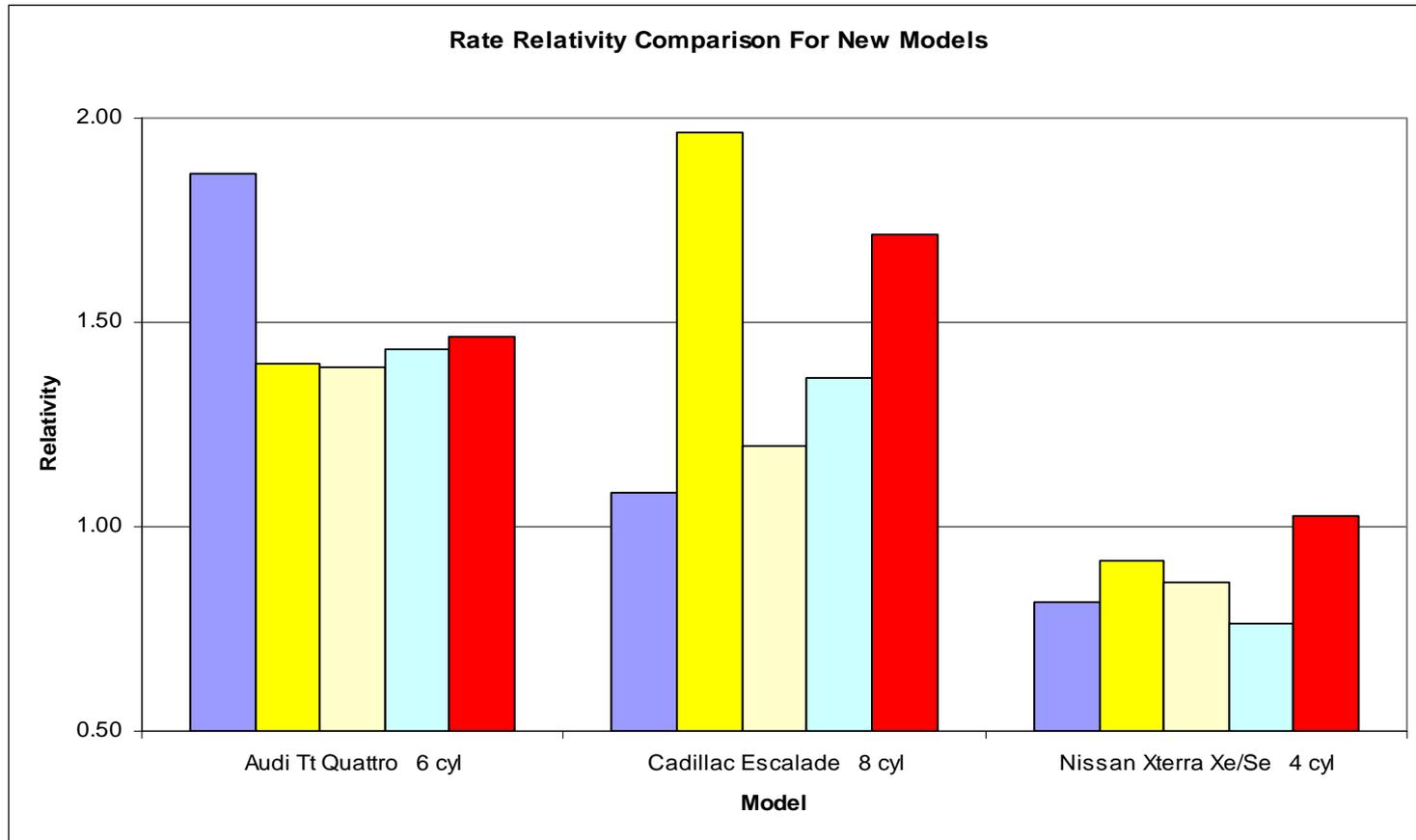
- **ESC is standard on 40 percent of 2006 passenger vehicle models and optional on another 15 percent. It's standard on every 2006 Audi, BMW, Infiniti, Mercedes, and Porsche. Another 8 vehicle makes (Cadillac, Jaguar, Land Rover, Lexus, Mini, Toyota, Volkswagen, and Volvo) offer at least optional ESC on all of their models. But ESC, standard or optional, is limited to 25 percent or fewer models from Chevrolet, Dodge, Ford, Hummer, Mazda, Mitsubishi, Saturn, Subaru, and Suzuki**

# Aluminum Parts, Hybrid Cars Boost Crash Costs

(NU Online News Service, March 3, 12:25  
p.m. EST)

- Auto repair costs are going up in part because of changes in parts and new, more complex vehicles, an insurance information management firm said.

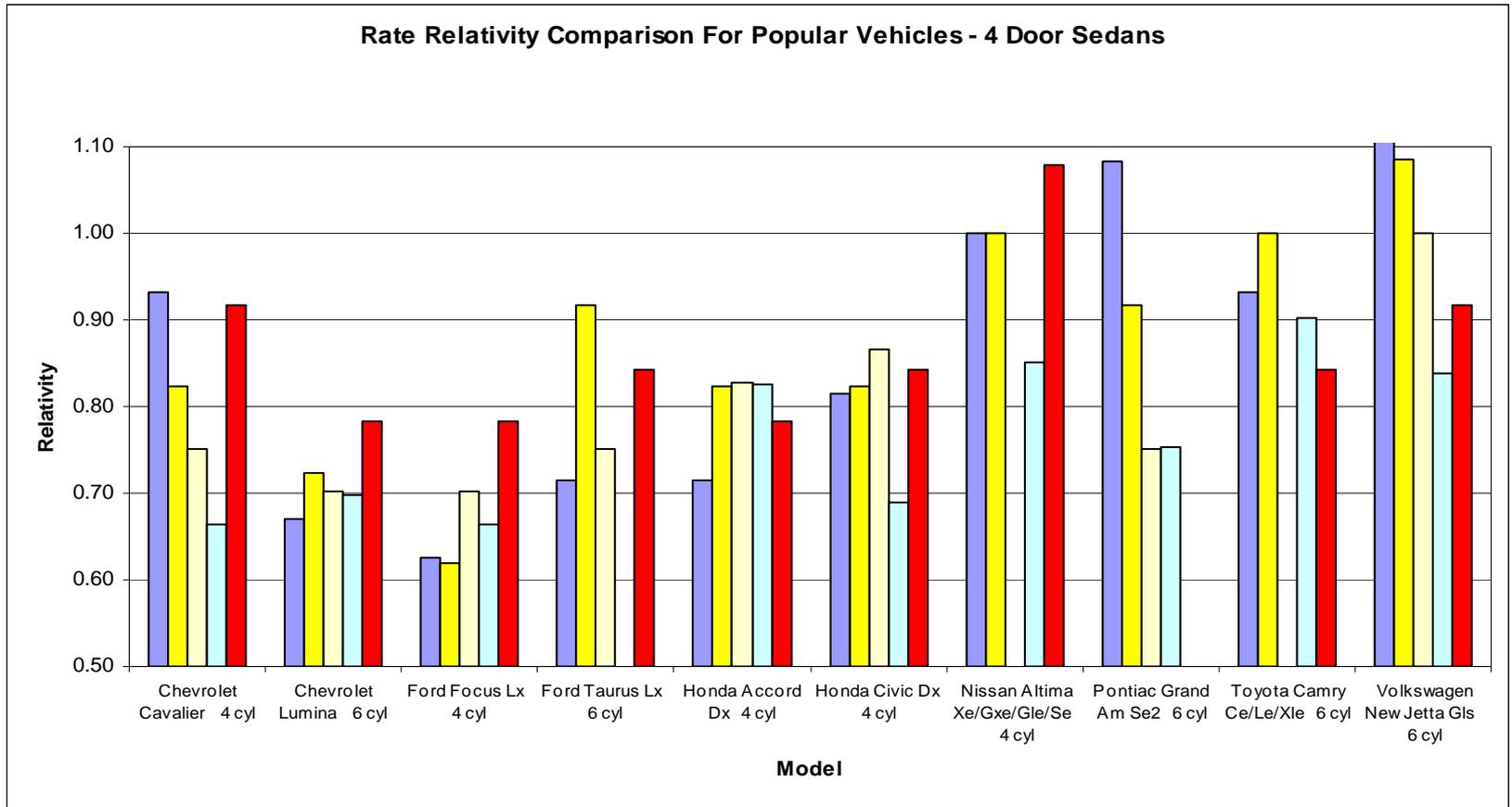
# Significant Differences By Company for New Models



# Significant Differences By Company for New Models

- Difference in rates > 80%
- The Porsche Boxster symbol assignment from inception dropped at least 5 symbols.

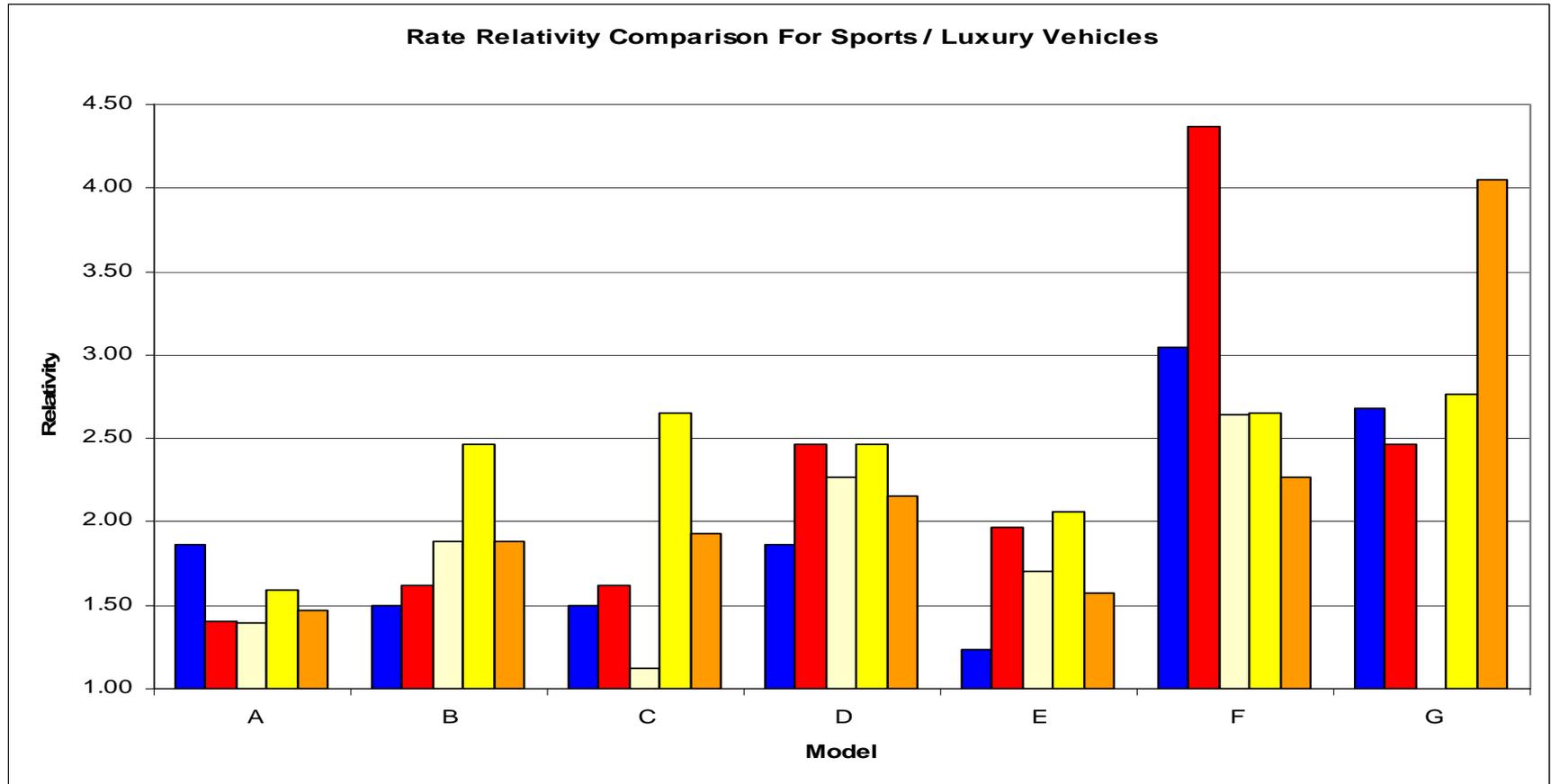
# Significant Differences By Company for Most Popular Models



# Significant Differences By Company for Most Popular Models

- Smallest difference with high and low company is 16%
- Greatest difference is 44%
- Average difference is 28%

# Sports and Luxury Vehicles



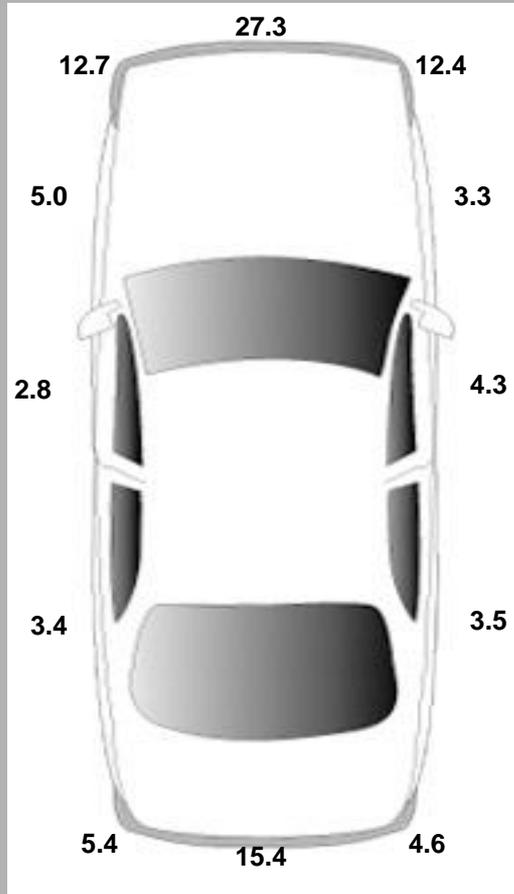
# Sports/Luxury Models

<b>A</b>	<b>AUDI : TT QUATTRO 6 cyl 2 doors COUPE</b>
<b>B</b>	<b>PORSCHE BOXSTER S 6 cyl 2 doors CONVRT</b>
<b>C</b>	<b>CHEVROLET CORVETTE 8 cyl 2 doors HCHBK</b>
<b>D</b>	<b>JAGUAR XJR 8 cyl 4 doors SEDAN</b>
<b>E</b>	<b>MERCEDES-BENZ SLK230 KOMPRESSOR BASE/SPORT 4 cyl 2 doors CONVRT</b>
<b>F</b>	<b>BMW 750IL 12 cyl 4 doors SEDAN</b>
<b>G</b>	<b>PORSCHE 911 CARRERA 6 cyl 2 doors CABRI</b>

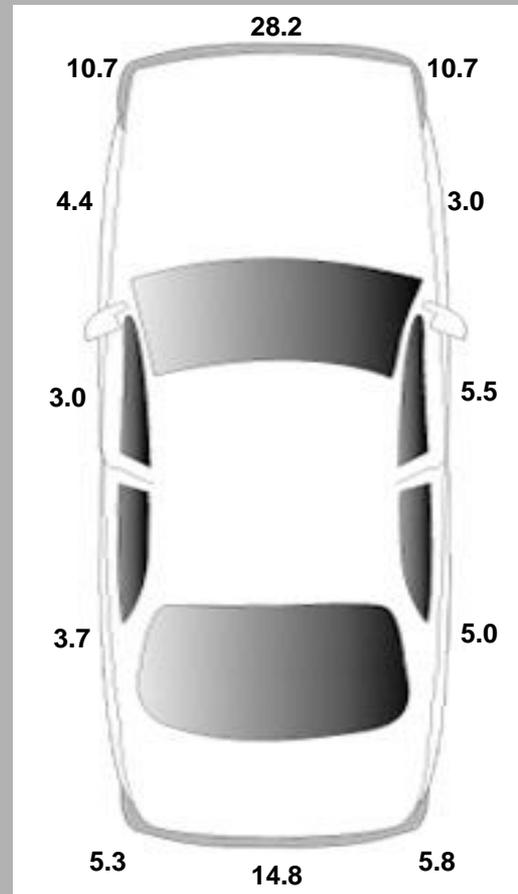
# Sports/Luxury Models

- Variations for “published” rates are 32% to 137%
- Differences may be greater as some companies do not provide “published” rates for these models

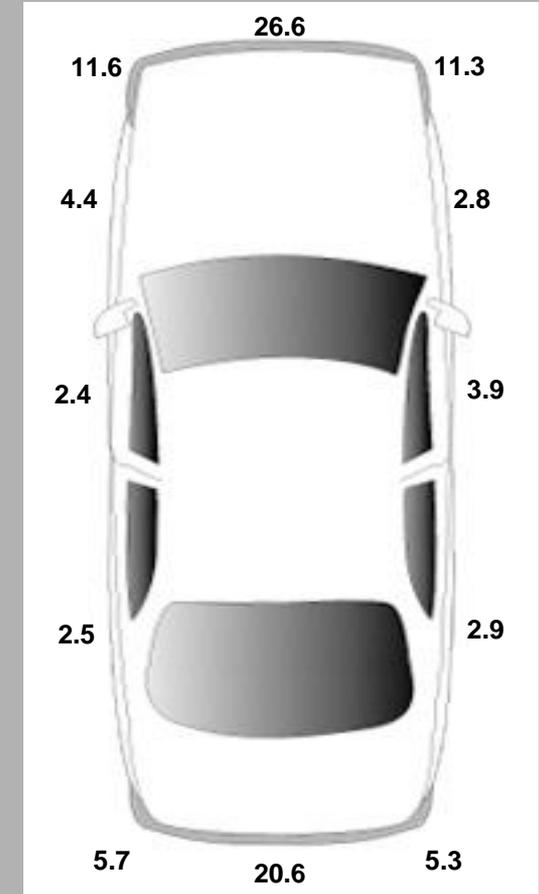
# Percent of Collision Claims by Point of Impact By Vehicle Type



Passenger cars

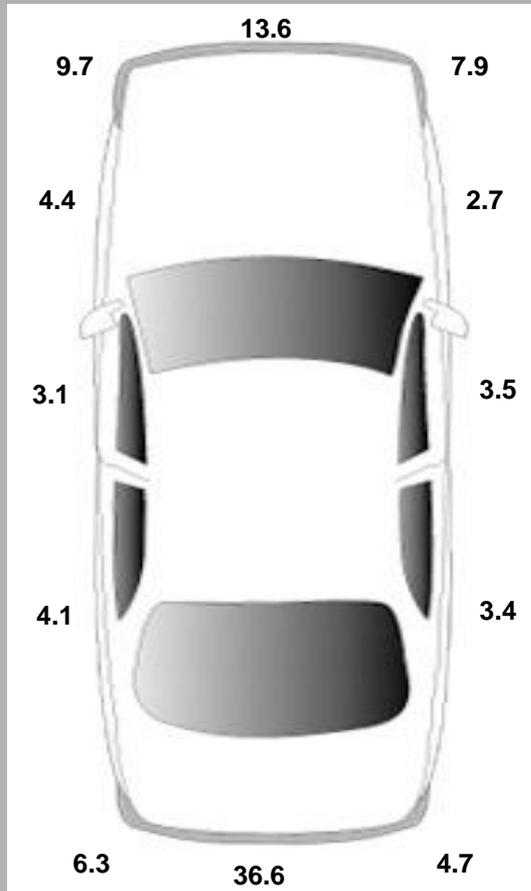


Pickups

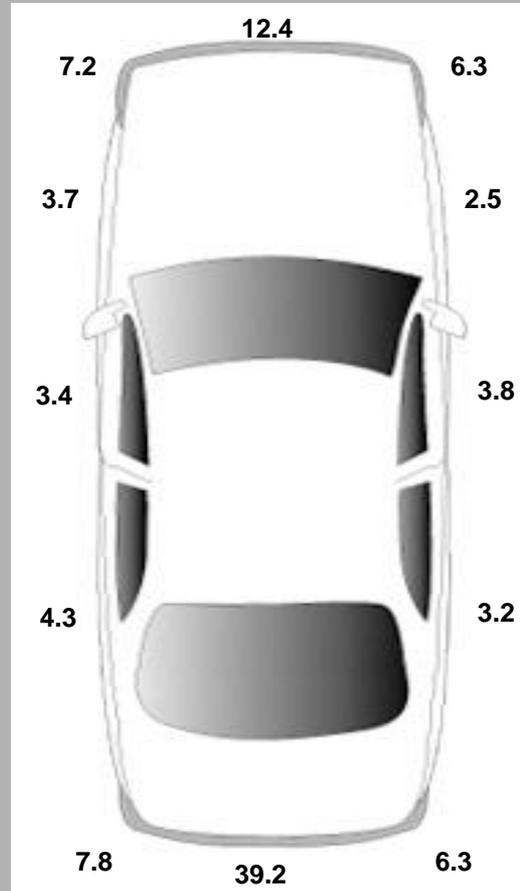


Utility vehicles

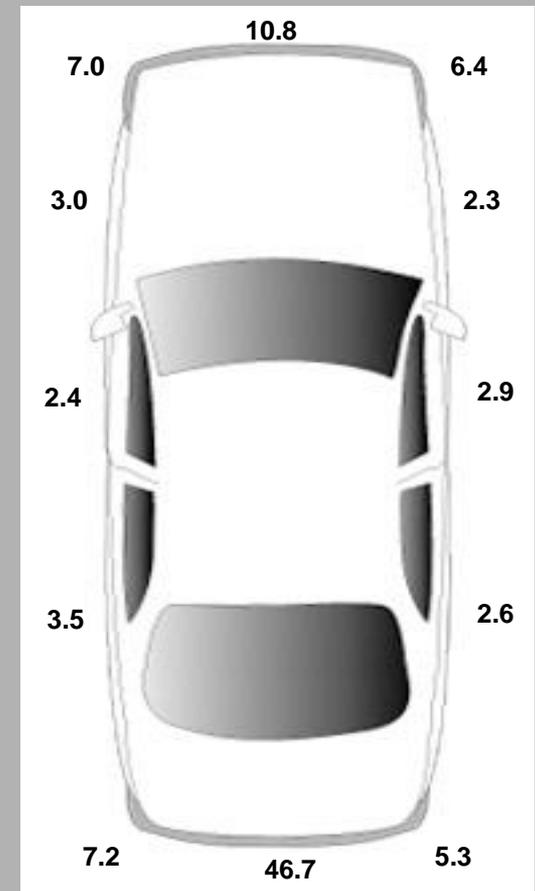
# Percent of Property Damage Liability Claims by Point of Impact By Vehicle Type



Passenger cars



Pickups



Utility vehicles

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# Solution to Rear Accidents

- Back up avoidance device
- Or a mirror?

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# Liability Vehicle Rating

# ISO Liability Rating

- Since data used was 1997 – 2001 vehicles, minimal data for Unibody > 5,250 lb.
- Thus curbweight capped at 5,250 lb.

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# ISO Liability Rating

- 2-way GLM analysis using combination of curb weight and chassis type (although manufacturer had highest  $r^2$ ).

# ISO Liability Rating

## ■ New Vehicles

- ❑ Only Model Years 1996 – 2001 evaluated.
- ❑ Will review LPMP every 2 years.
- ❑ Will not change LPMP on annual basis e.g. October 1.
- ❑ LPMP symbol manual pages are not Model Year specific and do not include vehicle Model Year references except 2001 as earliest and certain new model types.

# ISO Liability Rating

- GLM analysis based upon:
  - ❑ Manufacturer
  - ❑ Chassis type
  - ❑ Weight
  - ❑ Horsepower
  - ❑ Wheelbase
  - ❑ Height
  - ❑ Width

# ISO Liability Rating

- Manufacturer was the most significant variable but rejected based upon credibility concerns.
- Chassis type was very significant thus 2-way GLM used to test chassis type in combination with other variables other than Manufacturer.
- Best fit achieved with Weight and Chassis type.

# ISO Liability Rating

- For liability – curb weight indications are different depending on chassis type –
  - Frame – predicted relativity increases as weight increases.
  - UniBody - predicted relativity decreases as weight increases.
- First Party Coverages - predicted relativity always decreases as weight increases.

# ISO Liability Rating

- New Vehicle Types
  - Relativities for new vehicle series will be determined by giving 50% weight to the predicted loss ratio relativity (based on chassis type and curb weight) and 50% weight to 1.00. (Note: Curb weights for Unibody vehicles will be capped at 5,250 pounds).

# ISO Liability Rating

- New Vehicle Types (con't)
  - For 2002-2004 new vehicles - like vehicle series adjustments have not been applied. Nor will such adjustments be applied on a prospective basis for new vehicles in the LPMP Vehicle Rating Plan. That is, adjustments to ensure consistent treatment of like vehicles will not be made for any vehicles until historical insurance experience for such vehicles is available for analysis.

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# Predictive Modeling Applications

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# Advantages of using Vehicle Characteristics for Rating

- **Easier to rate newer vehicle types.**
- More accurate reflections of safety equipment and other vehicle characteristics.
- For physical damage coverages, and now Liability and PIP symbol can account for significant differences in rates between different insureds.
- Get leg up on competition that don't use GLM.
- Obviates some credibility issues.

# Considerations

- Need VIN.
- Append external data via Polk, HLDI, ISO, CARFAX or other.
- Need VIN for liability too.

# Possible Vehicle Characteristics

<b>Lease</b>	<b>Model year</b>	<b>Gross vehicle weight</b>
<b>Lien</b>	<b>Symbol</b>	<b>High performance code</b>
<b>Daytime running lights</b>	<b>Ton rating</b>	<b>Roof type</b>
<b>Anti lock brakes</b>	<b>vehicle existing damage</b>	<b>Transmission</b>
<b>ESC (Electronic stability control)</b>	<b>Anti theft device</b>	<b>Wheel base</b>
<b>airbags/passive restraint</b>	<b>Cubic inch displacement</b>	<b>New / Used indicator</b>
<b>weight</b>	<b>Cost price new</b>	<b>Height</b>
<b>engine size</b>	<b>Body type</b>	<b>Length</b>
<b>make</b>	<b>Carburetion</b>	<b>Width</b>
<b>model</b>	<b>Cylinders</b>	<b># of doors</b>
<b>segmentation</b>	<b>Driving wheels</b>	<b>Backup avoidance</b>
<b>theft device</b>	<b>Fuel type</b>	<b>Construction</b>

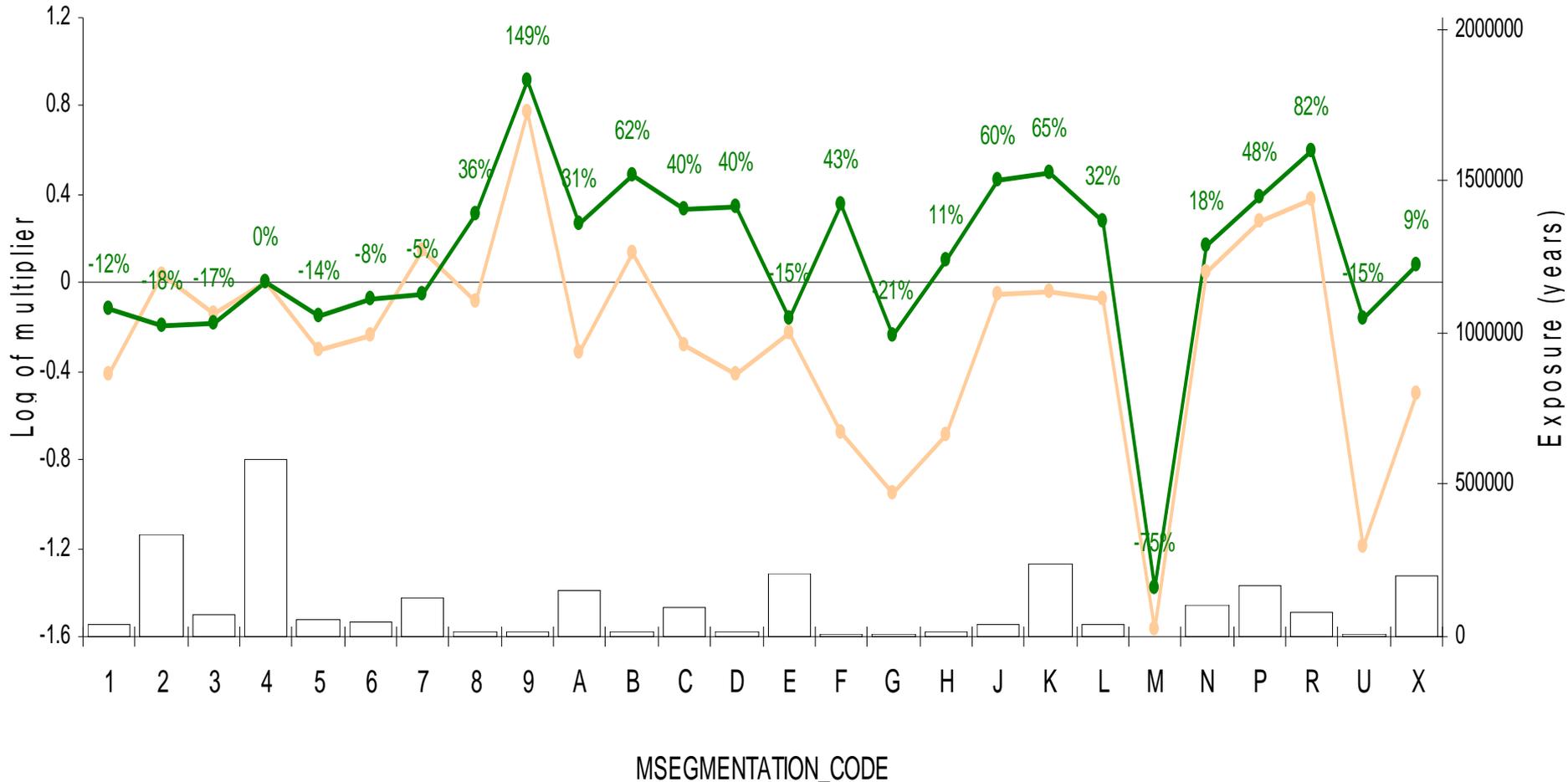
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# Additional Non-traditional Characteristics

- Branded title
- Length of last ownership
- Salvaged
- Prior damage
- Was vehicle repossessed

# Example Company Vehicle Classification Job

Run 2 Model 1 - Collision Pure Premium - Smoothed standard risk premium model (single claim type)



CAS RPM Seminar

—●— Onew ay relativities 
 —●— Unsmoothed estimate 
 —●— Smoothed estimate

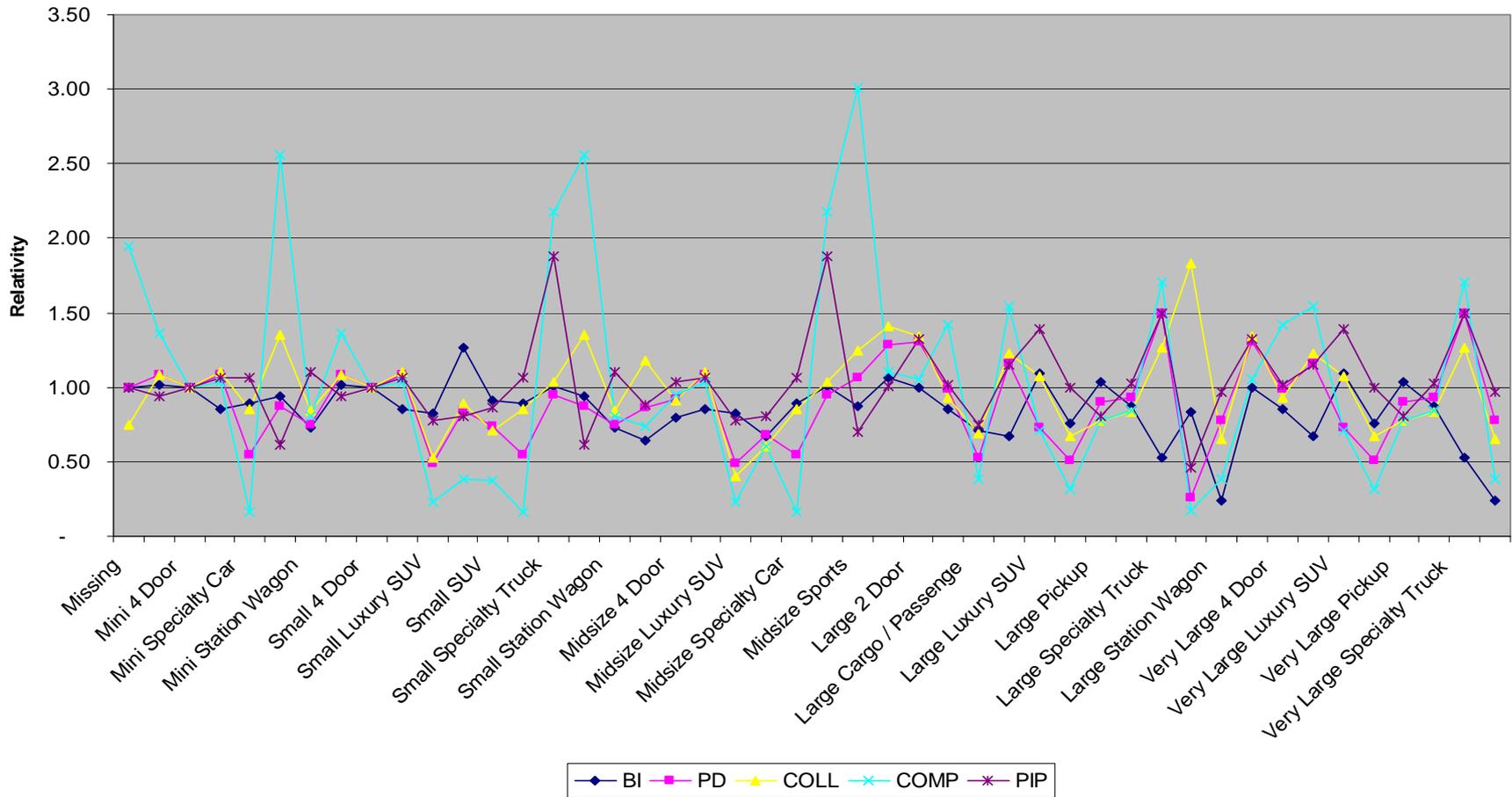
**PINNACLE**  
ACTUARIAL RESOURCES, INC.



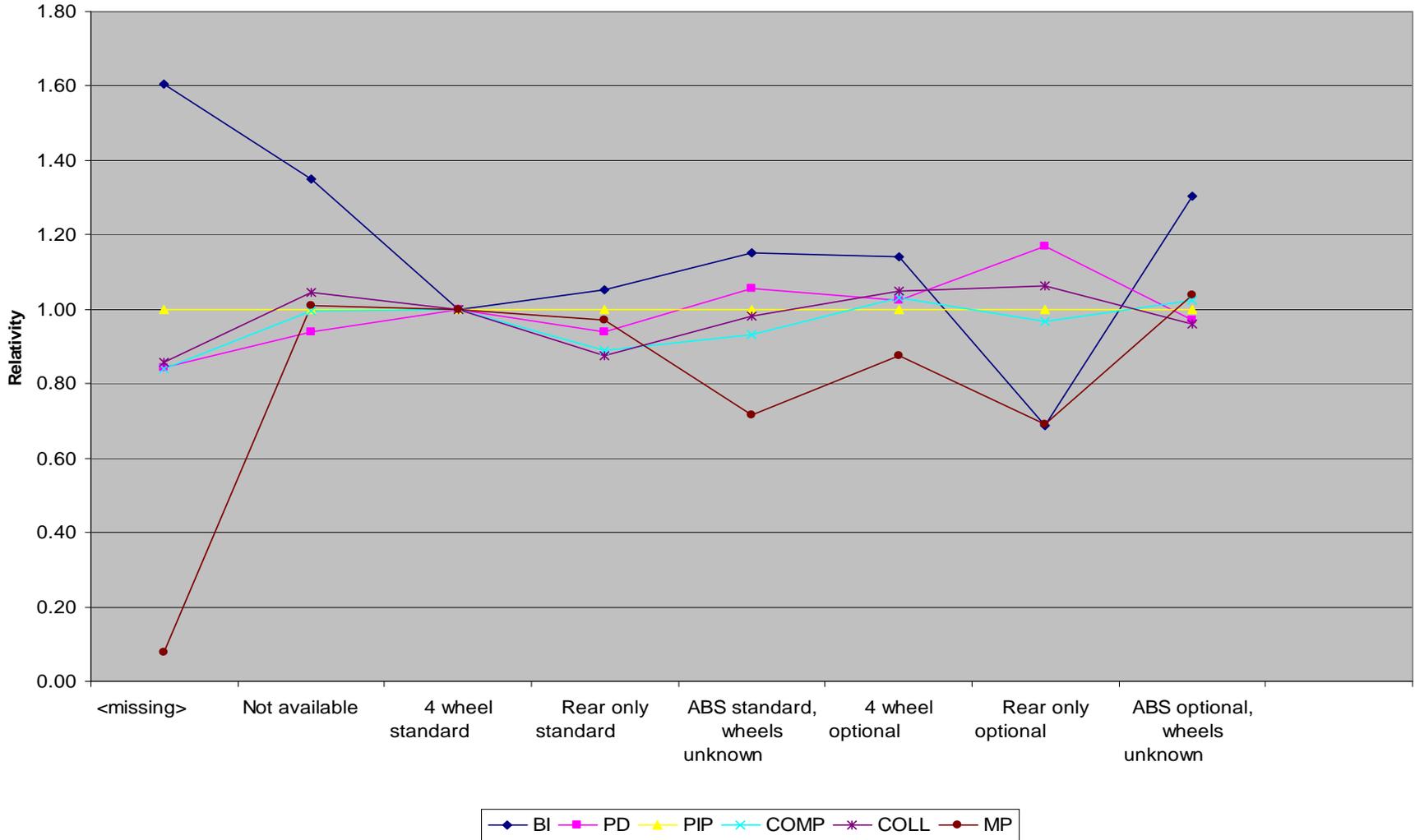
# Polk Segmentation Code

<b>A</b>	<b>Compact Pickup</b>	<b>1</b>	<b>Entry Level (Car)</b>
<b>B</b>	<b>Midsize Pickup</b>	<b>2</b>	<b>Basic Economy (Car)</b>
<b>C</b>	<b>Fullsize Pickup</b>	<b>3</b>	<b>Lower Midsize (Car)</b>
<b>D</b>	<b>Heavy Duty Pickup</b>	<b>4</b>	<b>Upper Midsize (Car)</b>
<b>E</b>	<b>Minivan (Passenger)</b>	<b>5</b>	<b>Upper Midsize Specialty (Car)</b>
<b>F</b>	<b>Minivan (Cargo)</b>	<b>6</b>	<b>Traditional Large (Car)</b>
<b>G</b>	<b>Passenger Van</b>	<b>7</b>	<b>Basic Sporty (Car)</b>
<b>H</b>	<b>Full Size Van (Cargo)</b>	<b>8</b>	<b>Middle Sporty (Car)</b>
<b>J</b>	<b>Full Size Utility</b>	<b>9</b>	<b>Prestige Sporty (Car)</b>
<b>K</b>	<b>Sport Utility</b>		
<b>L</b>	<b>Mini Sport Utility</b>		
<b>M</b>	<b>Medium/Heavy Trucks</b>		
<b>N</b>	<b>Basic Luxury (Car)</b>		
<b>P</b>	<b>Middle Luxury (Car)</b>		
<b>R</b>	<b>Prestige Luxury (Car)</b>		

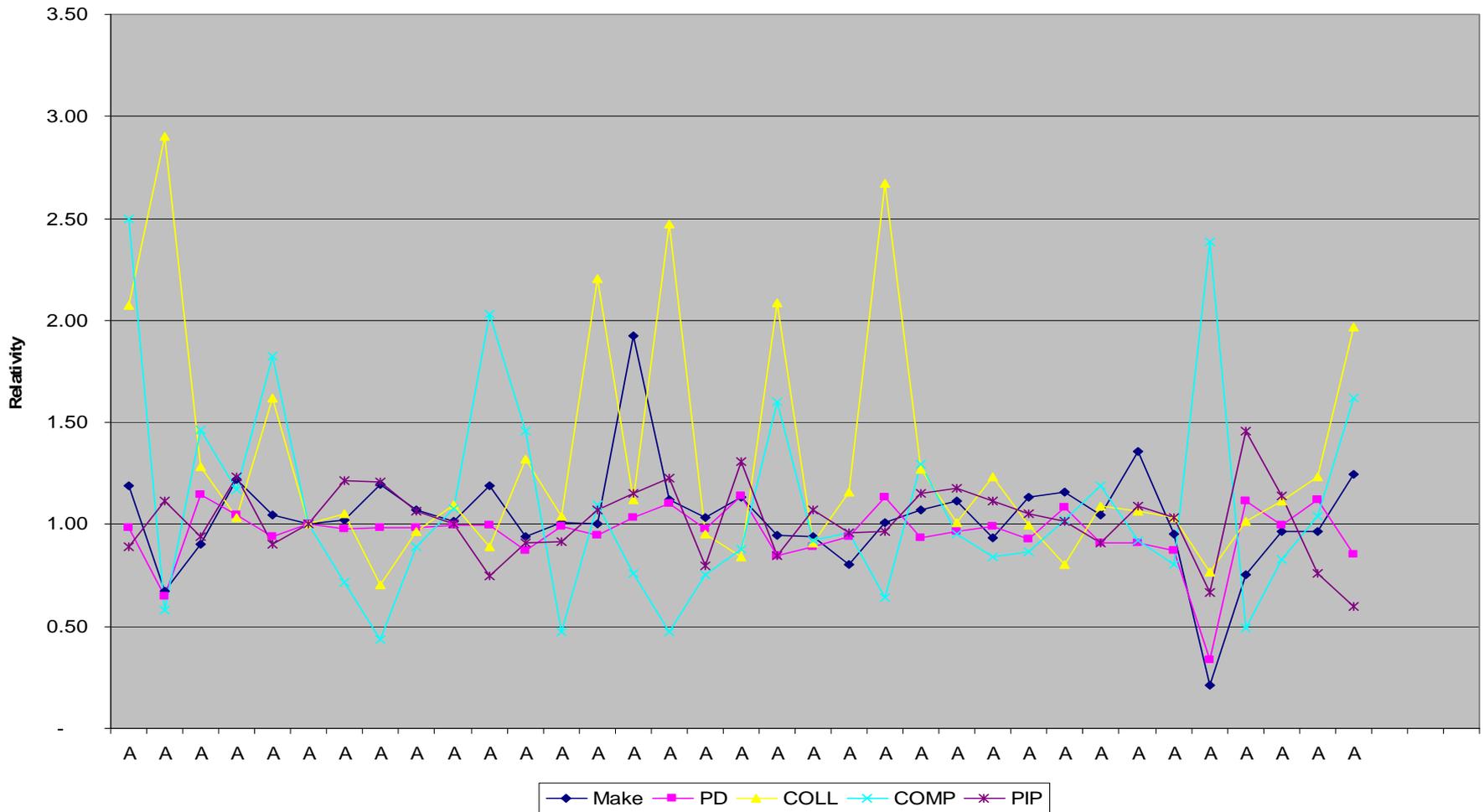
# Vehicle Class - Indicated Pure Prem Relativities



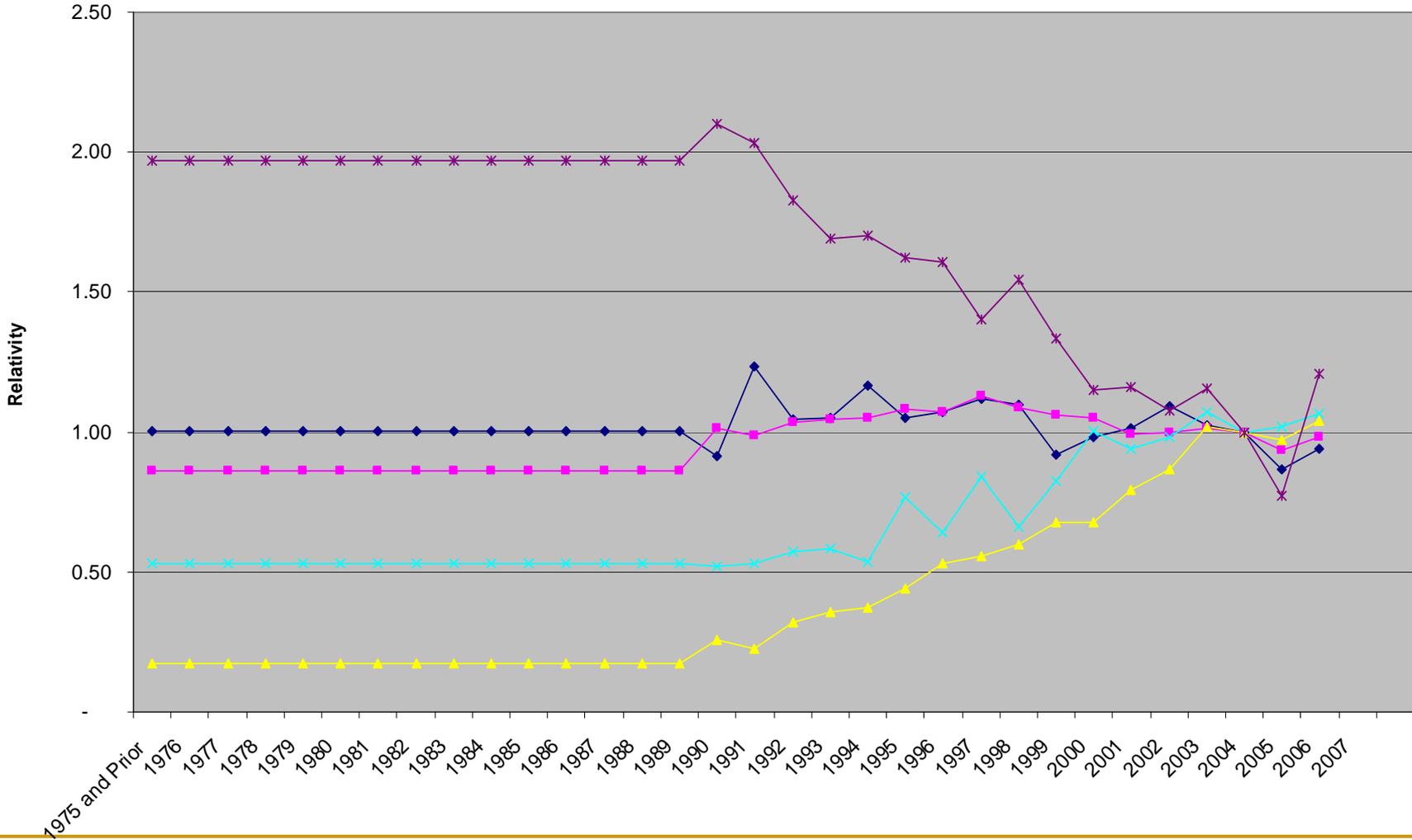
### Anti\_lock\_brakes



# Make



# Model Year

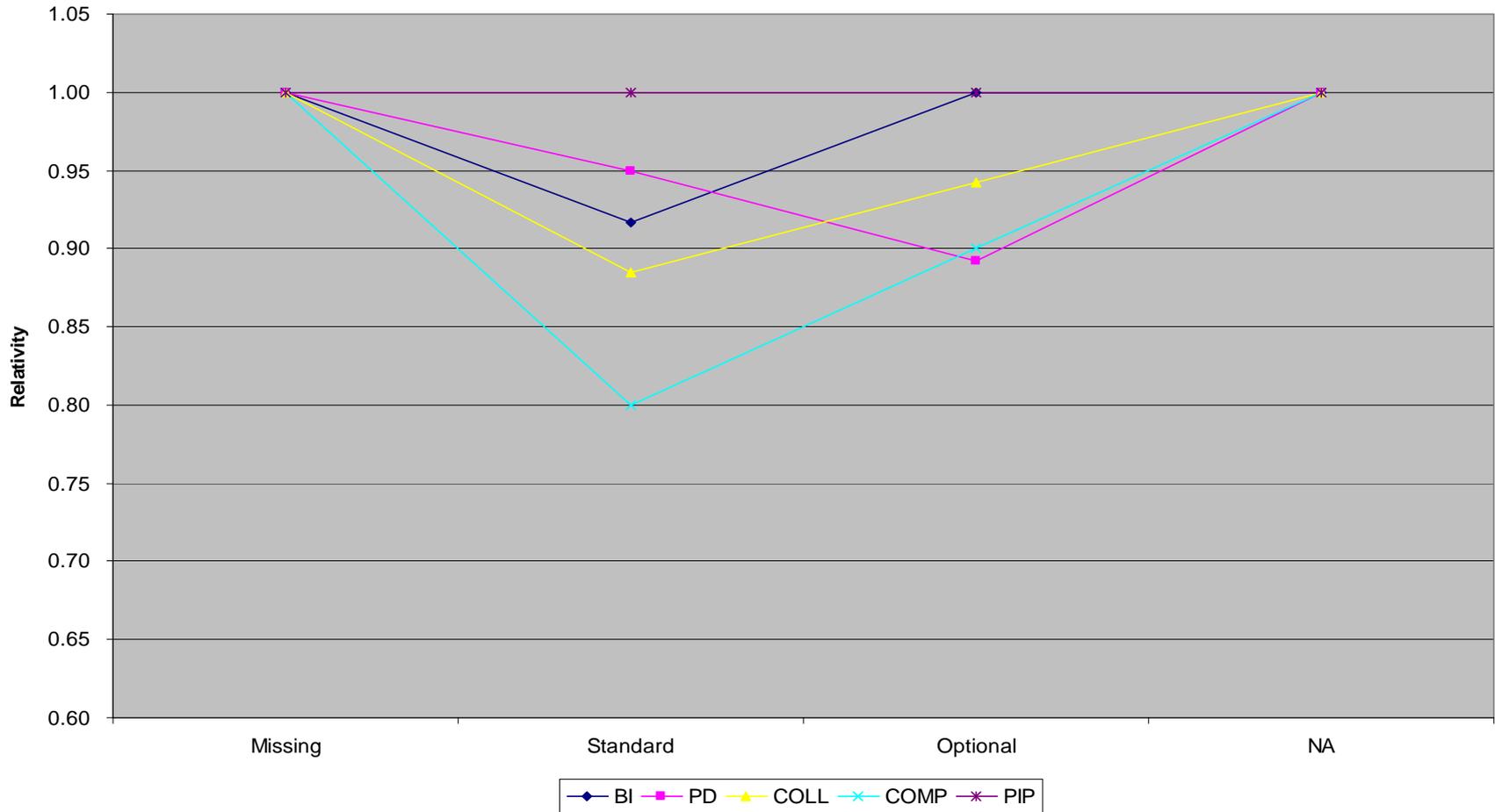


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# Effect of Latest Economic Crisis on Rating

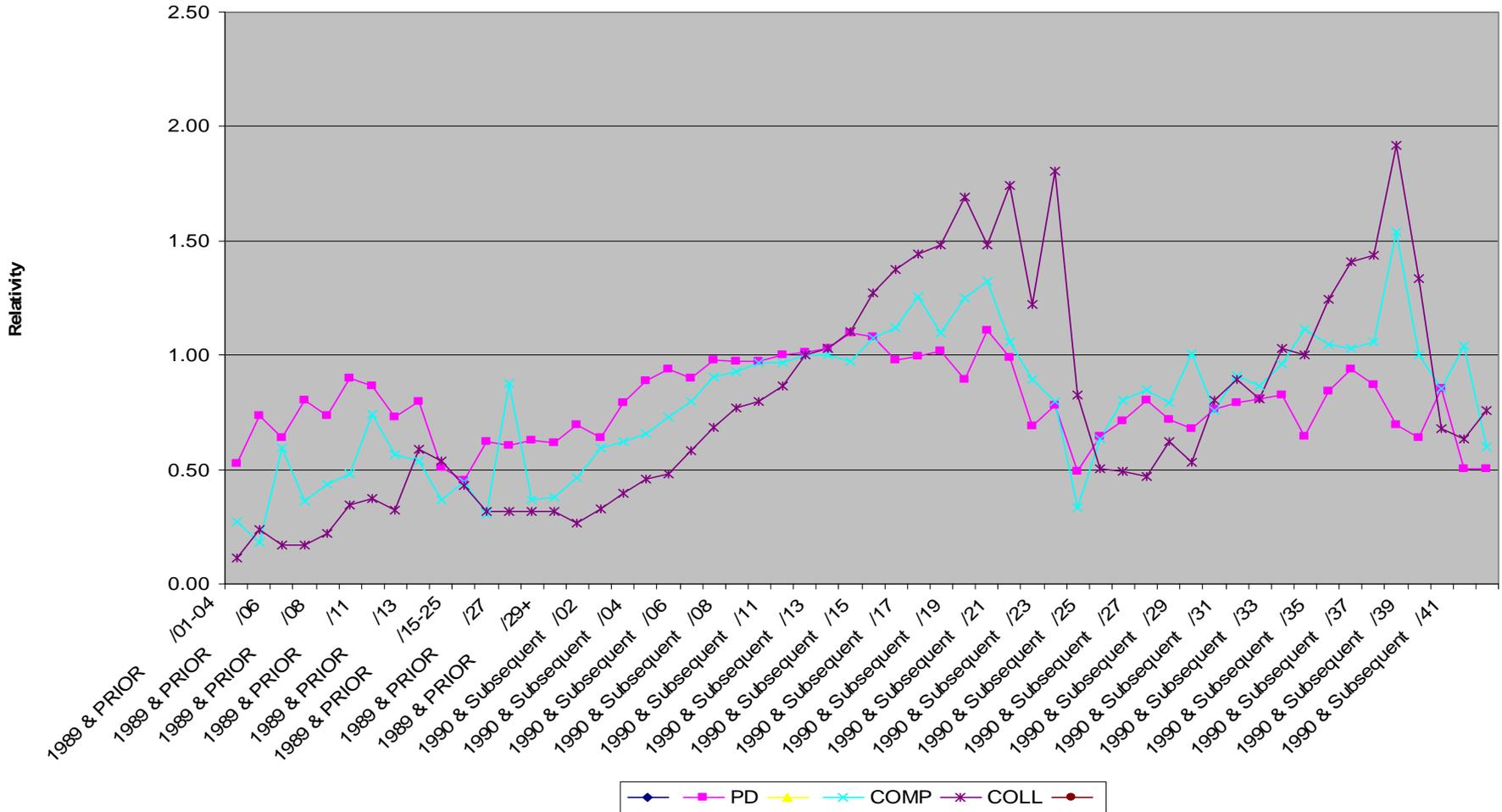
- New cars sales for January down 40-50%
- Premium Trend effects
- Potential effect on older cars which are being kept longer

# Dynamic Stability Control - Indicated Pure Prem Relativities



# Symbol

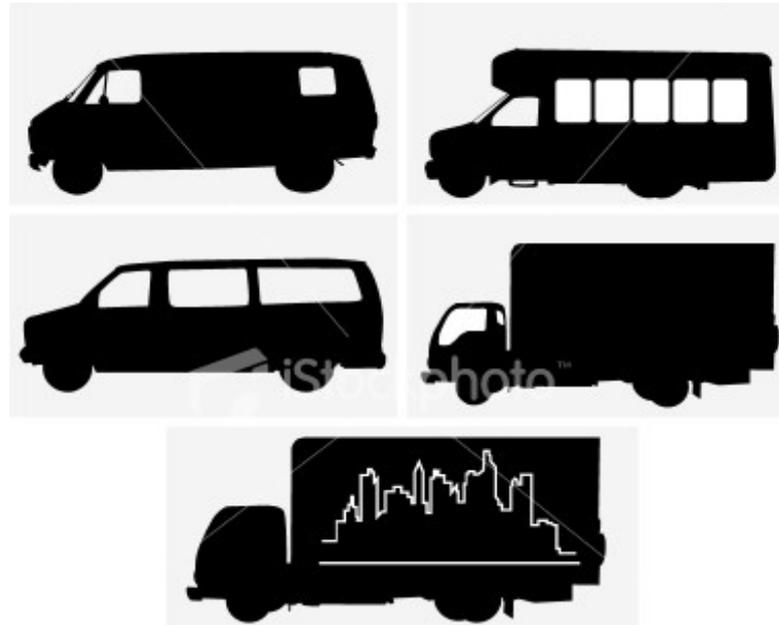
My\_symbol



# Commercial Auto Applications

- VIN decoding works as well in CA as PPA
  - Truck VINs define their ICC weight class (which is more detailed than ISO weight classes)
  - Private passenger types (cars) are not typically symbol rated in CA and either can be or the vehicle characteristics can be used to create a simplified symbol system.
  - Many of the characteristics that PPA VIN decoding returns are also available and valuable for CA (passive restraints, antilock breaks, engine size, model year)
  - However, VIN only contains information about the truck as it left the assembly line and many features are added post production

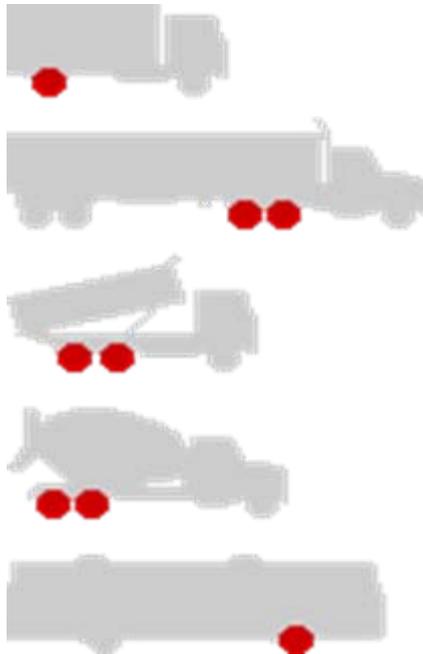
# Not All Trucks are the Same



# Commercial Auto Applications

- The type of container on a truck (aka body type) also matters (refrigerator, dump, flatbed, box, tanker, cranes and specialize equipment (e.g. scaffolding for ladders etc.))
- The type of container on a trailer also matters (refrigerator, low boy, flatbed, box, tanker) as does what kind of cargo you're hauling (coiled steel, chemicals, grain, perishables, less than trailer load (LTL), sand and gravel, moving and storage)

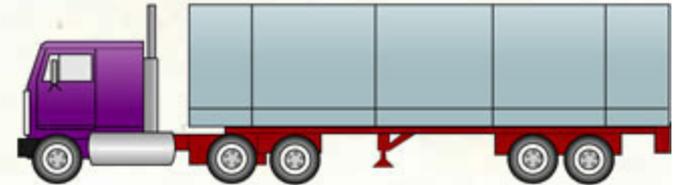
# Types of Loads



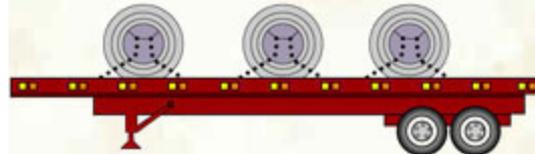
## TYPES OF TRUCKS (2 de 2)



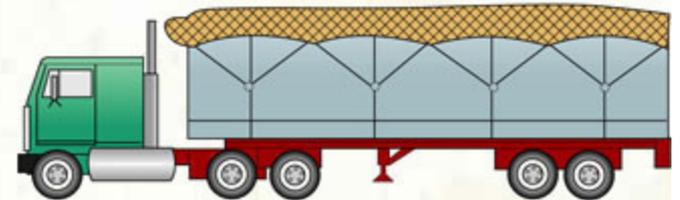
truck



semitrailer



semitrailer flatbed



semitrailer with rails

[www.infovisual.info](http://www.infovisual.info)

# Commercial Auto Applications

- Mileage information is typically not available/verifiable unless the insured is engaged in for hire trucking, however, Standard Industrial Classification (SIC) codes can be a strong indicator of mileage/vehicle use. For example, contractors normally drive to the jobsite while wholesalers tend to drive routes to retailers all day and florists make deliveries.

# Commercial Auto Applications

- Personal use is also a key factor (pickup trucks and company cars with a cooler full of beer at a softball field on Thursday night are a real and difficult risk). Unfortunately, it is hard to verify until after a claim, especially on small risk where a fenced garaging location may not be verified due to policy size.

# Vehicle Weight

- ISO's class plan has four vehicle weight classes: Light, Medium, Heavy and Extra-Heavy.
- Alternatively, the Interstate Commerce Commission (ICC) developed eight weight classes that do a much better job of grouping similar vehicles that are readily verifiable using VINs.

# Vehicle Weight

- This verifiable approach to vehicle weight also addresses popular misconceptions regarding specific vehicle types.
- The most common misperception is that all pick-up trucks are “Light.” Most large pickup trucks have gross vehicle weights well in excess of the “Light” limit of 10,000 pounds.

# National Underwriter – July, 2007

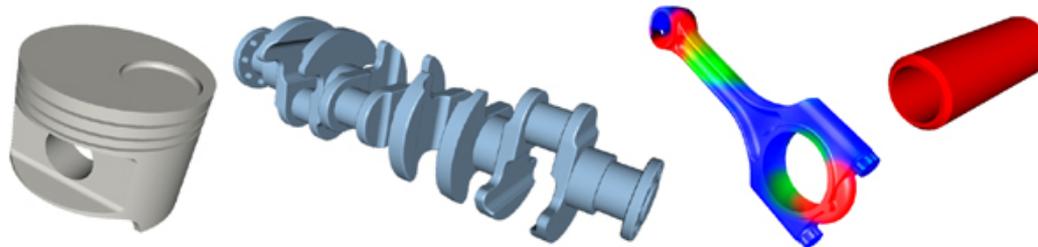
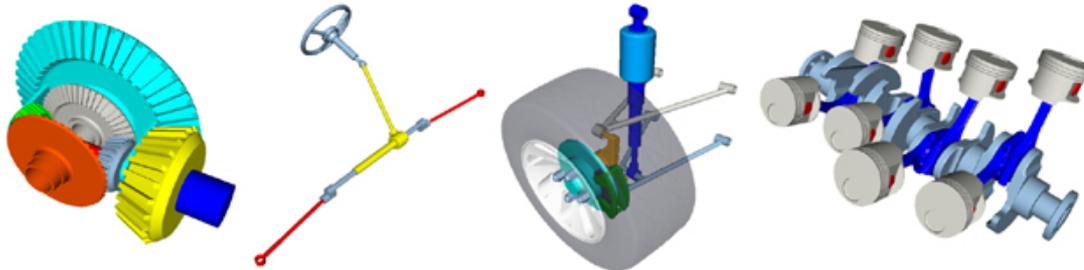
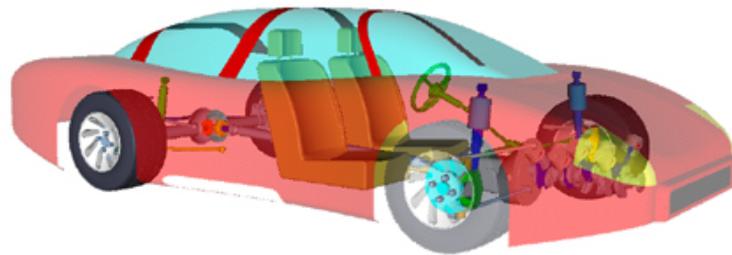
- “From a physical damage perspective, new designs in trucks to reduce their weight and streamline them for fuel efficiency have led to more damage to the vehicle in lower speed collisions.
- Where a steel bumper used to protect the tractor with minimal front-end damage, now an entire engine hood must be replaced with engine parts, which are now protected”

# Tomorrow

- Greater use of true multi-variate analyses by actuaries will greatly improve predictability of symbol rating.
- Computer simulation of crashes will vastly improve accuracy of initial symbol assignment.
- Use of Telematic devices to verify driving characteristics.

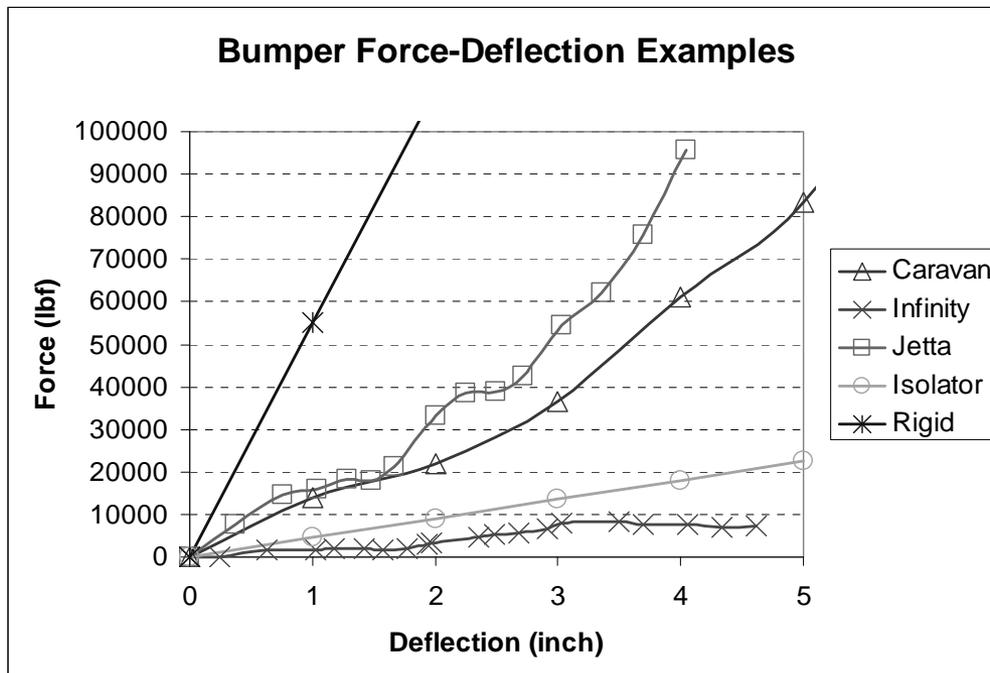
# THE POWER OF SIMULATION

Enables vehicles and vehicle components to be virtually tested under real world stresses, strains, crash avoidance situations, driver reactions, high-speed and low-speed crashes, etc.

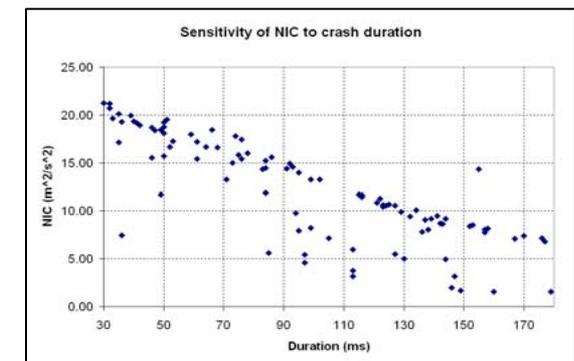
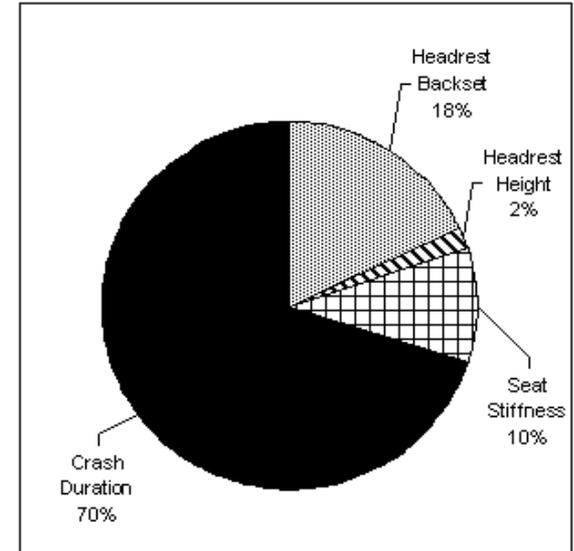


# EXAMPLE: INJURY EFFECT OF BUMPER DESIGN

## Key Bumper Characteristics

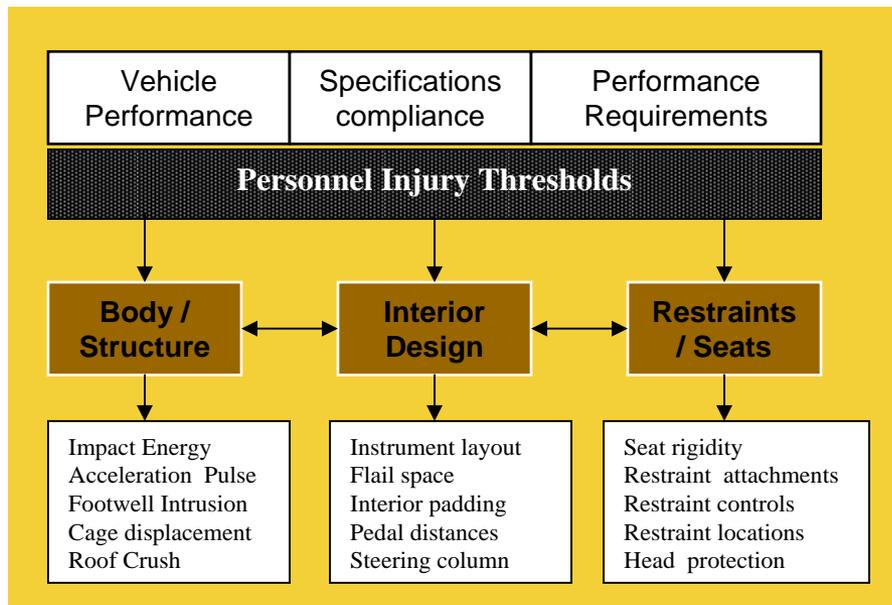


## Affect on Whiplash Injury



# CRASH ANALYSIS PLATFORM

<b>Simulation Environment</b>	<ul style="list-style-type: none"> <li>• Fast and accurate multi-body dynamics solver</li> <li>• 3D CAD kernel to facilitate data exchange</li> <li>• Generates vehicle models “on the fly” from vehicle specifications database</li> </ul>
<b>Analysis Types</b>	<ul style="list-style-type: none"> <li>• Design of Experiments (DOE)</li> <li>• Monte Carlo</li> <li>• Goal-Seeking</li> </ul>



## Better than anyone else, we can:

- Rapidly and statistically analyze large quantities of vehicle crash scenarios.
- Evaluate the impact of a vehicle design change on crash results.
- Correlate vehicle design characteristics to crash results.
- Both for the striking vehicle and for all vehicles struck.

# Telematics

