Causes and Severity of Motor Vehicle Crashes in Iowa

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Background

- The Injury Registry of the University of Iowa Injury Prevention Research Center (IPRC) with Iowa Department of Transportation
- Crash data from 1.2 million observations for the years 2001 to 2013
- Hundreds of variables grouped in 17 annual datasets pertaining to crash location, environment and roadway, vehicle, driver and passenger characteristics, and contributing factors
- Reduced to 765,894 crashes
Motivation: According to CDC, unintentional motor vehicle accidents are in the top three leading causes of injury deaths for all age groups.

What causes of motor vehicle crashes resulted in the highest cost, both financially and in human life?

- Relationship between crash cause and severity
- Relationship between crash cause and repair cost
- Change in repair cost over time
- Change in crash severity over time

Focused on overall crash instead of individual vehicles.
Variables

Crash Causes

1. Vehicle/Equipment Failure (0.54%)
2. Failure to yield the right of way (19.19%)
3. Inattentive/Distracted (1.24%)
4. Obstruction in road/Evasive action (18.99%)
5. Disregard of Road Signs/Signals (9.15%)
6. Reckless/Inadequate Driving (33.28%)
7. Road Departures (7.33%)
8. Unknown (10.28%)
Variables Cont.

- **Severity**
  1. Fatal (0.65%)
  2. Major Injury (2.78%)
  3. Minor Injury (9.85%)
  4. Possible Injury (16.83%)
  5. Property Damage Only (69.89%)

- **Repair Cost**
  - Ranging from $0 to $4 million

- **Year**
  - 2001 to 2013
Cause vs. Severity

Proportion of Crashes - Severity (Left side)
1. Fatal (Red)
2. Major Injury (Orange)
3. Minor Injury (Yellow)
4. Possible Injury (Green)
5. Property Damage Only (Blue)

Cause of Crash (Top)
1. Vehicle/Equipment Failure
2. Failure to yield the right of way
3. Inattentive/Distracted
4. Obstruction in road/Evasive action
5. Disregard of Road Signs/Signals
6. Reckless/Inadequate Driving
7. Road Departures
8. Unknown
Cause vs. Severity

- Nominal vs. Ordinal Data
- Kruskal-Wallis Rank Sum Test: p-value < 2.2e-16
- Followed up with Ordinal Logistic Regression
- General effect on crash severity based on coefficient values

<table>
<thead>
<tr>
<th>Crash Cause</th>
<th>Odds Ratio</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Disregard of Road Signs</td>
<td>0.61</td>
<td>High influence in fatal crashes</td>
</tr>
<tr>
<td>• Road Departure</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>• Failure to yield</td>
<td>0.96</td>
<td>Mid influence in fatal crashes</td>
</tr>
<tr>
<td>• Inattentive/Distracted</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>• Reckless/Inadequate Driving</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>• Vehicle/Equipment Failure</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>• Obstruction in Road/Evasive Action</td>
<td>2.00</td>
<td>Low influence in fatal crashes</td>
</tr>
<tr>
<td>• Unknown</td>
<td>1.15</td>
<td></td>
</tr>
</tbody>
</table>
Median, Mean, and Standard Deviation of Cost

1. Vehicle/ Equipment Failure
2. Failure to yield the right of way
3. Inattentive/Distracted
4. Obstruction in road/Evasive action
5. Disregard of Road Signs/Signals
6. Reckless/Inadequate Driving
7. Road Departures
8. Unknown

*outliers removed from Maximum Cost*
Severity vs. Year

- Proportions given a specific level of severity
Severity vs. Year

- Change in severity over time
  - Coefficient Value = 0.021
  - Per decade: odds of less severe crash increases by 24%
- Compared Year to Year
  - Years with more fatal tendencies
    - 2003-2005
    - 2009-2012
Cost vs. Year

- Spearman’s Rank Correlation Coefficient: 0.116
- National Automobile Dealership Association (NADA) reports average increase in new and used car sale prices
  - After correction for price increase, general increase in median cost
Conclusion

- Disregard of Road Signs/Signals (group 5) and Road Departures (group 7) had the highest cost both financially and in human life.
- Crash Severity decreased over time.
- Financial cost slightly increased over time.
- Our findings could be used in:
  - educational campaigns by driving schools
  - insurance companies
  - government agencies
- Further investigations
  - Cases of Outliers
  - Years that tended toward fatal accidents
Acknowledgements

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Thank you

- Questions?
