Model Year and Vehicle Rating

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CAS RPM Seminar
Las Vegas, NV
Discussion Topics

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

- Based upon MSRP.
- Applied only to 1st 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

<table>
<thead>
<tr>
<th>Age</th>
<th>Factor</th>
<th>Model Year</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X + 2</td>
<td>(1.05)(1.05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X + 1</td>
<td>1.05</td>
</tr>
<tr>
<td>1</td>
<td>1.00</td>
<td>X</td>
<td>1.00</td>
</tr>
<tr>
<td>2,3</td>
<td>0.85</td>
<td>X - 1</td>
<td>0.95</td>
</tr>
<tr>
<td>4,5</td>
<td>0.75</td>
<td>X - 2</td>
<td>0.90</td>
</tr>
<tr>
<td>6 &amp; over</td>
<td>0.65</td>
<td>X - 3</td>
<td>0.85</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Class</th>
<th>MM</th>
<th>Symbol</th>
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</thead>
<tbody>
<tr>
<td>1995 Honda Civic</td>
<td>HC1</td>
<td>0.99</td>
</tr>
<tr>
<td>1989 Toyota Camry</td>
<td>TC1</td>
<td>0.96</td>
</tr>
<tr>
<td>1991 Honda Accord</td>
<td>HA1</td>
<td>1.23</td>
</tr>
<tr>
<td>1994 Dodge Caravan</td>
<td>DG1</td>
<td>0.99</td>
</tr>
<tr>
<td>1990 Acura Integra</td>
<td>AI1</td>
<td>0.99</td>
</tr>
<tr>
<td>1991 Nissan Sentra</td>
<td>NS1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

92-93 factor, 1.33 for '94-98, drops to .75 in 98
<table>
<thead>
<tr>
<th>Year</th>
<th>Make</th>
<th>Model</th>
<th>BHP</th>
<th>Horsepower</th>
<th>TPS</th>
<th>0 to 60 Mph</th>
<th>60 to 120 Mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>GMC</td>
<td>YUKON/DENALI XL 1500</td>
<td>1.25</td>
<td>1.01</td>
<td>1.91</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>GMC</td>
<td>YUKON/DENALI XL 1500</td>
<td>1.28</td>
<td>1.23</td>
<td>1.97</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>GMC</td>
<td>YUKON/DENALI XL 1500</td>
<td>1.32</td>
<td>1.3</td>
<td>2.18</td>
<td>0.93</td>
<td></td>
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<tr>
<td>2007</td>
<td>GMC</td>
<td>YUKON/DENALI XL 1500</td>
<td>1.32</td>
<td>1.3</td>
<td>2.18</td>
<td>0.9</td>
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<tr>
<td>2000</td>
<td>GMC</td>
<td>YUKON/DENALI XL 2500</td>
<td>1.41</td>
<td>0.98</td>
<td>1.85</td>
<td>1.03</td>
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</tbody>
</table>

*Note: BHP stands for brake horsepower.*
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.

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

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

SOURCE: Insurance Institute for Highway Safety
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.
<table>
<thead>
<tr>
<th>Model Year</th>
<th>Make</th>
<th>Model</th>
<th>SubModel</th>
<th>BIPO</th>
<th>COLL</th>
<th>COMP</th>
<th>PIP</th>
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</thead>
<tbody>
<tr>
<td>1995</td>
<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>0.88</td>
<td>0.93</td>
<td>1.21</td>
<td>1.06</td>
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<td>1996</td>
<td>HONDA</td>
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<td>0.91</td>
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<td>1.13</td>
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<tr>
<td>1997</td>
<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>0.88</td>
<td>0.96</td>
<td>1.16</td>
<td>1.12</td>
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<tr>
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<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>0.84</td>
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<td>CIVIC</td>
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<td>1.2</td>
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<tr>
<td>1999</td>
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<td>CIVIC</td>
<td>SI/SIR</td>
<td>1.05</td>
<td>1.34</td>
<td>4.24</td>
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<tr>
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<td>CIVIC</td>
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<td>1.14</td>
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<tr>
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<td>CIVIC</td>
<td>SI/SIR</td>
<td>1.03</td>
<td>1.29</td>
<td>5.28</td>
<td>1.21</td>
</tr>
<tr>
<td>2001</td>
<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>1.01</td>
<td>1.1</td>
<td>0.95</td>
<td>1.19</td>
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<tr>
<td>2002</td>
<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>1.04</td>
<td>1.22</td>
<td>0.99</td>
<td>1.17</td>
</tr>
<tr>
<td>2003</td>
<td>HONDA</td>
<td>CIVIC</td>
<td></td>
<td>0.99</td>
<td>1.16</td>
<td>0.94</td>
<td>1.17</td>
</tr>
<tr>
<td>2003</td>
<td>HONDA</td>
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<td>1.16</td>
<td>0.94</td>
<td>1.17</td>
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<td>2004</td>
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<td>1.09</td>
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<tr>
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<td>0.98</td>
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<td>0.8</td>
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<td>0.97</td>
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<td>2005</td>
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<tr>
<td>2006</td>
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<td>CIVIC</td>
<td></td>
<td>0.96</td>
<td>1.44</td>
<td>1.07</td>
<td>1.02</td>
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<tr>
<td>2006</td>
<td>HONDA</td>
<td>CIVIC</td>
<td>HYBRID</td>
<td>0.96</td>
<td>1.44</td>
<td>1.07</td>
<td>1.02</td>
</tr>
</tbody>
</table>
Vehicle Rating

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

Rate Relativity Comparison For New Models

Model

- Audi Tt Quattro 6 cyl
- Cadillac Escalade 8 cyl
- Nissan Xterra Xe/Se 4 cyl

Relativity

0.50 1.00 1.50 2.00
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

Rate Relativity Comparison For Popular Vehicles - 4 Door Sedans

- Chevrolet Cavalier 4 cyl
- Chevrolet Lumina 6 cyl
- Ford Focus Lx 4 cyl
- Ford Taurus Lx 6 cyl
- Honda Accord Dx 4 cyl
- Honda Civic Dx 4 cyl
- Nissan Altima Xe/Gxe/Gle/Se 4 cyl
- Pontiac Grand Am Se2 6 cyl
- Toyota Camry Ce/Le/Xle 6 cyl
- Volkswagen New Jetta Gls 6 cyl

Model Relativity
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

Rate Relativity Comparison For Sports / Luxury Vehicles

Model

A  B  C  D  E  F  G
## Sports/Luxury Models

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
<th>Engine</th>
<th>Doors</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AUDI : TT QUATTRO 6 cyl 2 doors COUPE</td>
<td>6</td>
<td>2</td>
<td>COUPE</td>
</tr>
<tr>
<td>B</td>
<td>PORSCHE BOXSTER S 6 cyl 2 doors CONVRT</td>
<td>6</td>
<td>2</td>
<td>CONVRT</td>
</tr>
<tr>
<td>C</td>
<td>CHEVROLET CORVETTE 8 cyl 2 doors HCHBK</td>
<td>8</td>
<td>2</td>
<td>HCHBK</td>
</tr>
<tr>
<td>D</td>
<td>JAGUAR XJR 8 cyl 4 doors SEDAN</td>
<td>8</td>
<td>4</td>
<td>SEDAN</td>
</tr>
<tr>
<td>E</td>
<td>MERCEDES-BENZ SLK230 KOMPRESSOR BASE/SPORT 4 cyl 2 doors CONVRT</td>
<td>4</td>
<td>2</td>
<td>CONVRT</td>
</tr>
<tr>
<td>F</td>
<td>BMW 750IL 12 cyl 4 doors SEDAN</td>
<td>12</td>
<td>4</td>
<td>SEDAN</td>
</tr>
<tr>
<td>G</td>
<td>PORSCHE 911 CARRERA 6 cyl 2 doors CABRI</td>
<td>6</td>
<td>2</td>
<td>CABRI</td>
</tr>
</tbody>
</table>
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**
  - Frontal: 13.6%
  - Right side: 7.9%
  - Left side: 9.7%

- **Pickups**
  - Frontal: 12.4%
  - Right side: 6.3%
  - Left side: 7.2%

- **Utility vehicles**
  - Frontal: 10.8%
  - Right side: 6.4%
  - Left side: 7.0%
Solution to Rear Accidents

- Back up avoidance device
- Or a mirror?
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.
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.
Predictive Modeling
Applications
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

<table>
<thead>
<tr>
<th>Lease</th>
<th>Model year</th>
<th>Gross vehicle weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lien</td>
<td>Symbol</td>
<td>High performance code</td>
</tr>
<tr>
<td>Daytime running lights</td>
<td>Ton rating</td>
<td>Roof type</td>
</tr>
<tr>
<td>Anti lock brakes</td>
<td>vehicle existing damage</td>
<td>Transmission</td>
</tr>
<tr>
<td>ESC (Electronic stability control)</td>
<td>Anti theft device</td>
<td>Wheel base</td>
</tr>
<tr>
<td>airbags/passive restraint</td>
<td>Cubic inch displacement</td>
<td>New / Used indicator</td>
</tr>
<tr>
<td>weight</td>
<td>Cost price new</td>
<td>Height</td>
</tr>
<tr>
<td>engine size</td>
<td>Body type</td>
<td>Length</td>
</tr>
<tr>
<td>make</td>
<td>Carburetion</td>
<td>Width</td>
</tr>
<tr>
<td>model</td>
<td>Cylinders</td>
<td># of doors</td>
</tr>
<tr>
<td>segmentation</td>
<td>Driving wheels</td>
<td>Backup avoidance</td>
</tr>
<tr>
<td>theft device</td>
<td>Fuel type</td>
<td>Construction</td>
</tr>
</tbody>
</table>
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)
<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Compact Pickup</td>
<td>Entry Level (Car)</td>
</tr>
<tr>
<td>B</td>
<td>Midsize Pickup</td>
<td>Basic Economy (Car)</td>
</tr>
<tr>
<td>C</td>
<td>Fullsize Pickup</td>
<td>Lower Midsize (Car)</td>
</tr>
<tr>
<td>D</td>
<td>Heavy Duty Pickup</td>
<td>Upper Midsize (Car)</td>
</tr>
<tr>
<td>E</td>
<td>Minivan (Passenger)</td>
<td>Upper Midsize Specialty (Car)</td>
</tr>
<tr>
<td>F</td>
<td>Minivan (Cargo)</td>
<td>Traditional Large (Car)</td>
</tr>
<tr>
<td>G</td>
<td>Passenger Van</td>
<td>Basic Sporty (Car)</td>
</tr>
<tr>
<td>H</td>
<td>Full Size Van (Cargo)</td>
<td>Middle Sporty (Car)</td>
</tr>
<tr>
<td>J</td>
<td>Full Size Utility</td>
<td>Prestige Sporty (Car)</td>
</tr>
<tr>
<td>K</td>
<td>Sport Utility</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Mini Sport Utility</td>
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</tr>
<tr>
<td>M</td>
<td>Medium/Heavy Trucks</td>
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</tr>
<tr>
<td>N</td>
<td>Basic Luxury (Car)</td>
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</tr>
<tr>
<td>P</td>
<td>Middle Luxury (Car)</td>
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</tr>
<tr>
<td>R</td>
<td>Prestige Luxury (Car)</td>
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</table>

CAS RPM Seminar
Make
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

- BI
- PD
- COLL
- COMP
- PIP

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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
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- 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
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- 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.
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- 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.
“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

Bumper Force-Deflection Examples

Affect on Whiplash Injury

Sensitivity of NIC to crash duration
## CRASH ANALYSIS PLATFORM

| Simulation Environment | • Fast and accurate multi-body dynamics solver  
|                        | • 3D CAD kernel to facilitate data exchange  
|                        | • Generates vehicle models “on the fly” from vehicle specifications database |
| Analysis Types         | • Design of Experiments (DOE)  
|                        | • Monte Carlo  
|                        | • Goal-Seeking |

**Personnel Injury Thresholds**

- Body / Structure
  - Impact Energy
  - Acceleration Pulse
  - Footwell Intrusion
  - Cage displacement
  - Roof Crush

- Interior Design
  - Instrument layout
  - Flail space
  - Interior padding
  - Pedal distances
  - Steering column

- Restraints / Seats
  - Seat rigidity
  - Restraint attachments
  - Restraint controls
  - Restraint locations
  - Head protection

**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

On-board algorithms that abstract data to protect privacy

On-Board SmartRate firmware

Total Time

Speed ranges

Time of Day ranges

Total Miles

Geographic area ranges

SmartRate Risk Analysis System

Time

Speed

Day

Geo

Miles

Database of either population-based or absolute risk-based measurements

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