
CAS
ANNUAL
MEETING
NOVEMBER 11-14, 2018
CAESARS PALACE LAS VEGAS
HOTEL AND CASINO • LAS VEGAS, NV

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Acknowledgments

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Background

- In the later half of 2013, auto insurance property damage and collision frequency noticeably increased.
- In response, the SOA, CAS, and PCI joined together to analyze these trends.
- These reports are the culmination of that effort.

Loss cost drivers

- We analyzed the frequency and severity of each of the major auto insurance coverages for each state (excluding D.C. and Hawaii)
  - Bodily Injury (BI)
  - Property Damage (PD)
  - Personal Injury Protection (PIP)
  - Comprehensive (Comp)
  - Collision (Coll)

Explanatory Variables

We examined the impact of the following variables:

- **UrbanVMTPercent**: Percent of the vehicle miles traveled (VMT) in an urban area.
- **LawyersPer1MillionCapita**: Number of lawyers in the state per 1 million people.
- **UrbanAvgCommuteTime**: Average commute time in minutes for people in urban areas.
- **RuralAvgCommuteTime**: Average commute time in minutes for people in rural areas.
- **MobileBroadbandPercent**: Percent of population with access to mobile broadband
- **InterstateGood**: Percent of interstate miles rated as good
- **DriversUnder20Percent**: Percent of drivers under age 20
- **DriversOver75Percent**: Percent of drivers over age 75
- **CommutePrivateVehiclePercent**: Percent of people who commute by private vehicle
- **AverageQuarterlyPrecipitation**: Average quarterly precipitation in inches.
- **BLSUnemployment**: Unemployment rate from Bureau of Labor Statistics (BLS)

Explanatory Variables (continued)

We examined the impact of the following variables:

- **UrbanVMTperLane**: Urban vehicle miles traveled per urban lane mile.
- **RuralVMTperLane**: Rural vehicle miles traveled per rural lane mile.
- **CapitalOutlayperVMT**: Total transportation dollars spent on capital projects, per vehicle miles travelled.
- **MaintenanceExpensesperVMT**: Total transportation dollars spent on maintenance expenses, per VMT.
- **PolicingExpensesperVMT**: Total transportation dollars spent on policing expenses, per VMT.
- **DUIs**: Total DUIs per driver
- **GasPricevsWage**: Average gas price in dollars divided by average hourly wage in dollars.
- **TortSystem**: No-fault, optional no-fault, tort
- **LicensedDrivers**: Number of licensed drivers in the state.
- **LaneMilesTotal**: Total number of lane miles in the state.
- **DriversperLaneMile**: LicensedDrivers/LaneMilesTotal

Trends

- Unfortunately, most of the economic data has a significant time lag.
- By the time the reports were mostly completed we had economic data through 2015.
- To get an idea of more recent trends (usually about a lag of 1.5 quarters), we also modeled the data directly without any covariates.

Full Reports and Podcast

- This presentation will only touch on a few findings from the reports.
- The full reports and code for the trends report are available online:

https://www.casact.org/press/index.cfm?fa=viewArticle&articleID=4174

https://www.soa.org/research-reports/2018/auto-loss-cost-trends/

- Or Google: Auto Loss Costs

Bodily Injury Liability

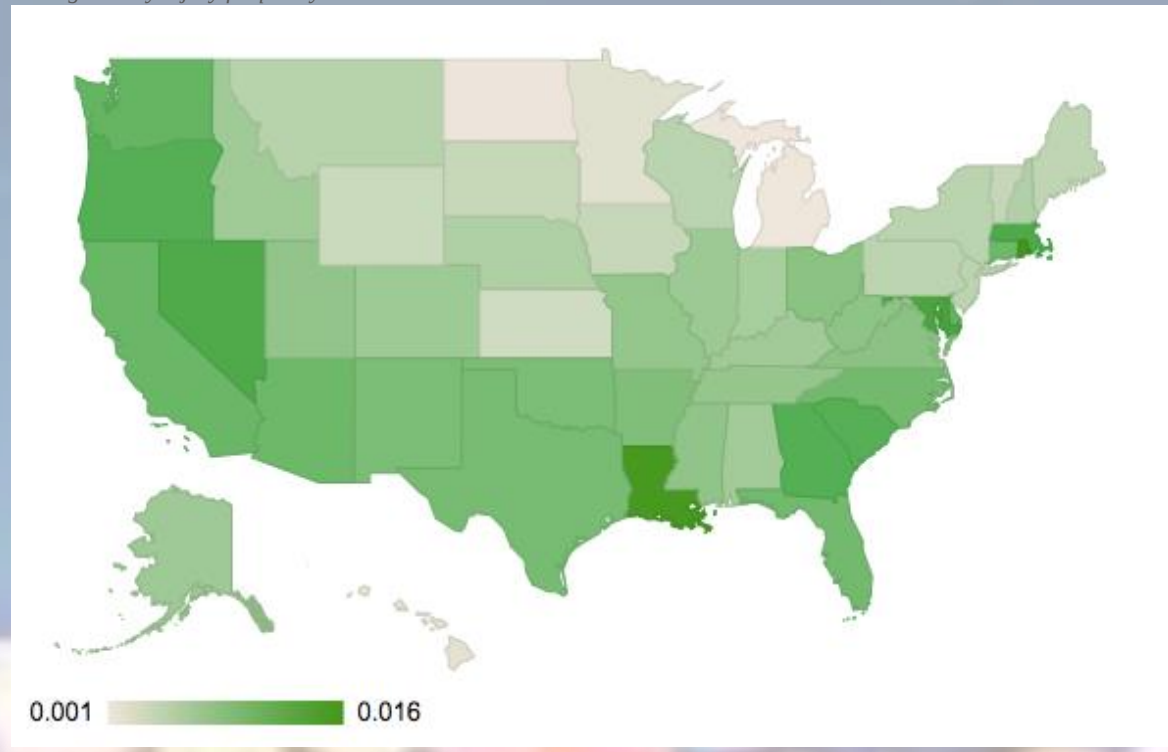
- If you are at fault in an accident, this coverage pays for costs related to the medical expenses of others involved.
- Quoted in the form $25,000/$50,000

Bodily Injury Frequency and Severity

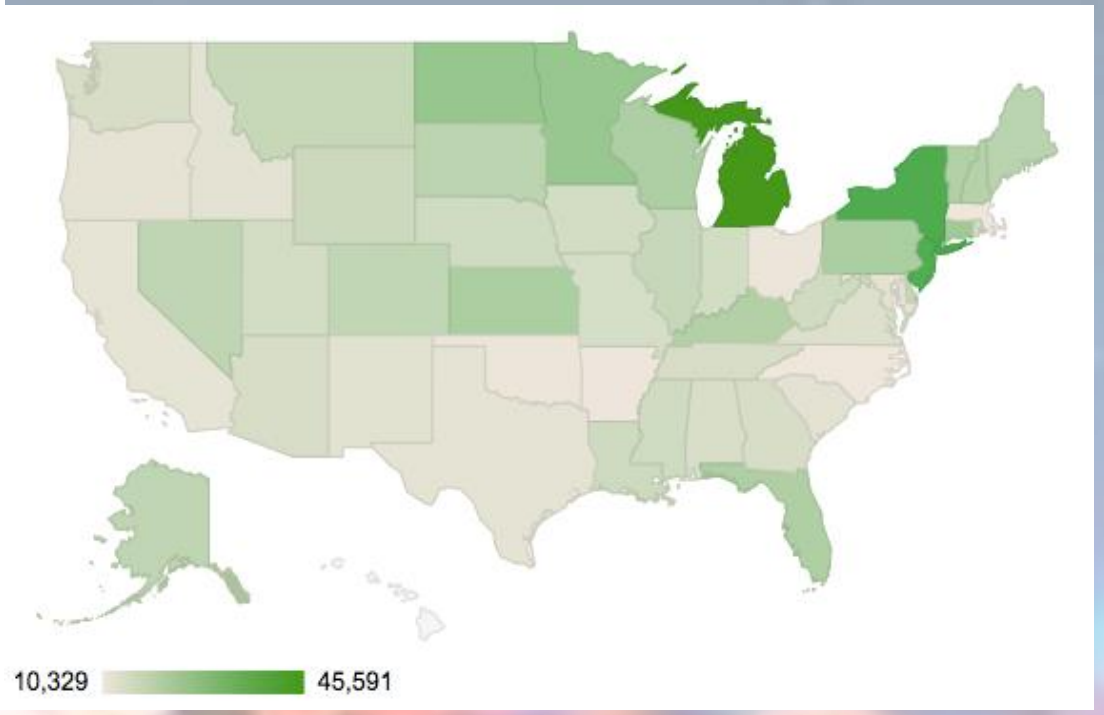
Looking at the plots of bodily injury frequency and severity, we notice the following two things:

- Frequency and severity are negatively correlated
- MI is an outlier for severity.

Average bodily injury frequency

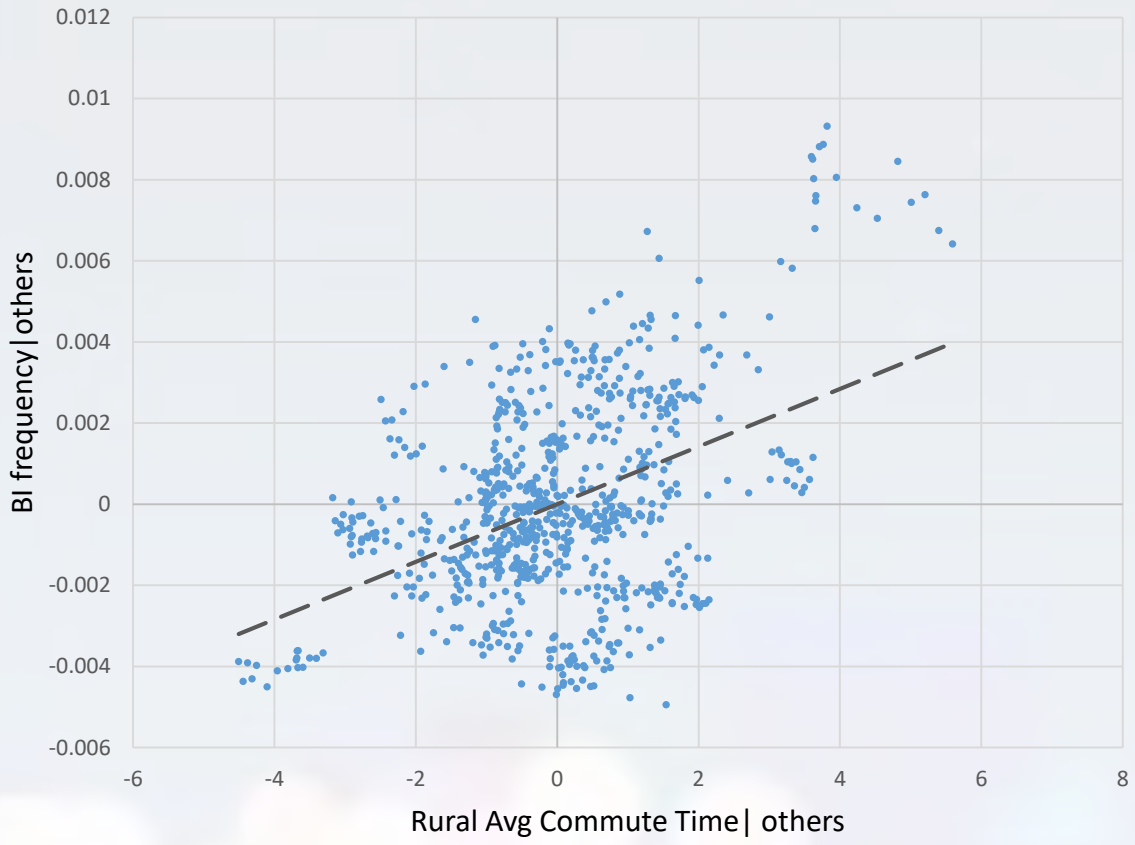


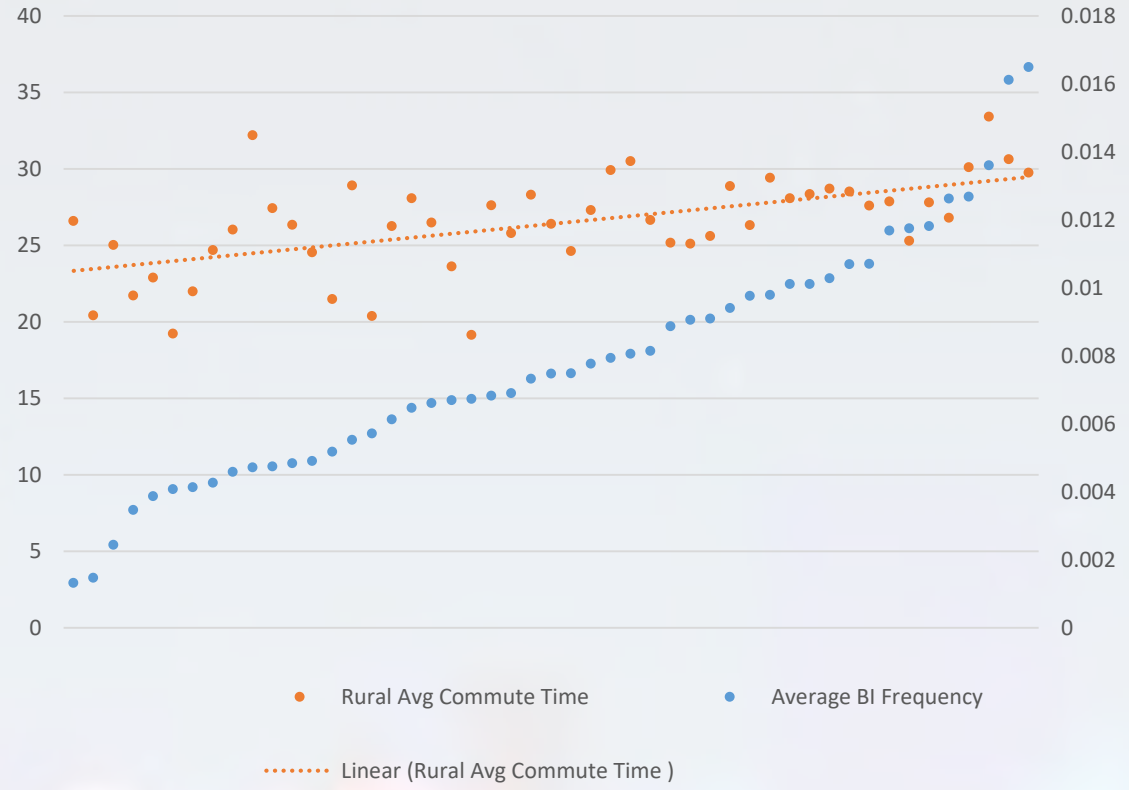
Average bodily injury severity



Bodily Injury Frequency

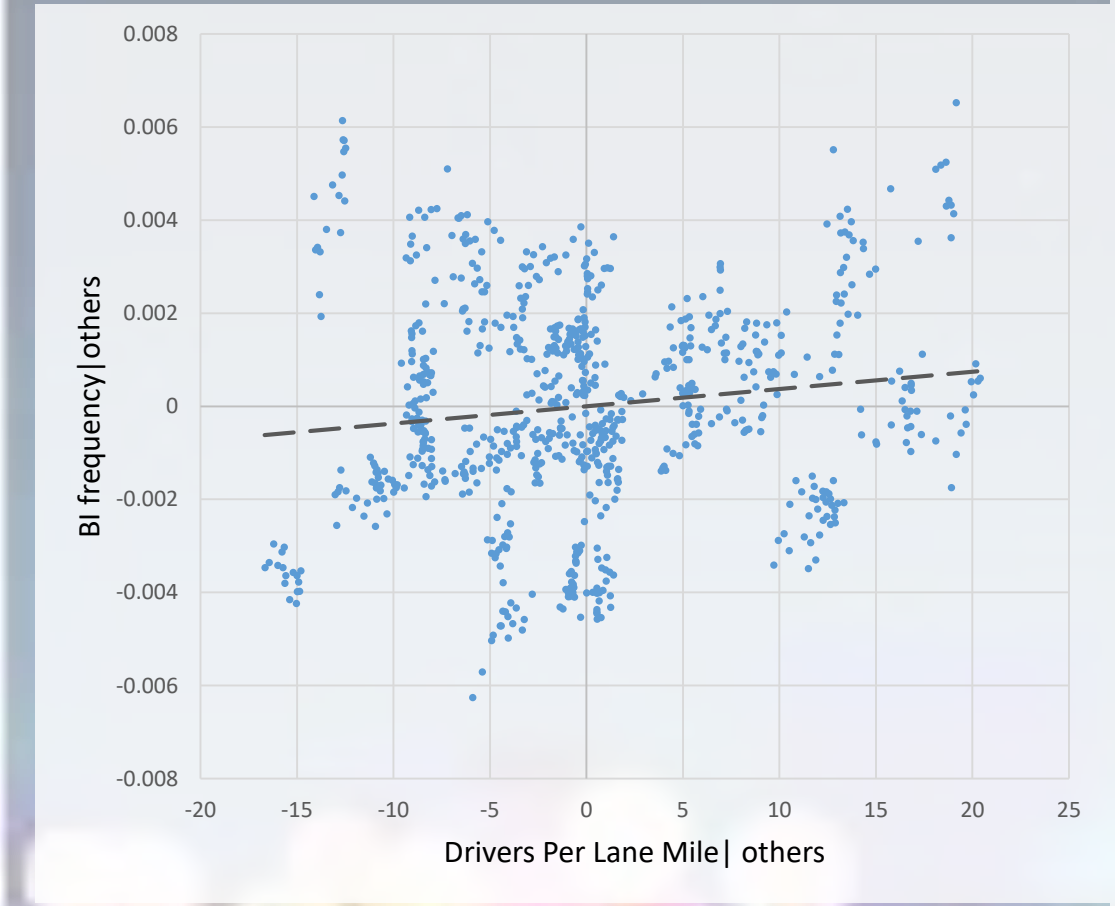
Relationship with rural average commute time

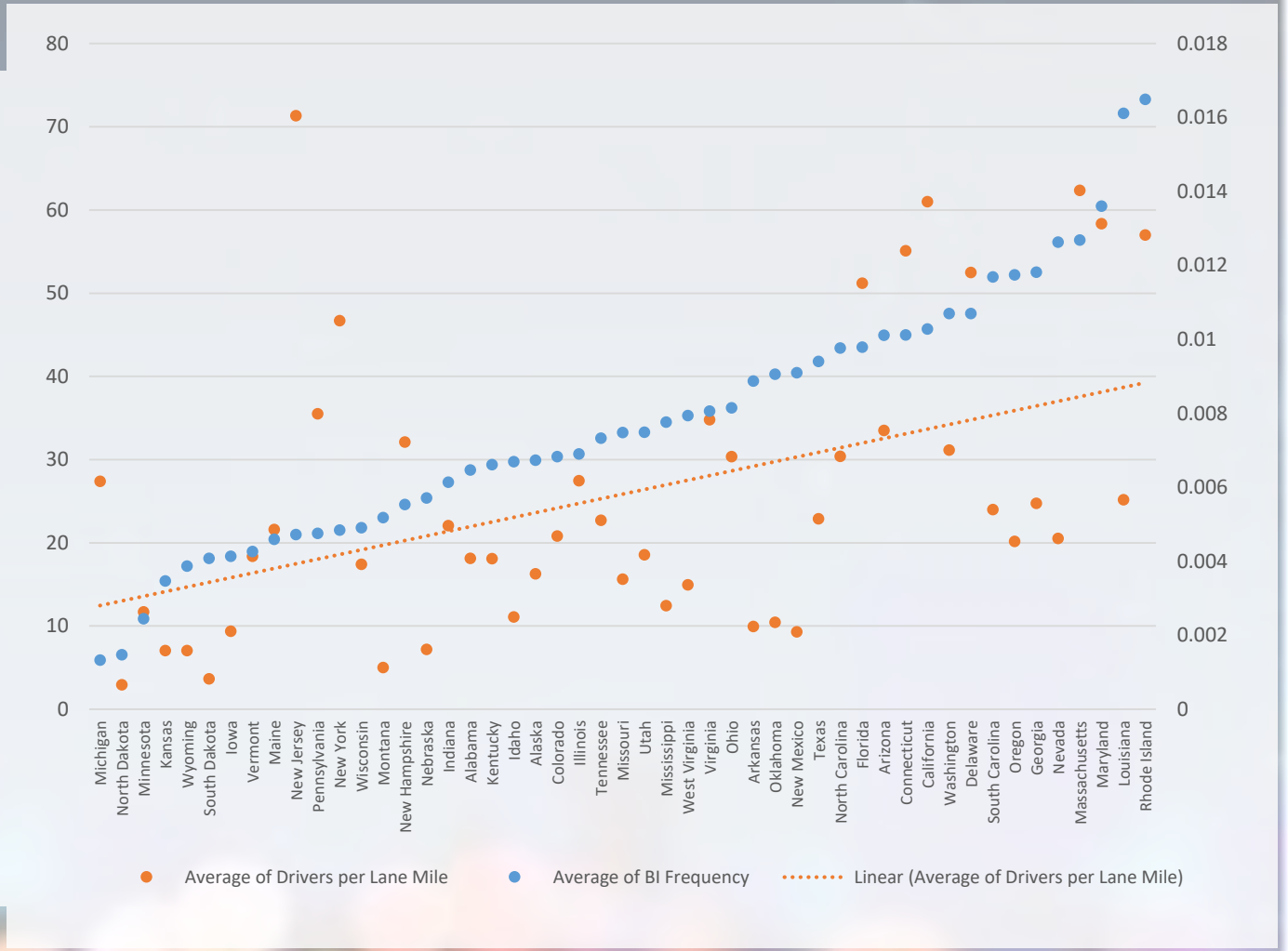




Bodily Injury Frequency

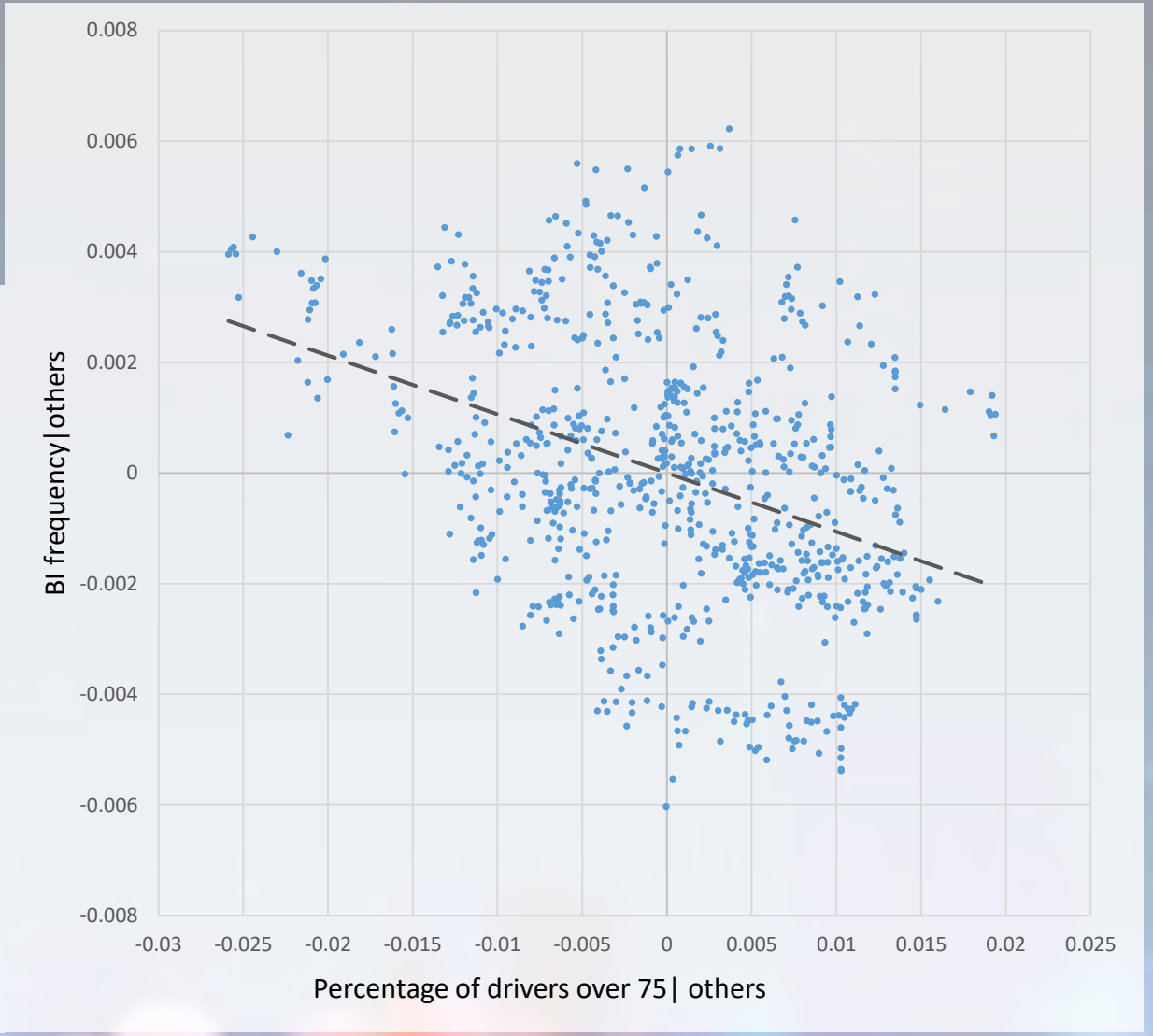
- Drivers per lane mile has a positive relationship with bodily injury frequency.





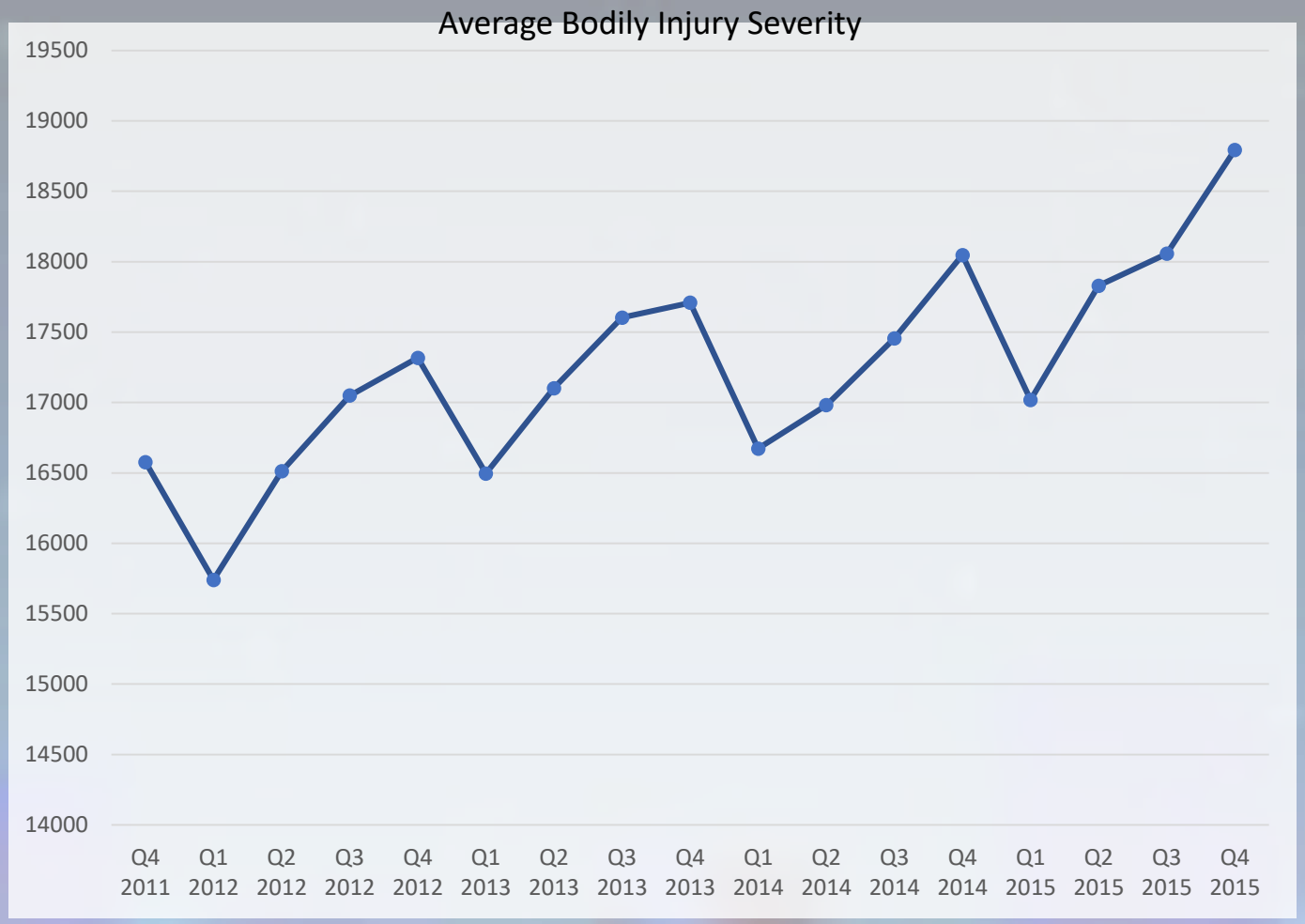
Bodily Injury Frequency

Both drivers under 20 and drivers over 75 have negative relationships with bodily injury frequency.



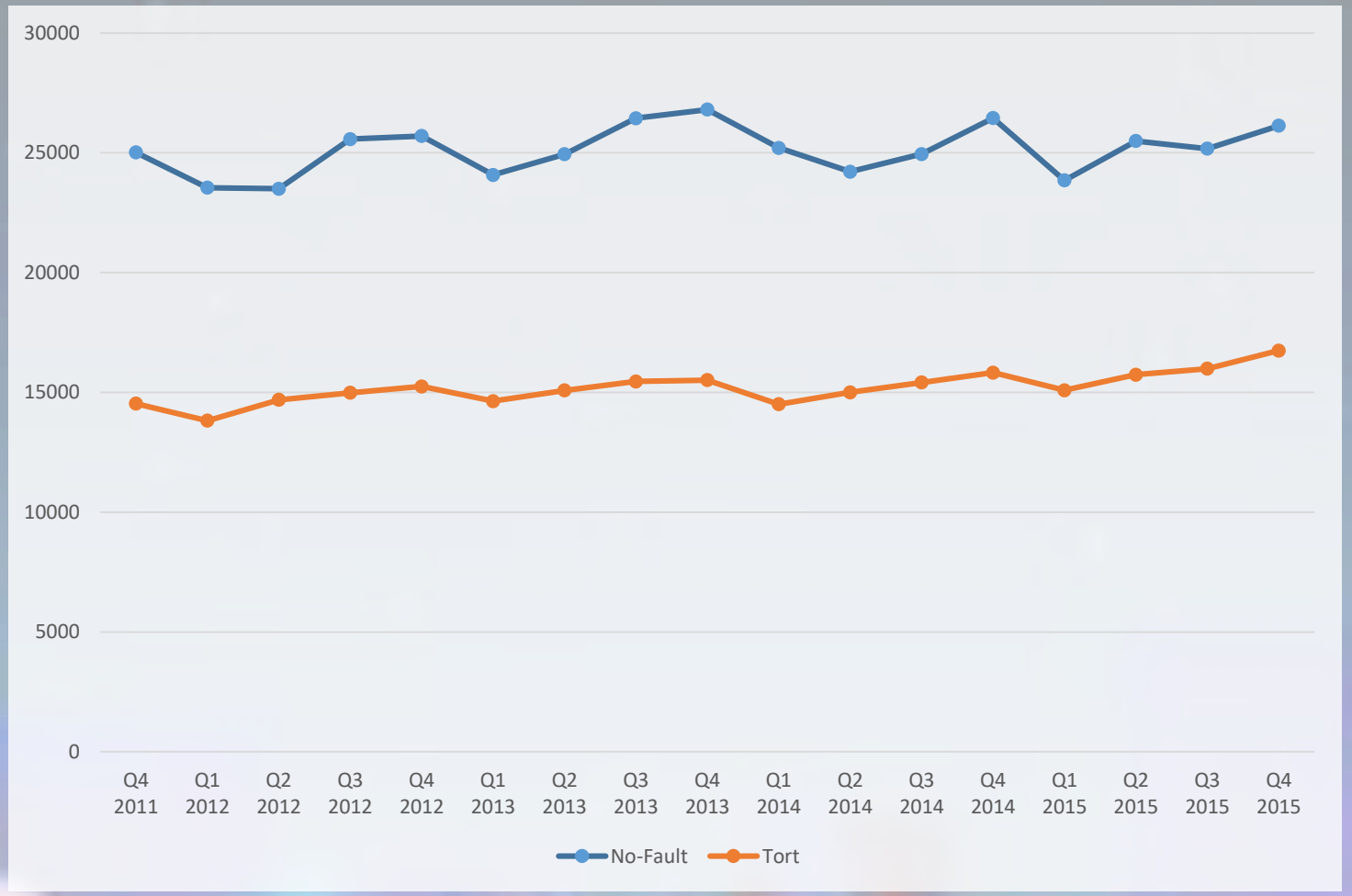
Bodily Injury Severity

- Bodily injury has strong seasonal and inflationary trends



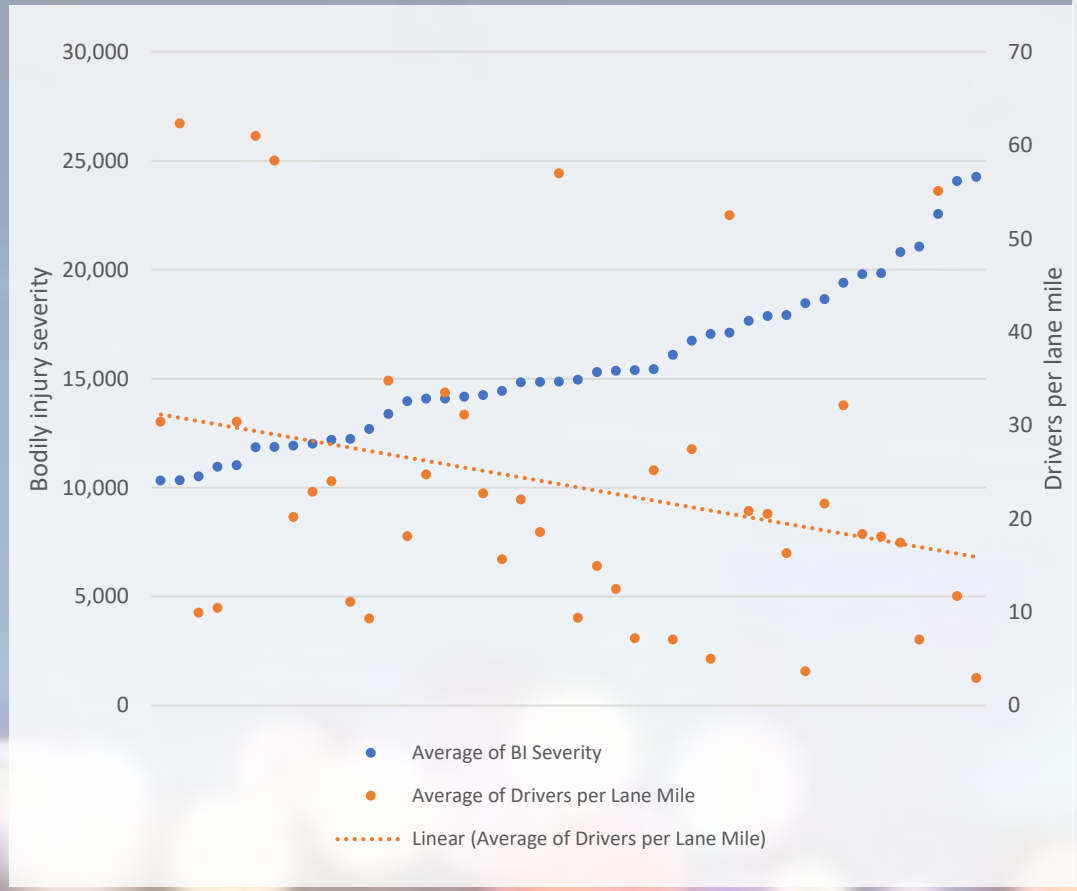
Bodily Injury Severity

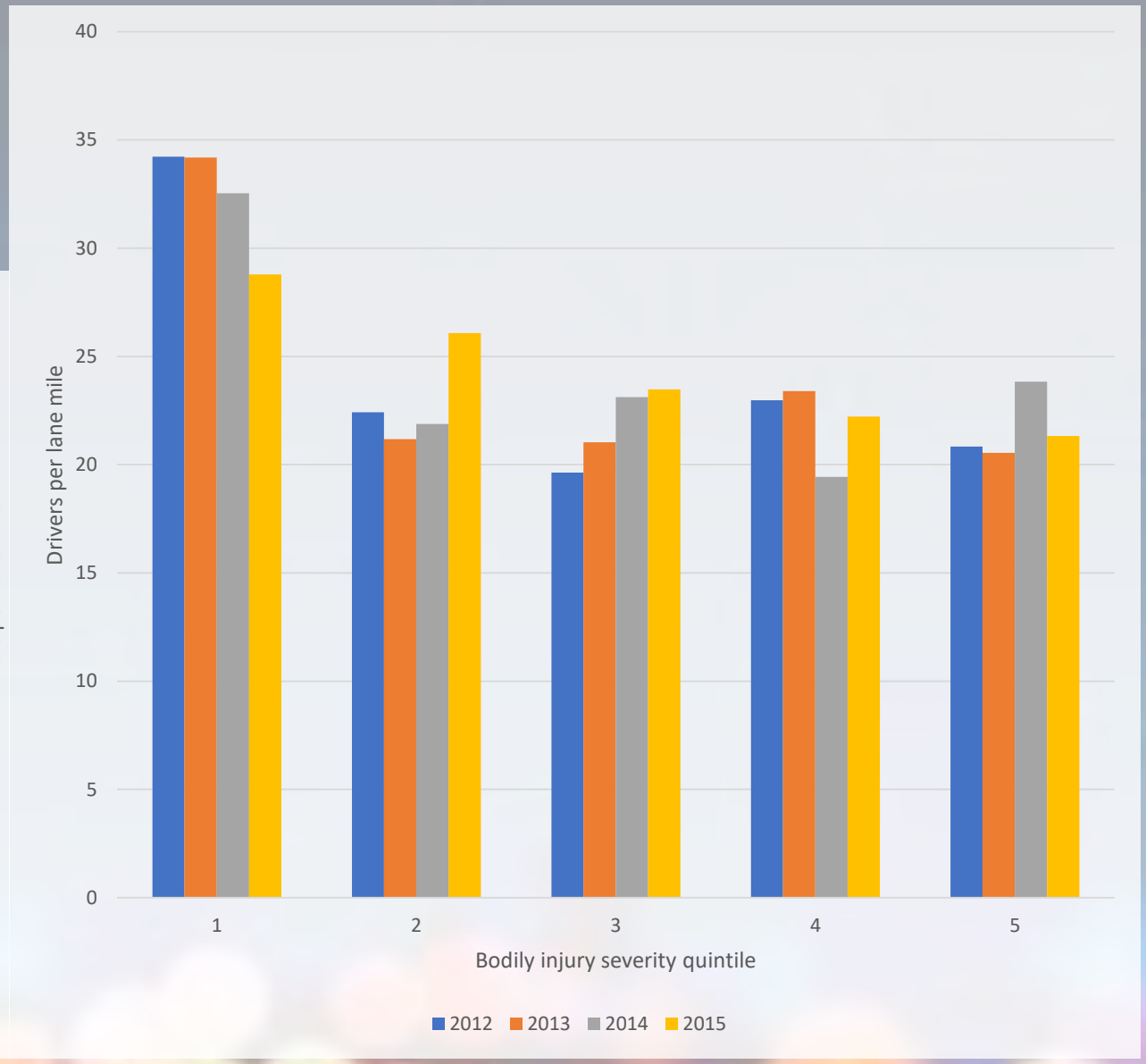
- Fault system is by far the most important variable.
- States with no-fault insurance laws have significantly higher bodily injury severity than states with tort systems.



Bodily Injury Severity

- Bodily injury severity is negatively correlated with drivers per lane mile.

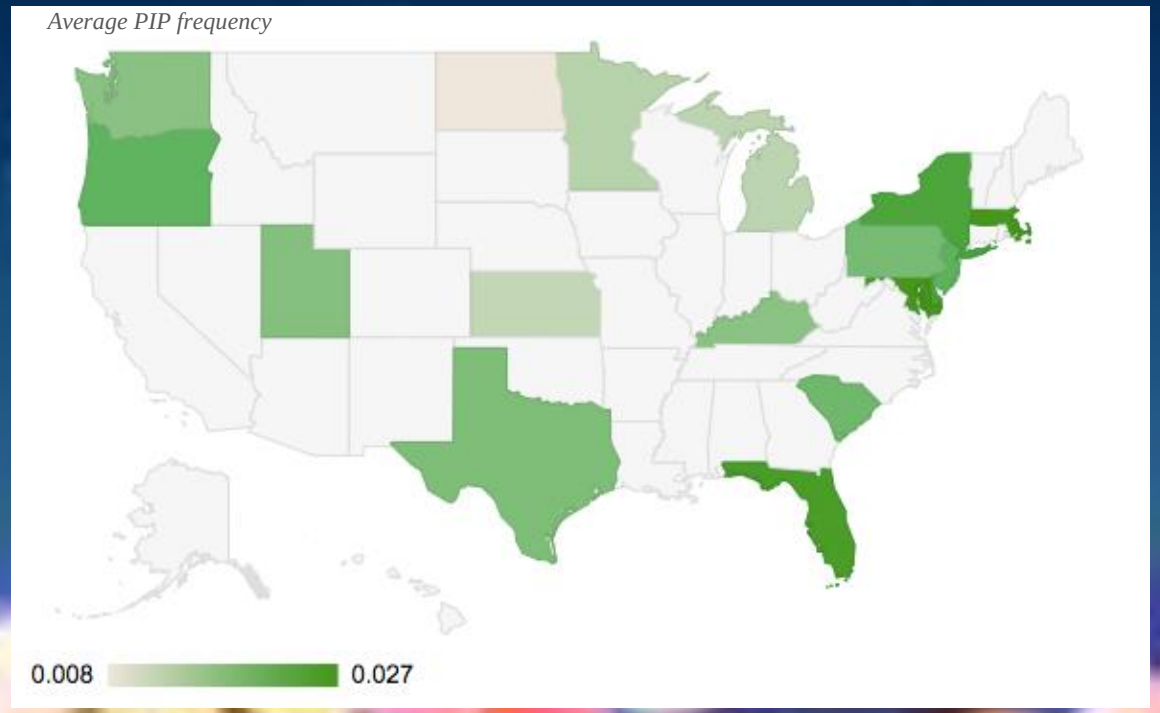


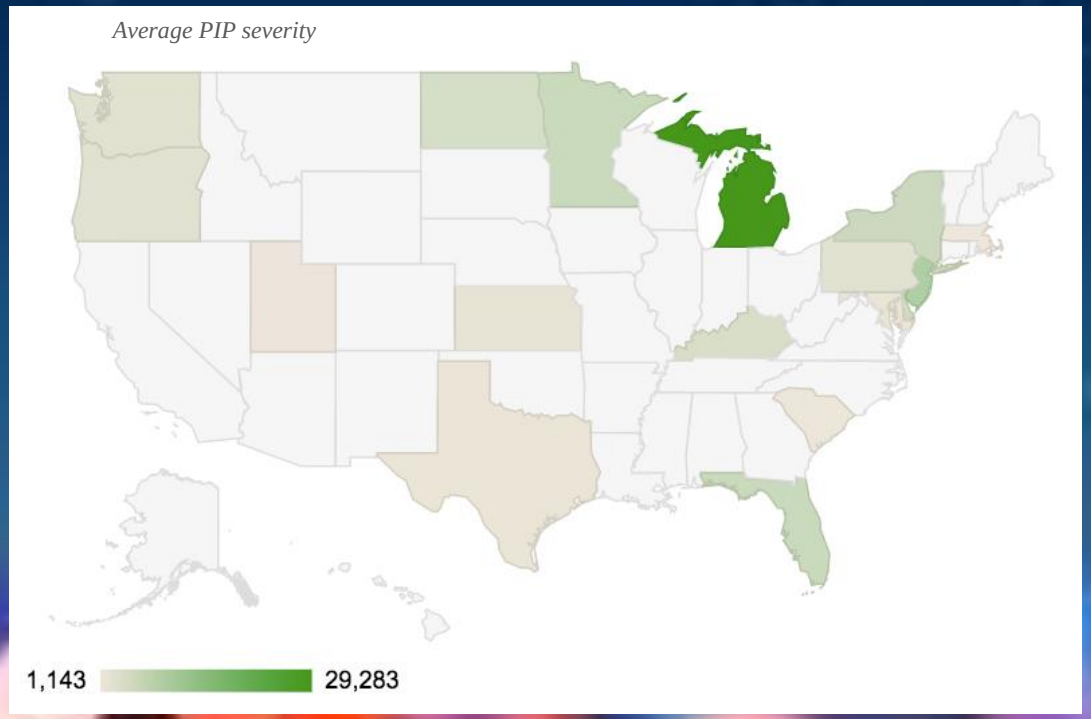


Personal Injury Protection

PIP insurance is required in states with no-fault insurance laws.

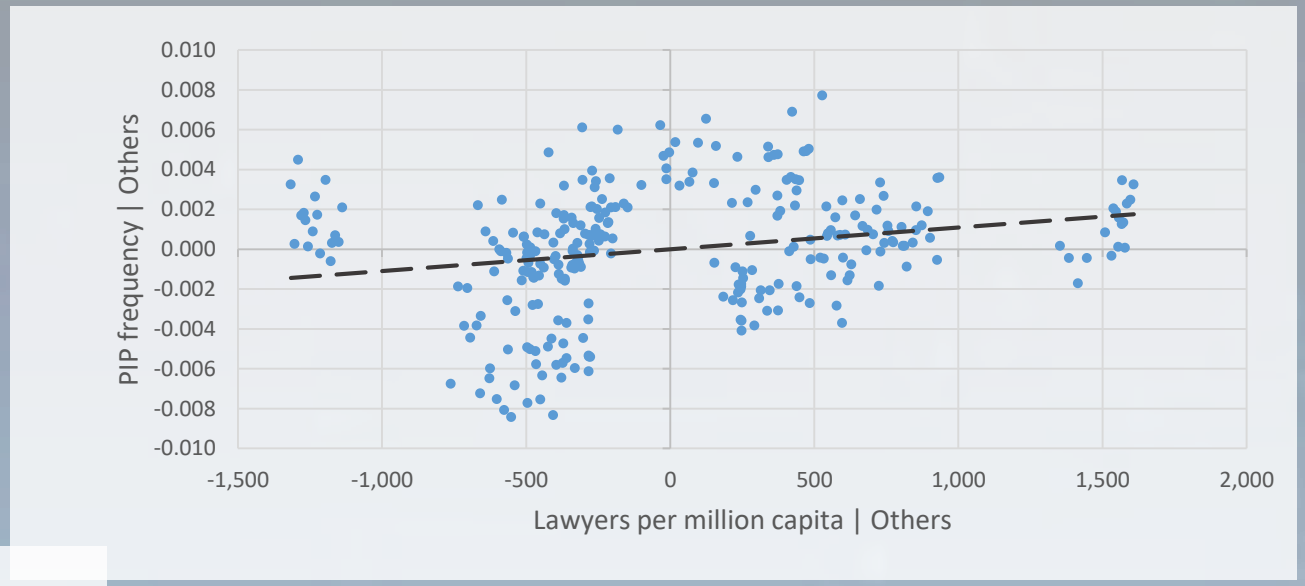
PIP insurance pays for your medical bills, lost wages, etc. if you are injured in an accident, regardless of who was at fault.

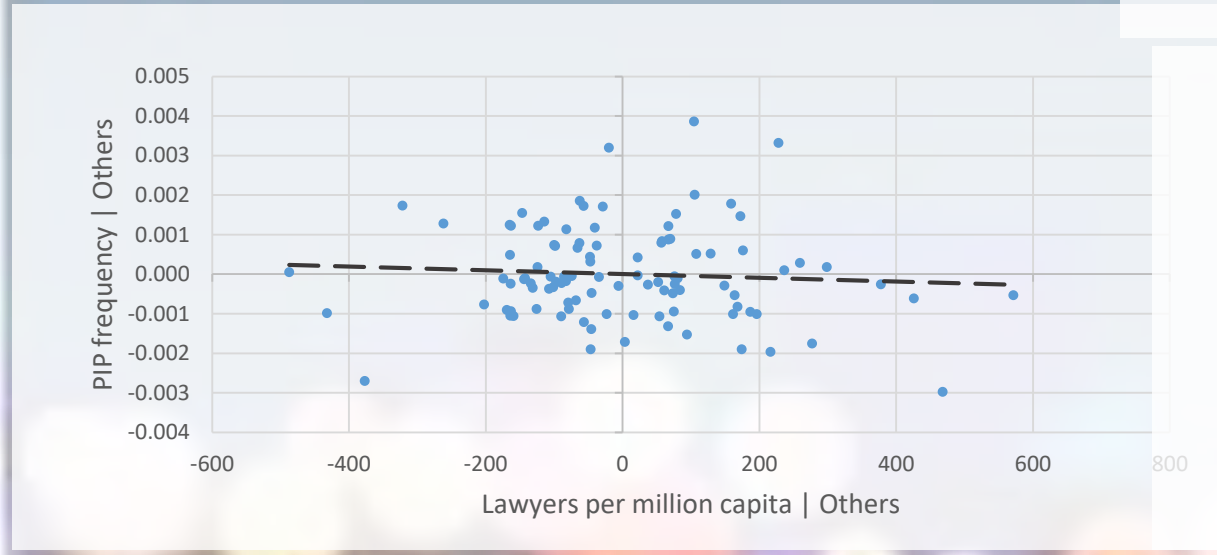


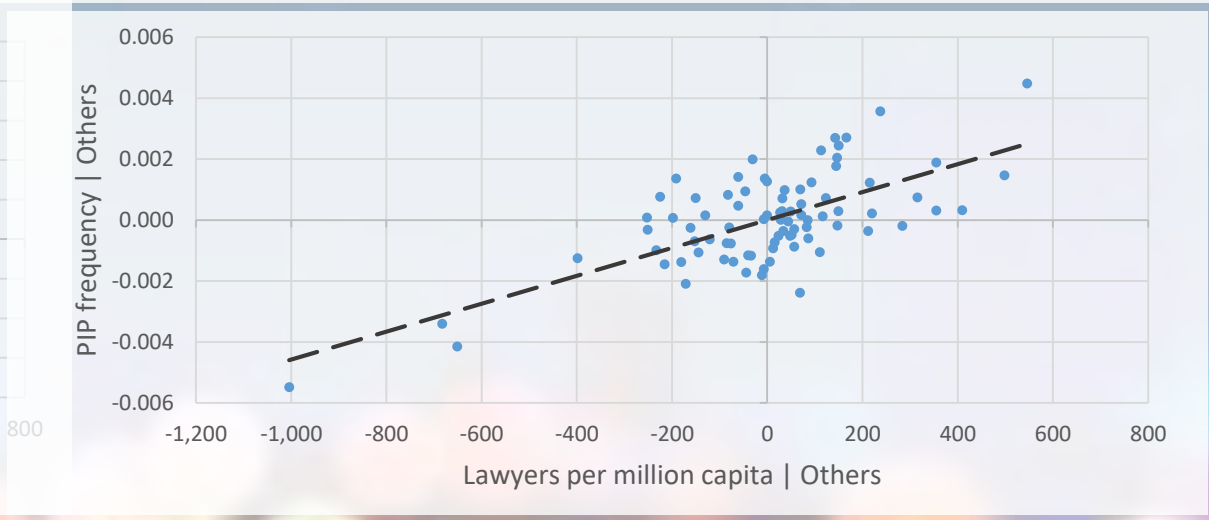


Personal Injury Protection Frequency

- When looking at all states, lawyers per million capita is positively related to PIP frequency
- The effect is driven completely by verbal threshold states.

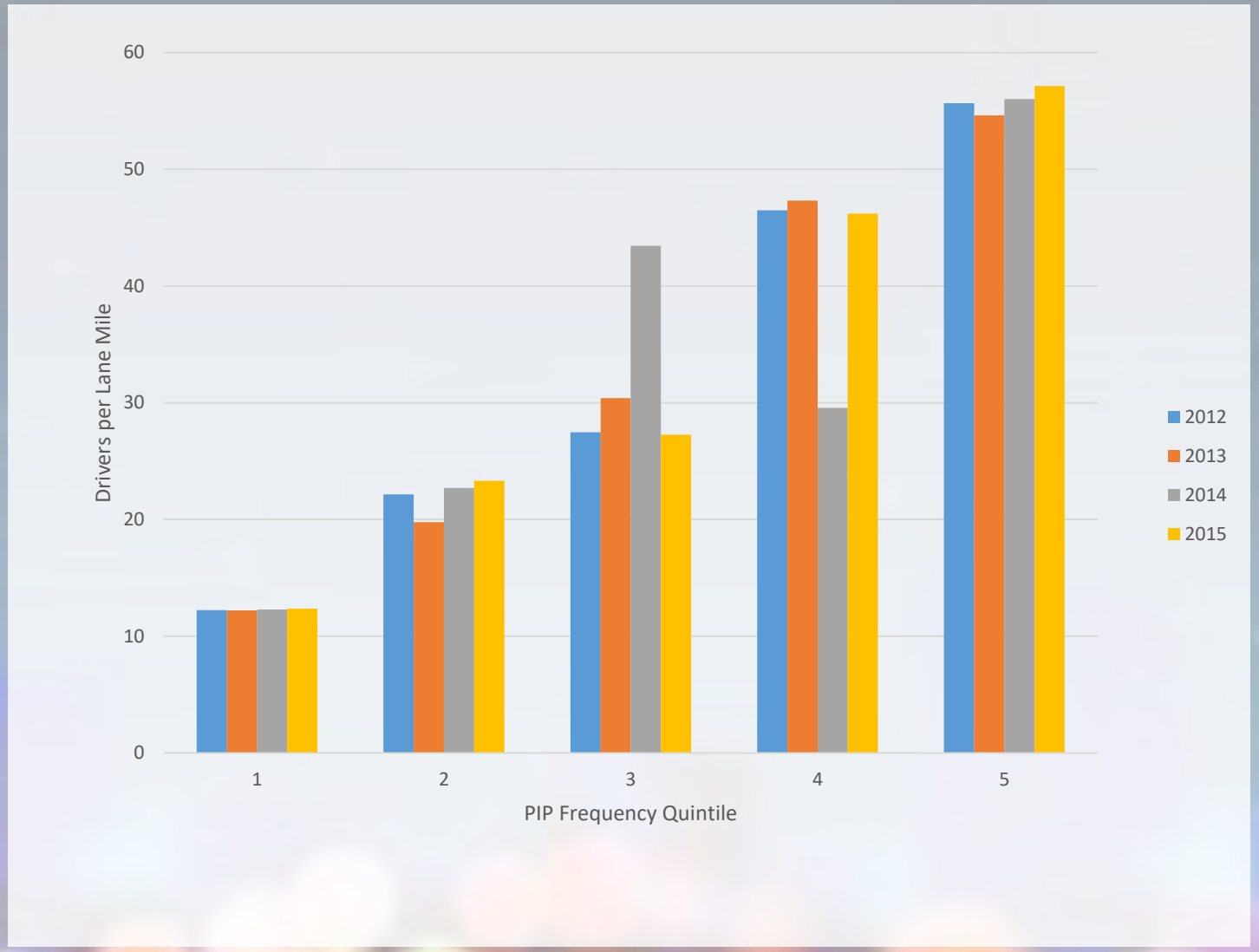






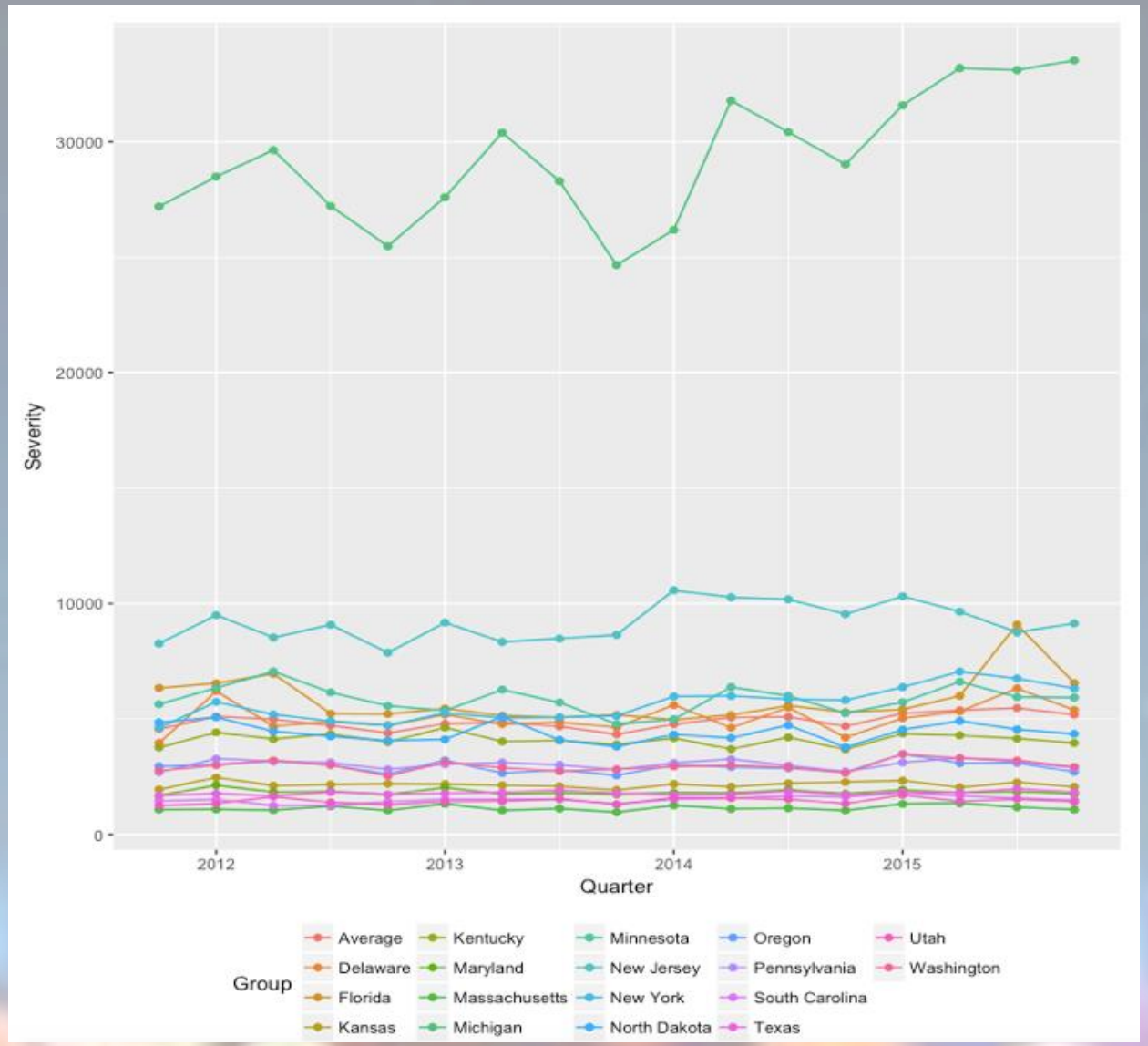
Personal Injury Protection Frequency

- Personal injury protection frequency is positively related to various measures of road congestion.



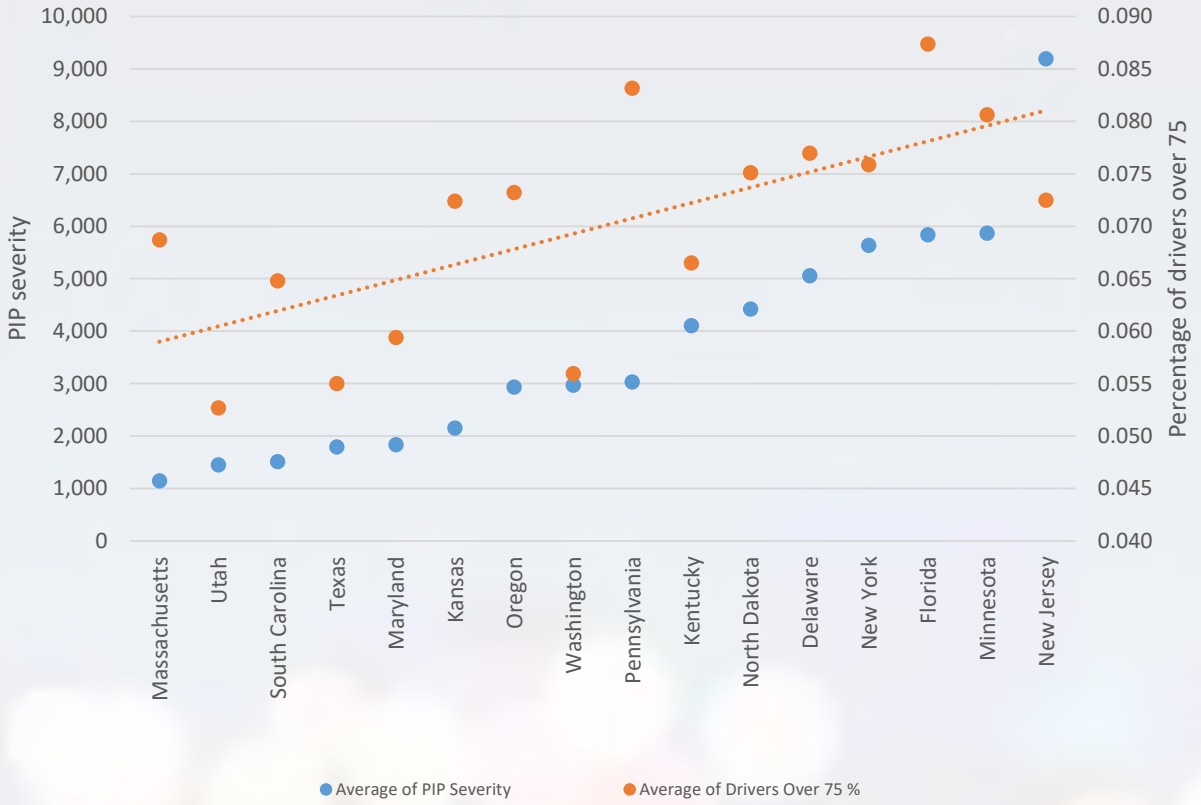
Personal Injury Protection Severity

- Michigan is an extreme outlier for PIP severity because of a unique no-fault insurance law.
- We removed it from this part of the analysis.



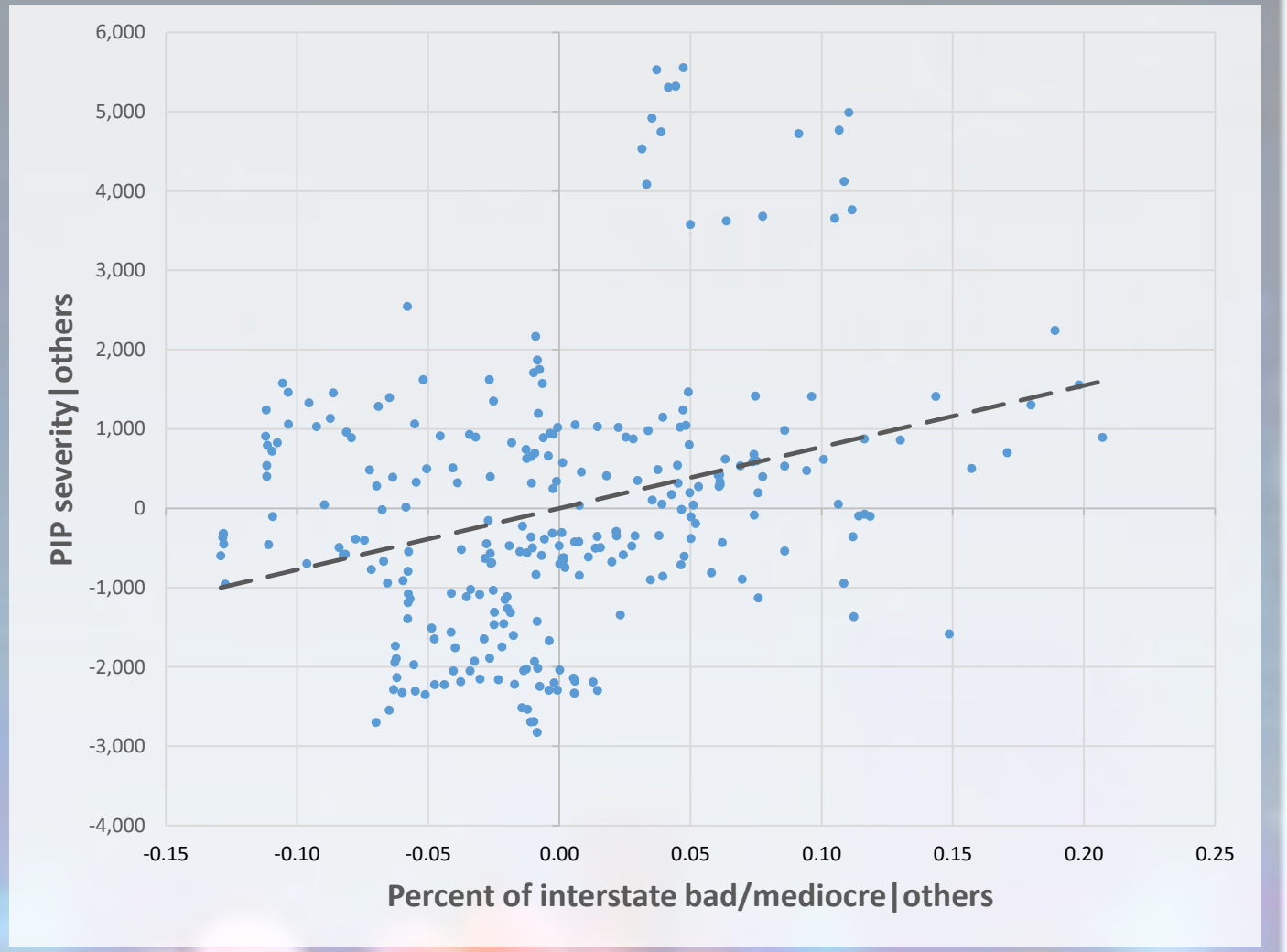
Personal Injury Protection Severity

- Percentage of drivers over 75 has a strong positive relationship with PIP severity.



Personal Injury Protection Severity

- Percentage of interstate miles labelled mediocre or bad has a positive relationship with PIP severity.
- This is true despite the inflationary trend in PIP severity and a negative trend in the percentage of interstate deemed mediocre/bad over time

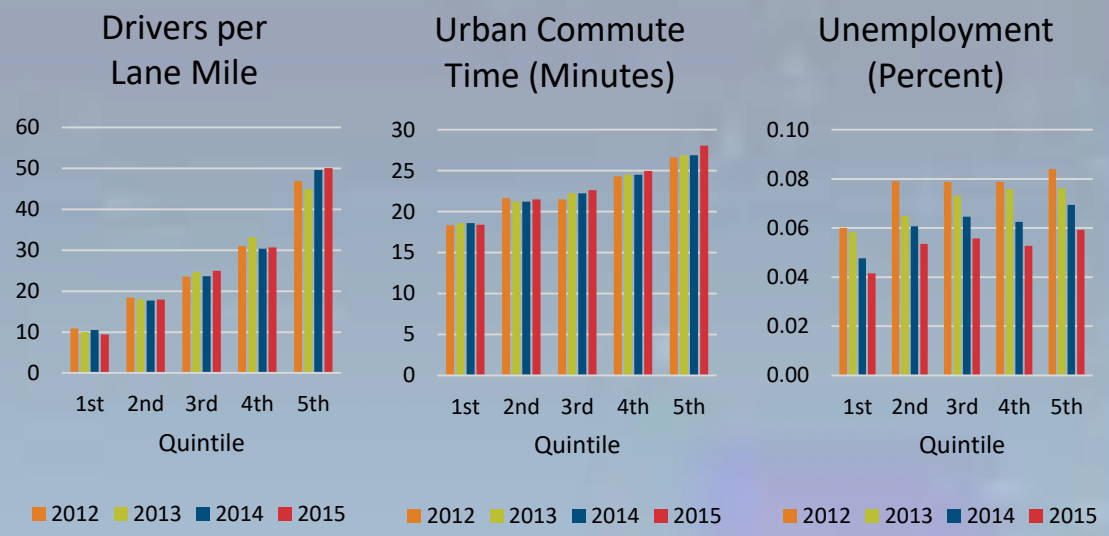


Collision

- Congestion is positively related to collision frequency
- Collision frequency has a strong seasonal pattern
- Collision severity is largely driven by economic factors

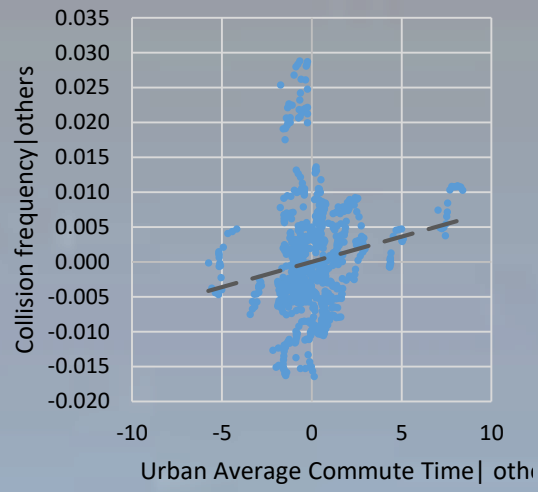
Collision Frequency

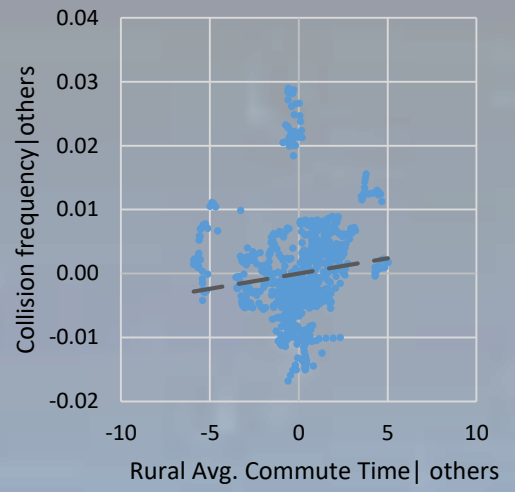
- We sorted the states by collision frequency and then divided them into quintiles.
- Congestion variables appear to be positively related to collision frequency.
- Unemployment has a strong annual trend, with little apparent relationship to collision frequency.

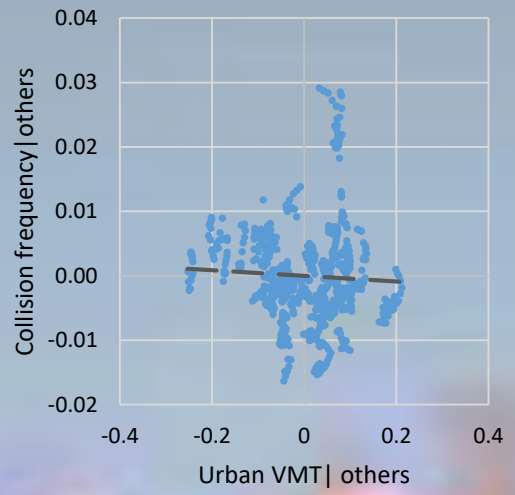


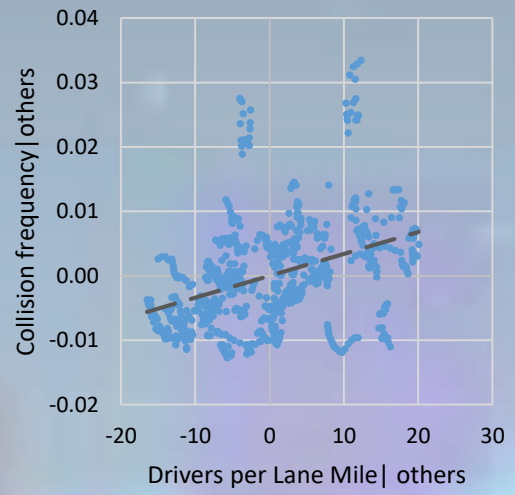
Collision Frequency

- After account for other variables, commute time variables and drivers per lane mile have positive trends with collision frequency
- Urban VMT became slightly negatively related, through the relationship is not terribly strong



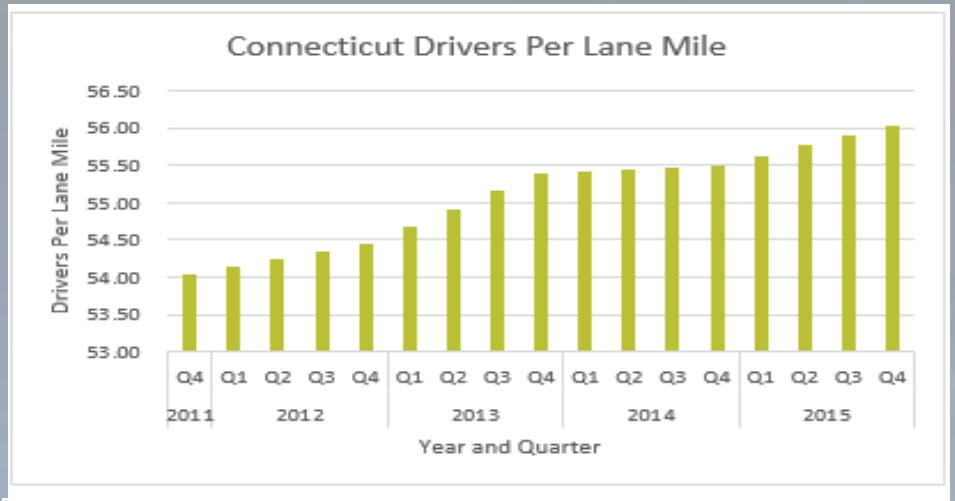


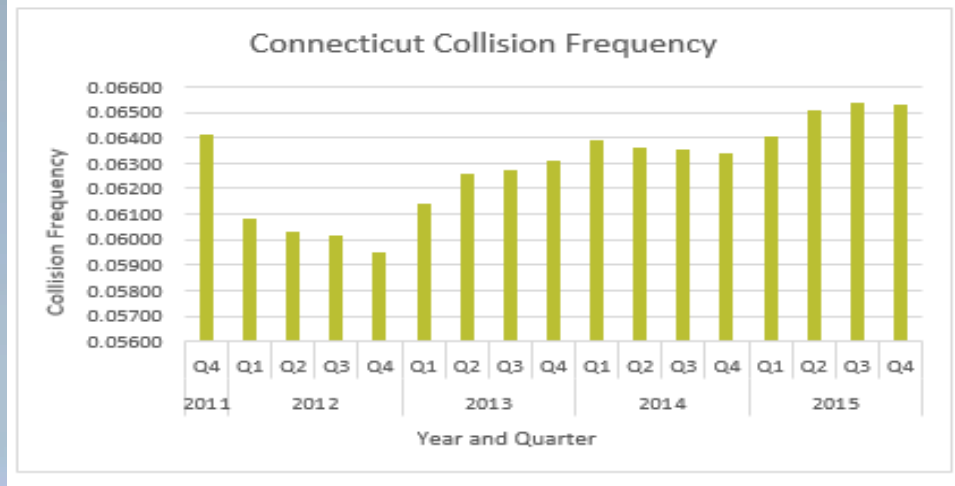




Collision Frequency

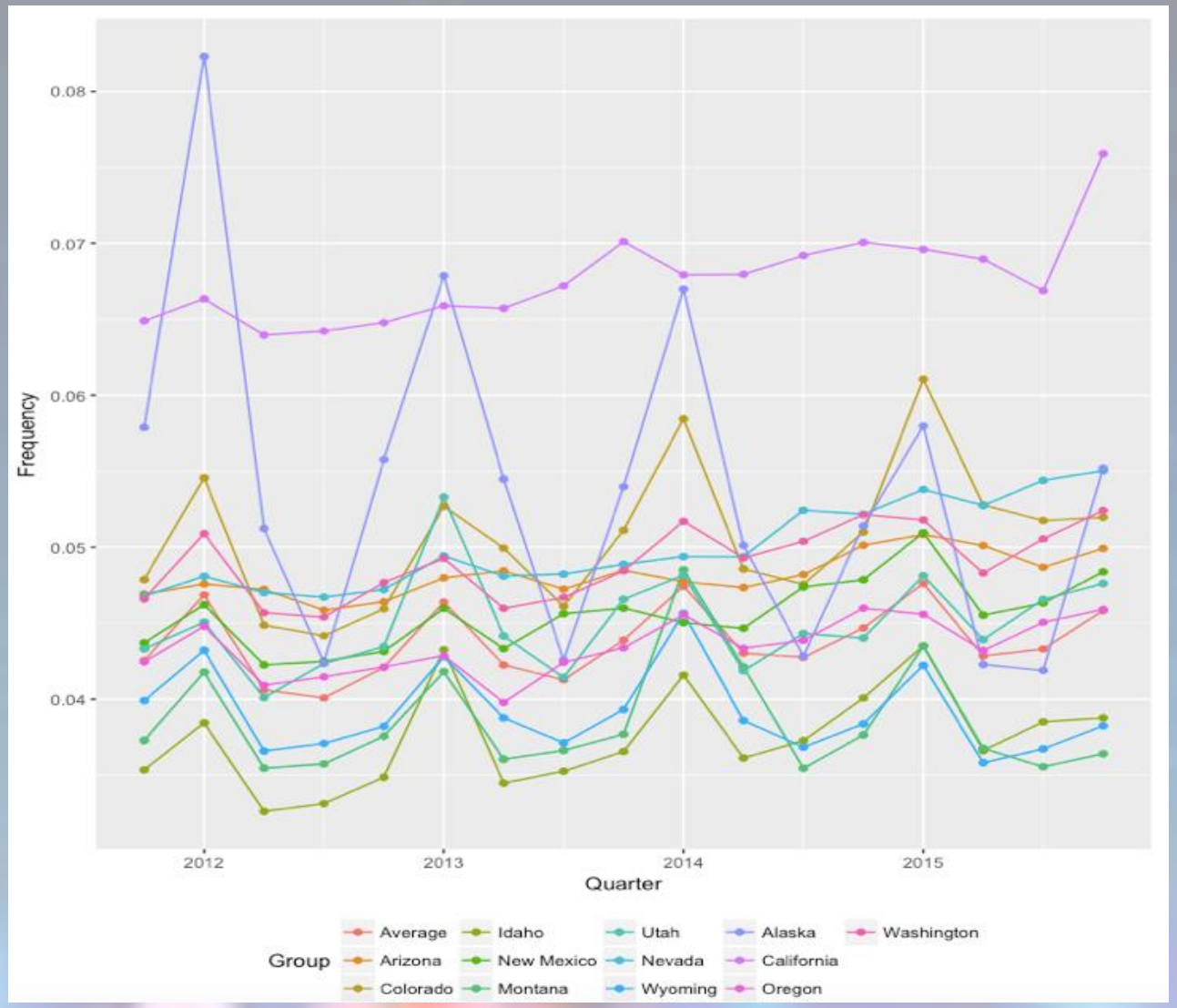
- Most states had a pretty consistent relationship between congestion and collision frequency.
- In Connecticut, the pattern didn't hold for Q4 2011.
- There was a major snow storm that quarter.





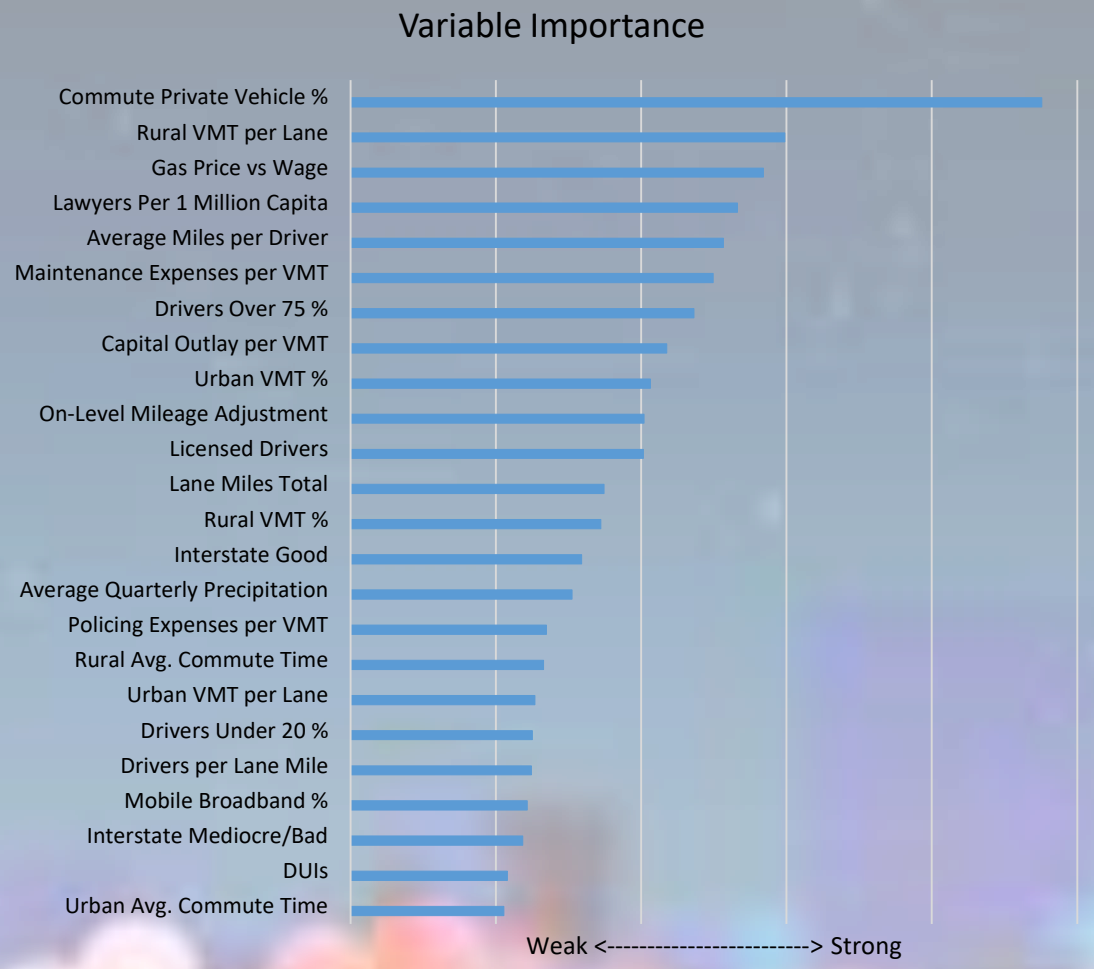
Collision Frequency

- When looking at states in the western US, those with severe winters (AK, CO, MT) have a strong seasonal pattern in their collision frequency.
- Those without severe winters (AZ, CA) do not have that same pattern



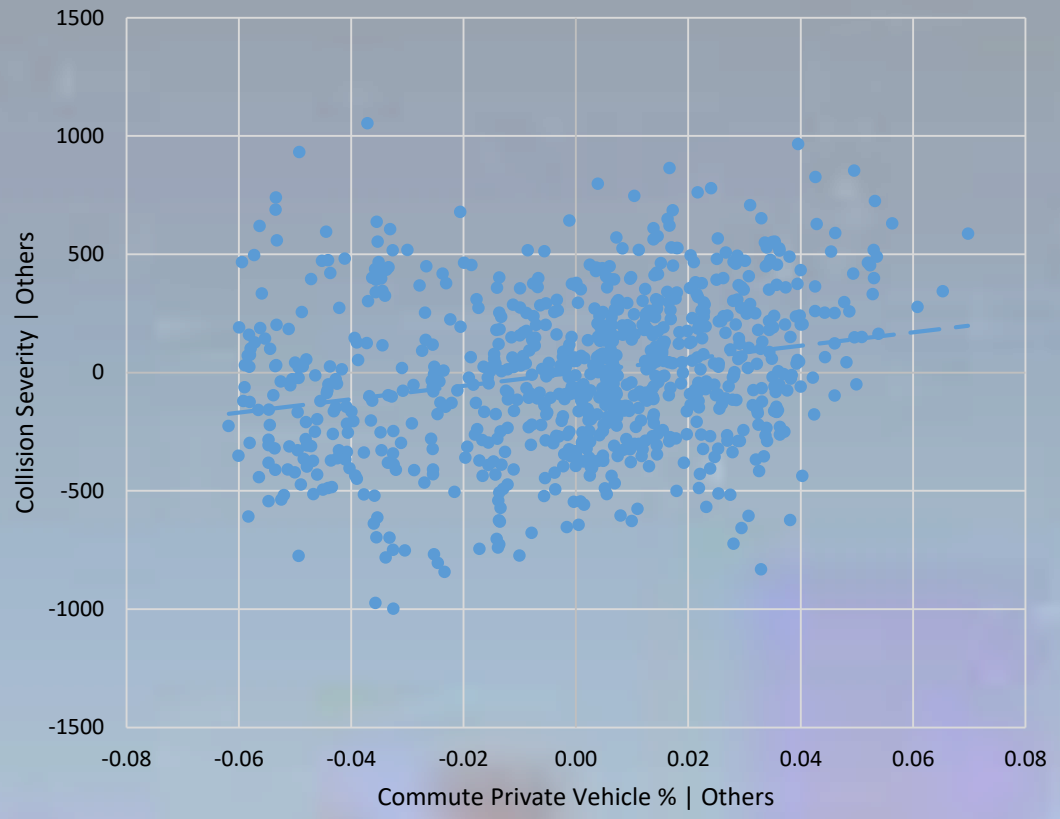
Collision Severity

- Most variables found to be important relate to the wealth of an area



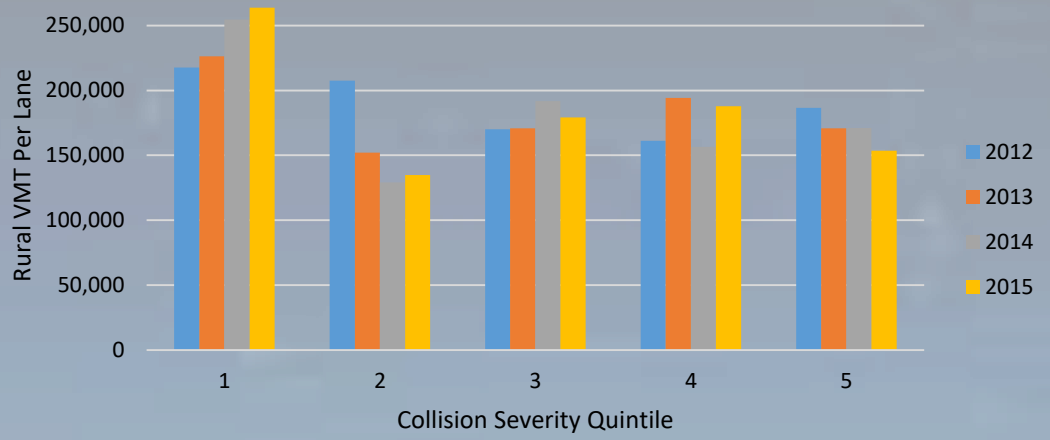
Collision Severity

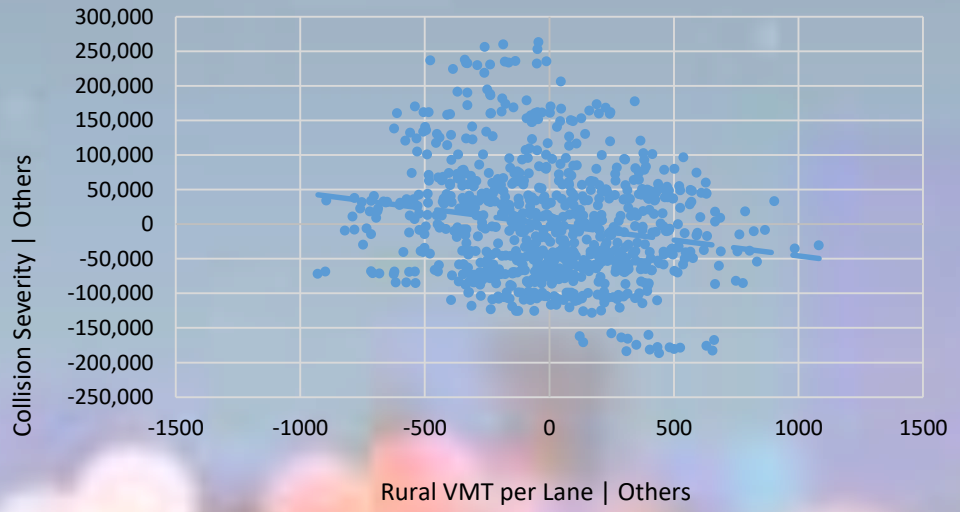
- Plot of percentages by collision by quintiles did not reveal a trend
- Percentage of commuters with private vehicles may largely be a surrogate, identifying NY



Collision Severity

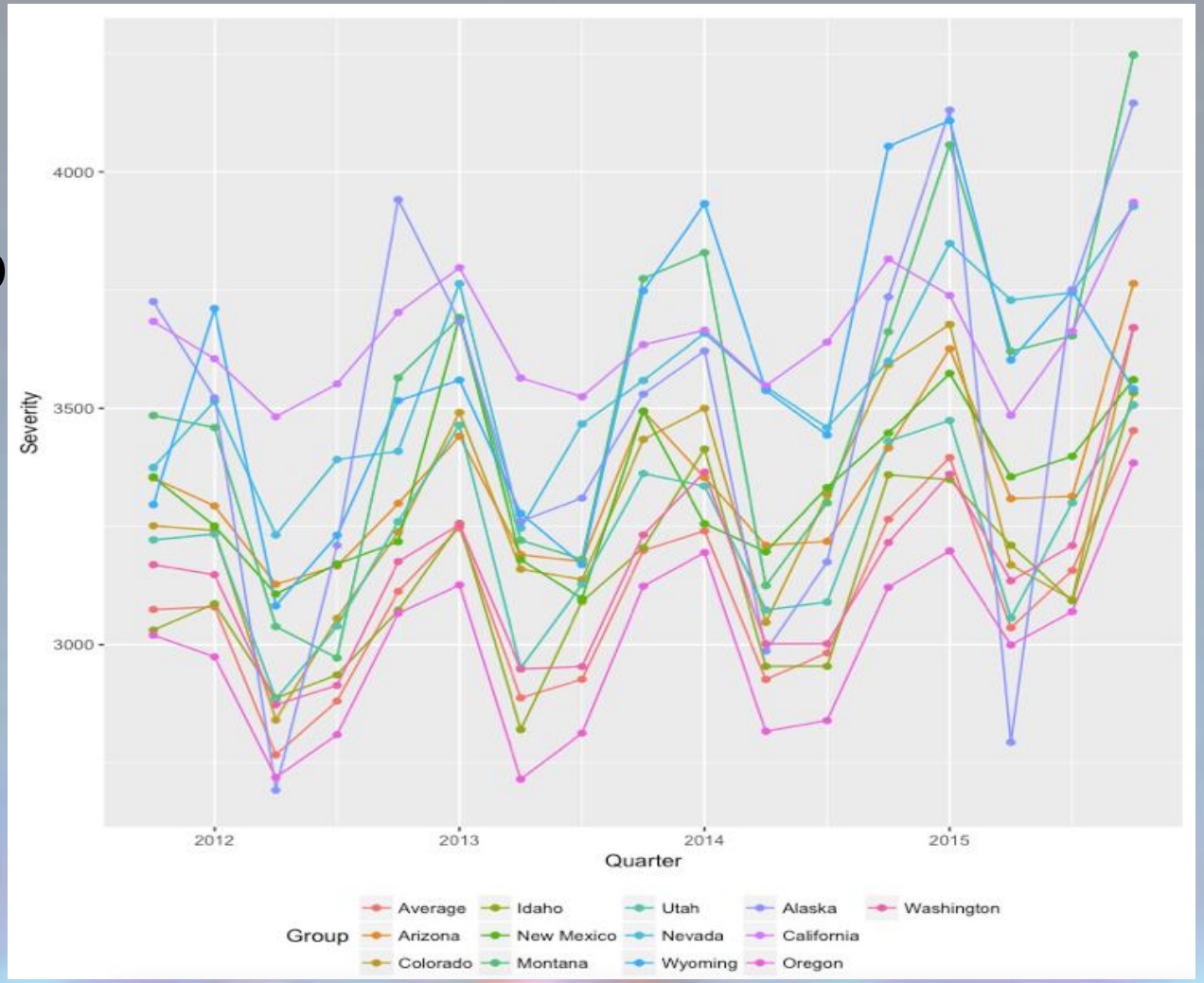
- Collision severity increases as rural vehicle miles traveled per lane decreases





Collision Severity

- A similar seasonal trend is seen in severity, though to a lesser extent.

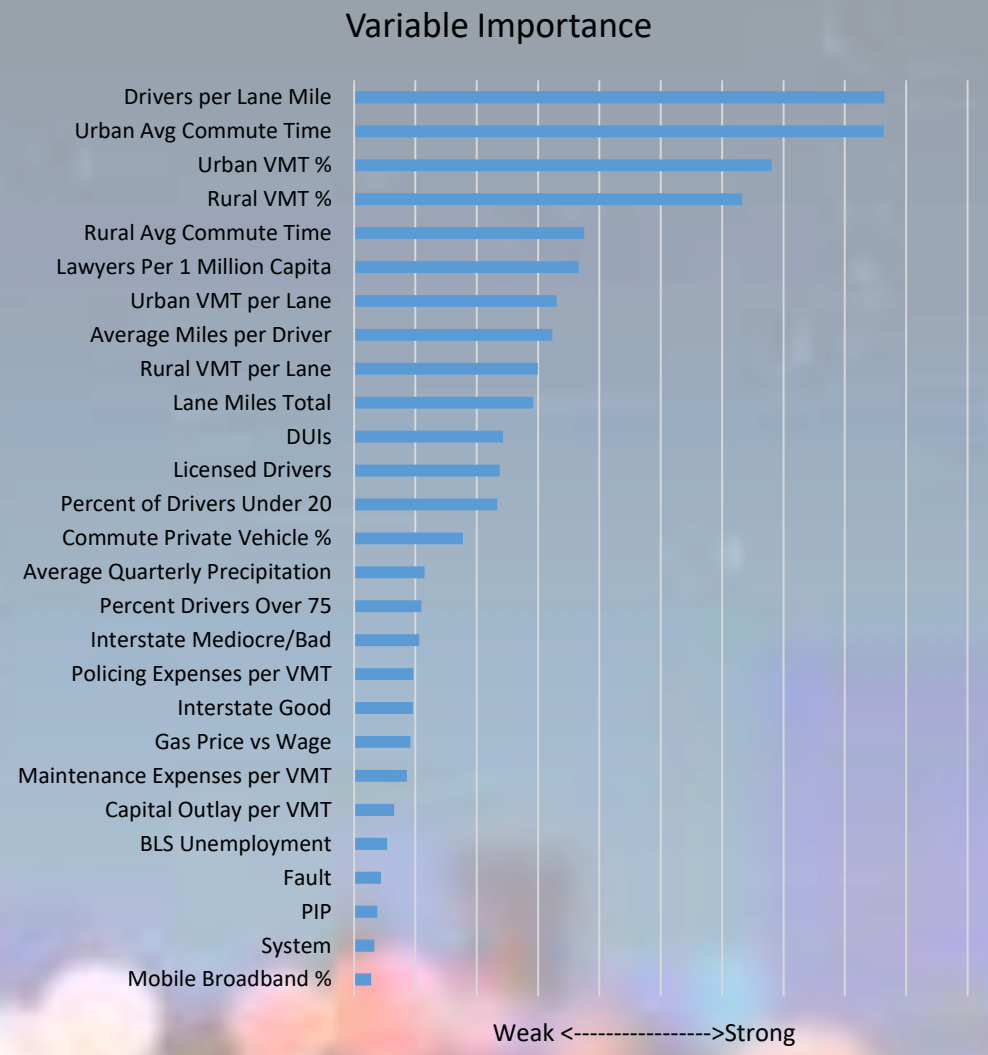


Property Damage

- Congestion is positively related to property damage frequency
- Property damage frequency analysis excludes Michigan

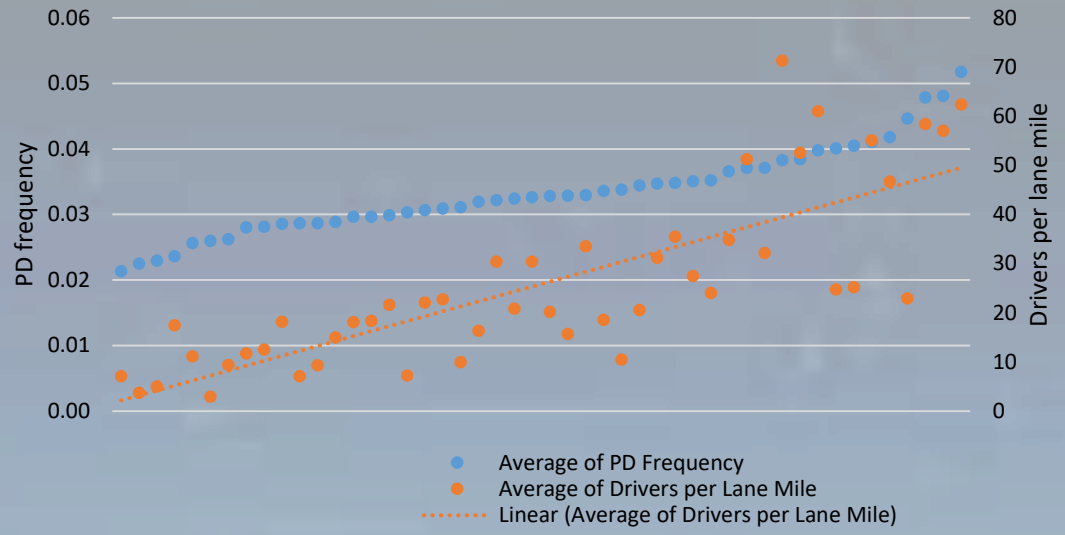
Property Damage Frequency

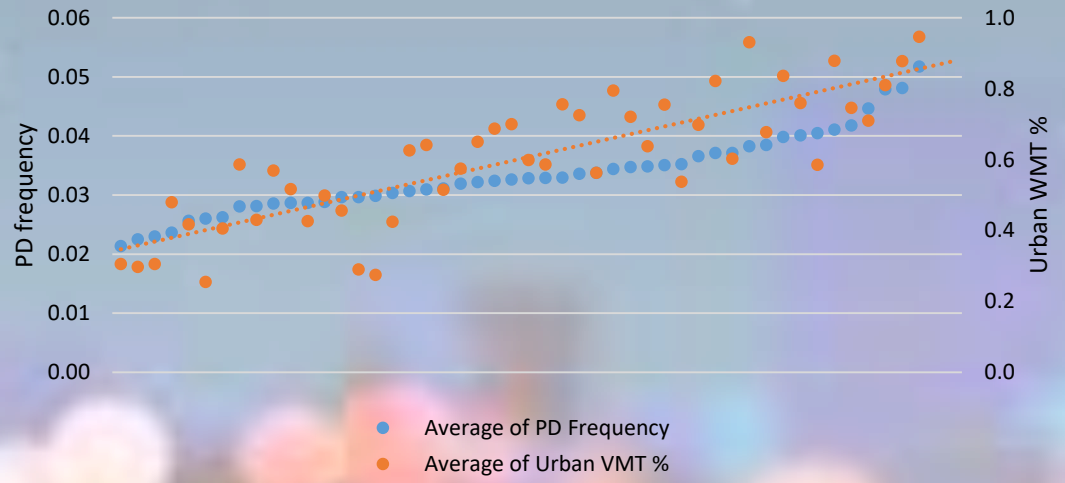
- Congestion variables were found to be some of the most useful in predicting property damage claim frequency



Property Damage Frequency

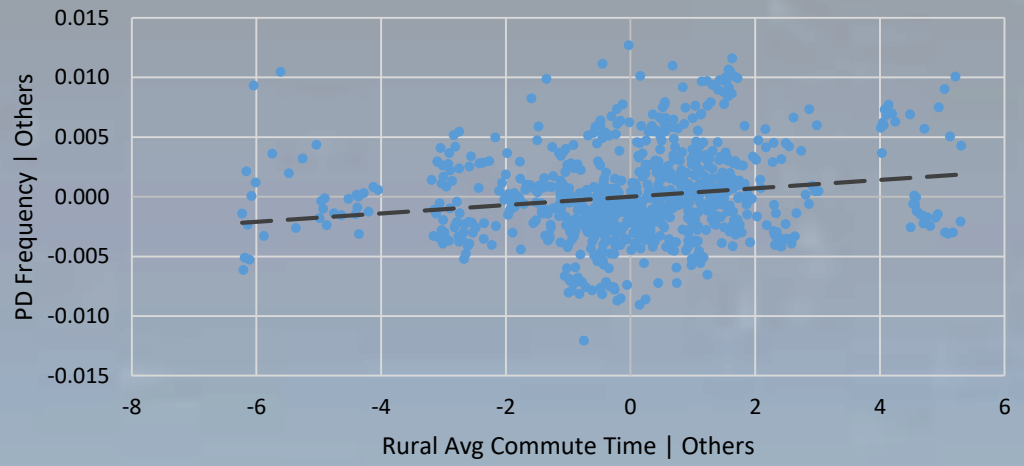
- Drivers per Lane Mile and Urban VMT have strong positive relationships with property damage frequency
- These together tell us that road congestion is a main driver of property damage frequency

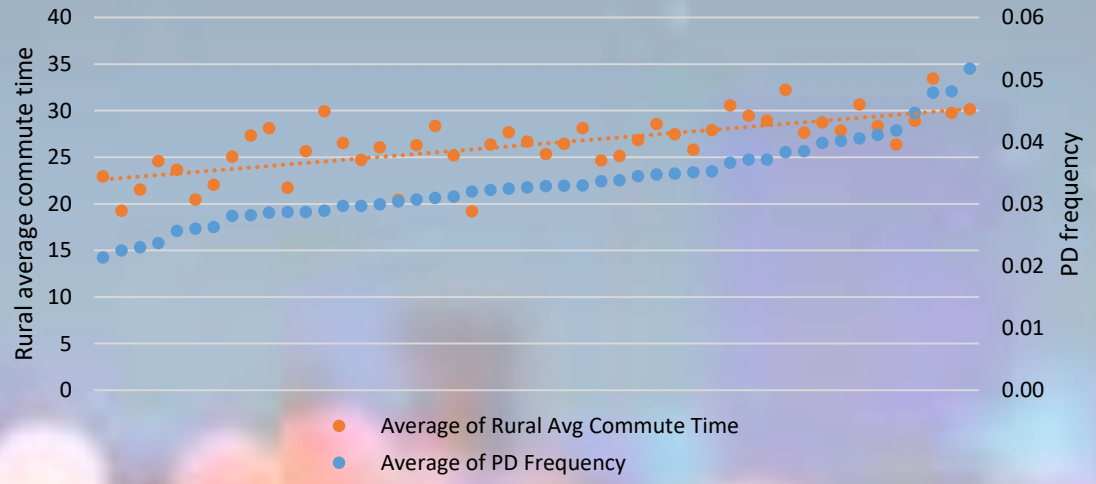




Property Damage Frequency

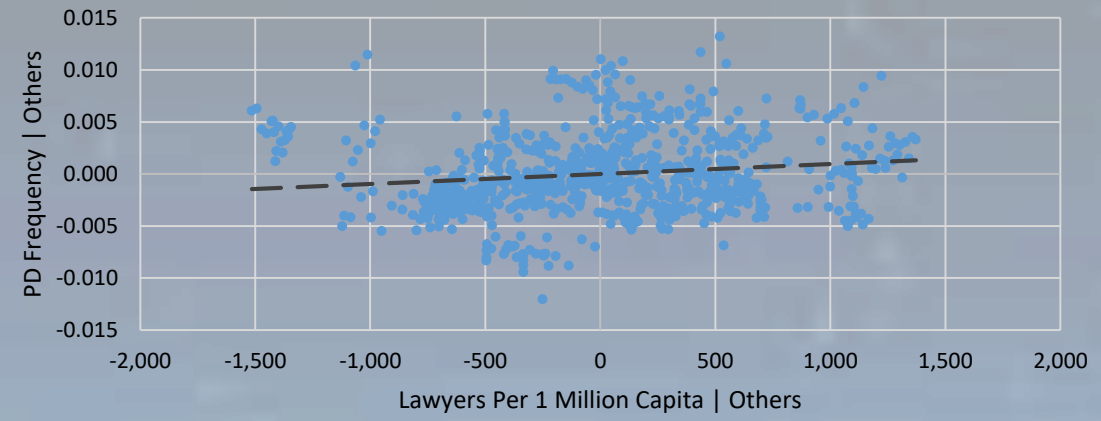
- Rural average commute time has a positive relationship with property damage frequency
- Interestingly, urban commute time had no effect

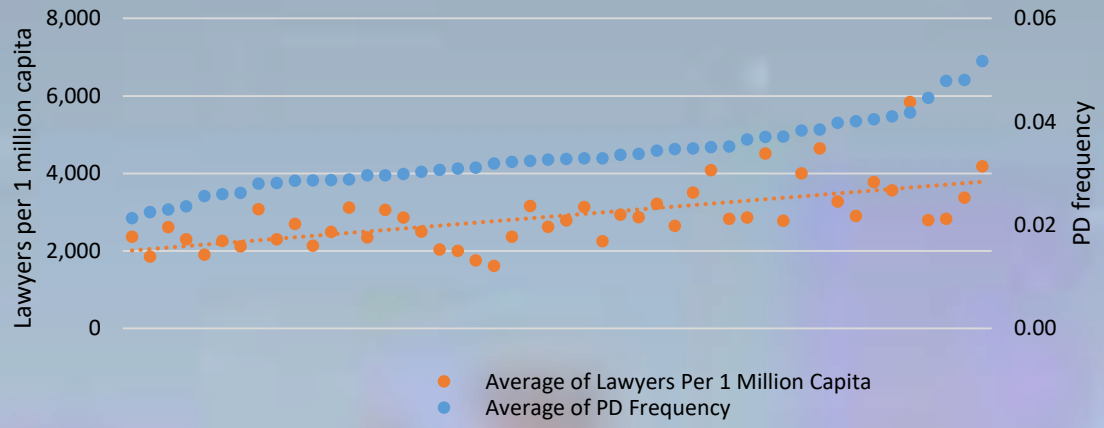




Property Damage Frequency

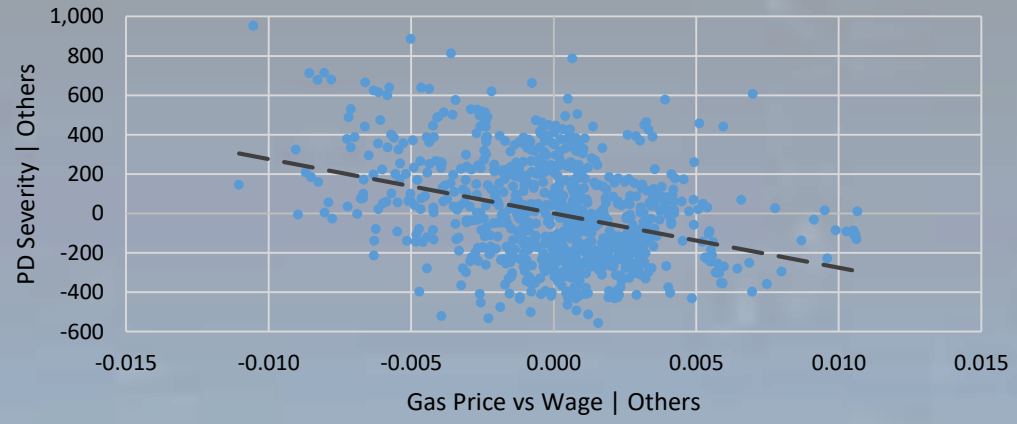
- Property damage frequency appears to be positively related to the number of lawyers per 1 million capita.

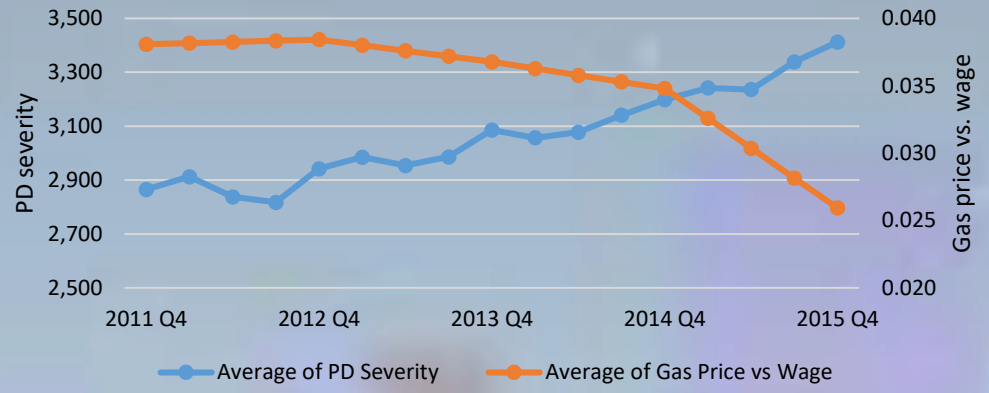




Property Damage Severity

- Property damage severity appears to be negatively related to the ratio of gas price to wage.
- But that is actually driven by the inflationary trend in PD severity and the decreasing trend in the ratio of gas price to wage.



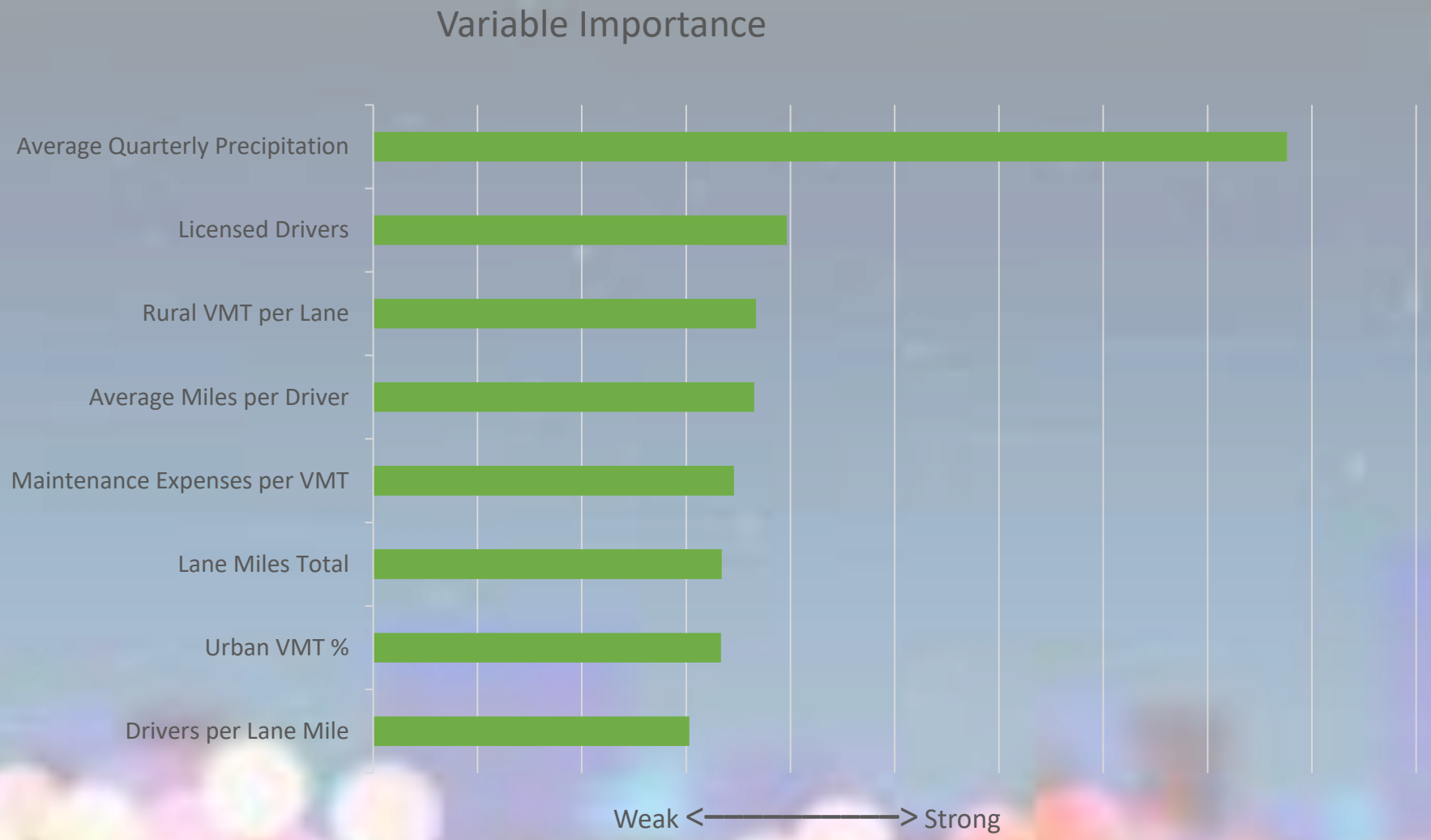



Comprehensive

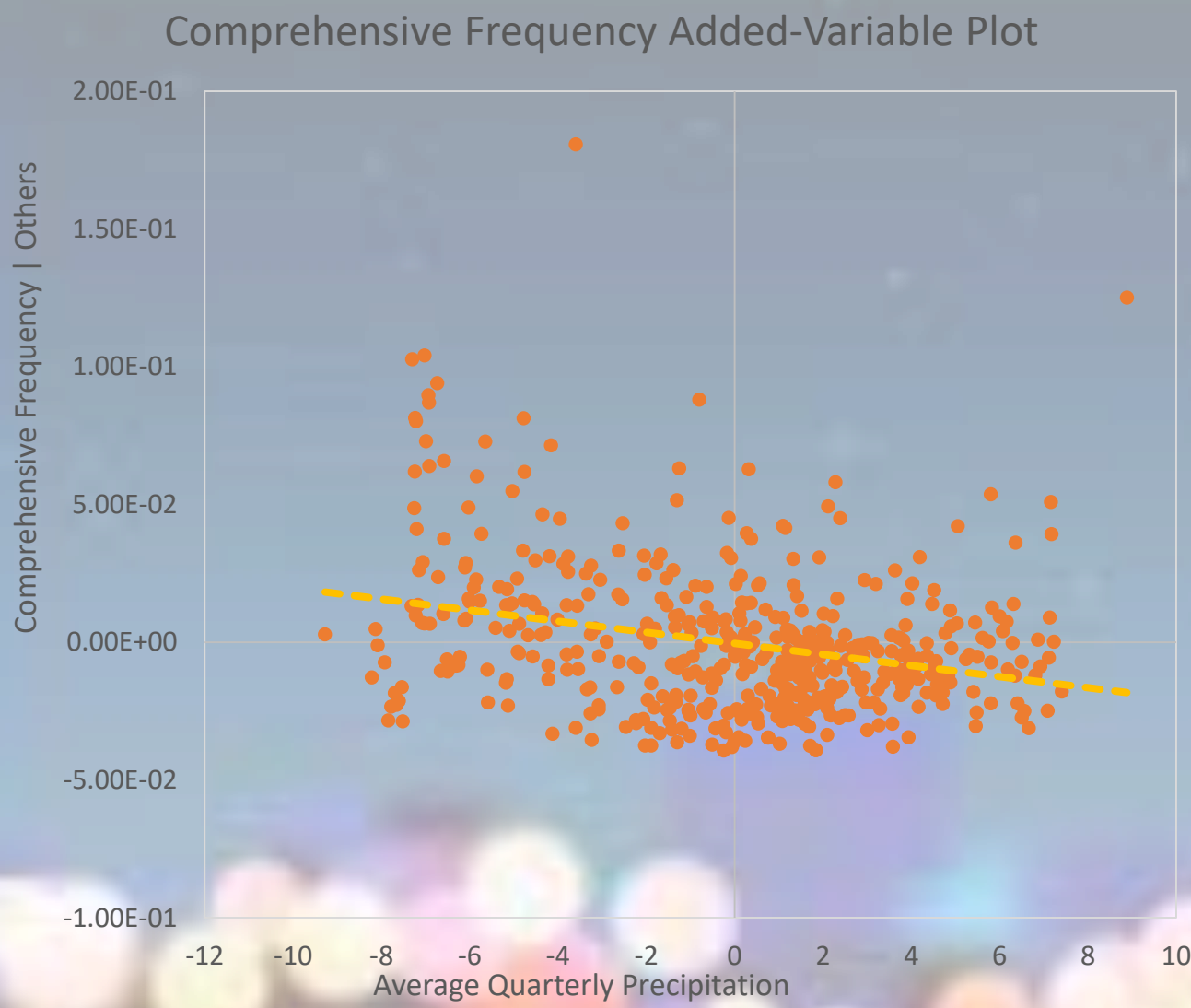
Outline

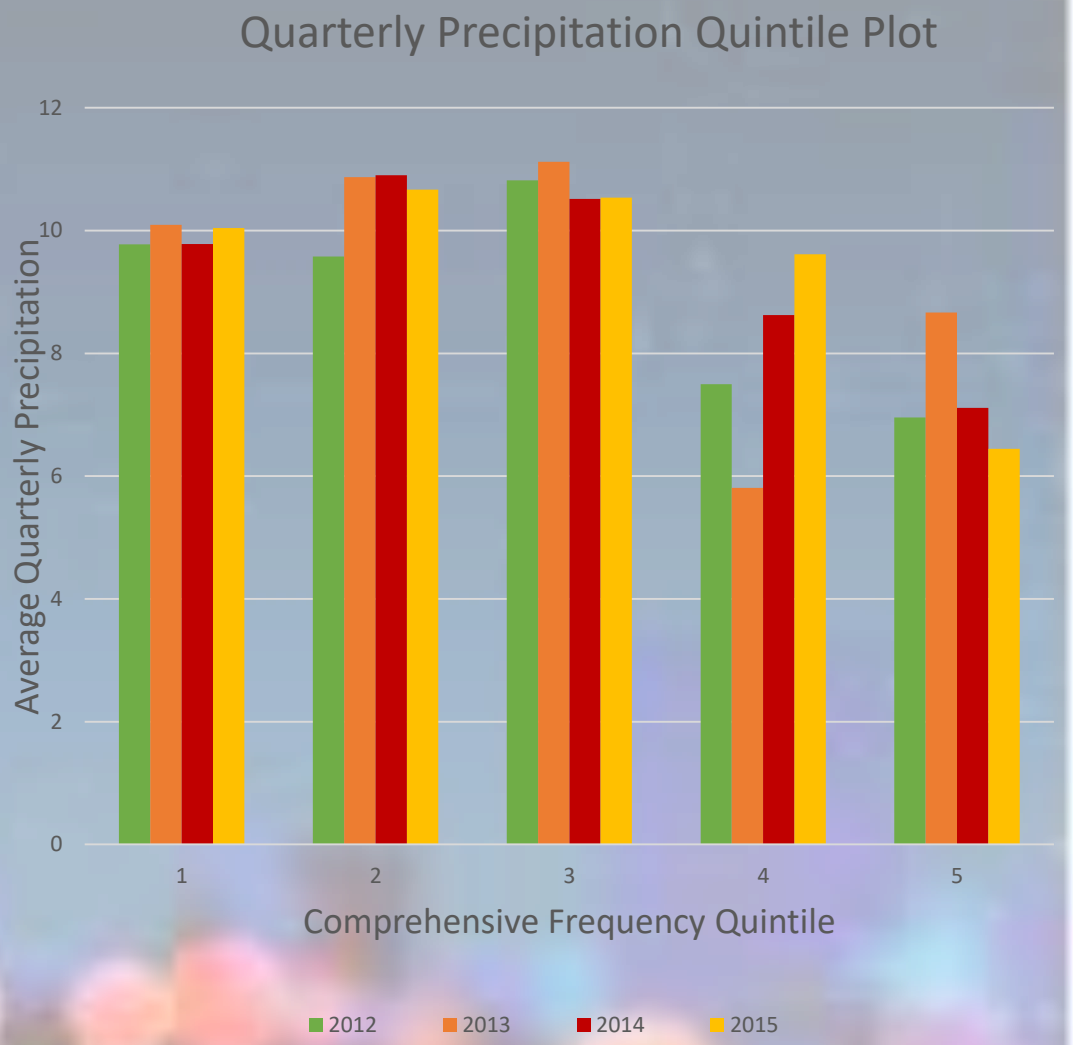
- Comprehensive claim frequency
  - Quarterly average precipitation
  - Hail
  - Windshield replacement
- Comprehensive claim severity
  - Average miles per driver
  - Drivers per lane mile
  - Natural disasters
- Relationship between frequency and severity

Frequency Drivers



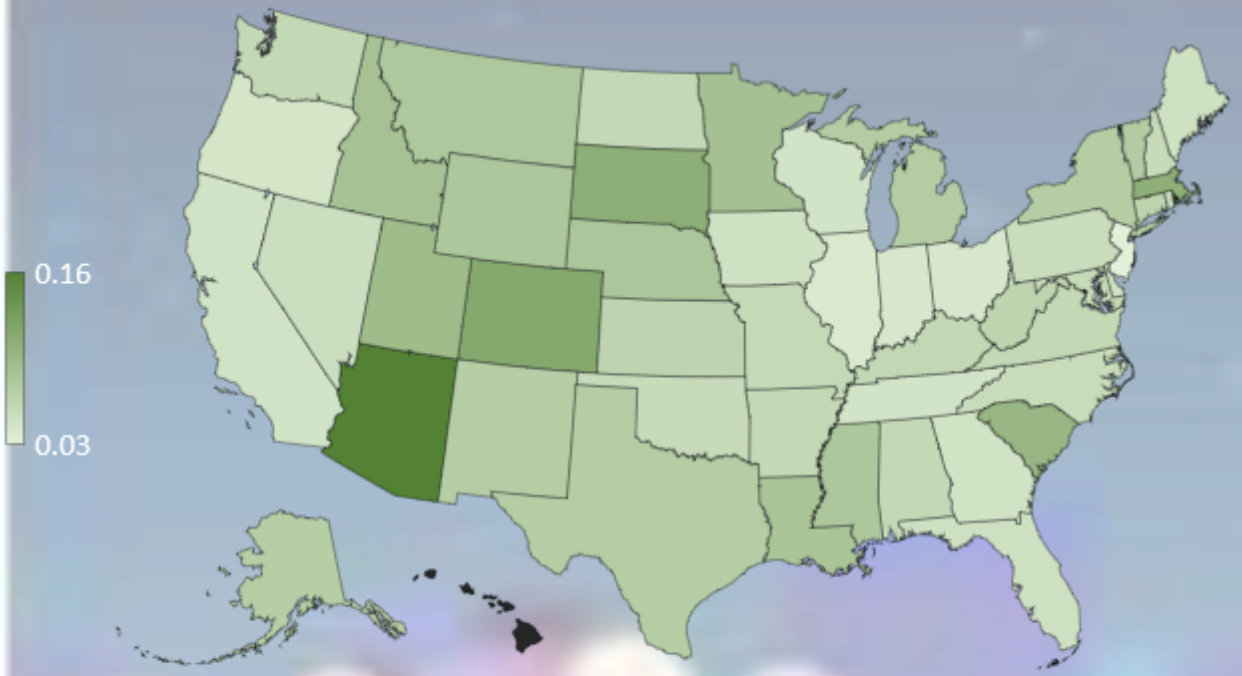
Precipitation Effect



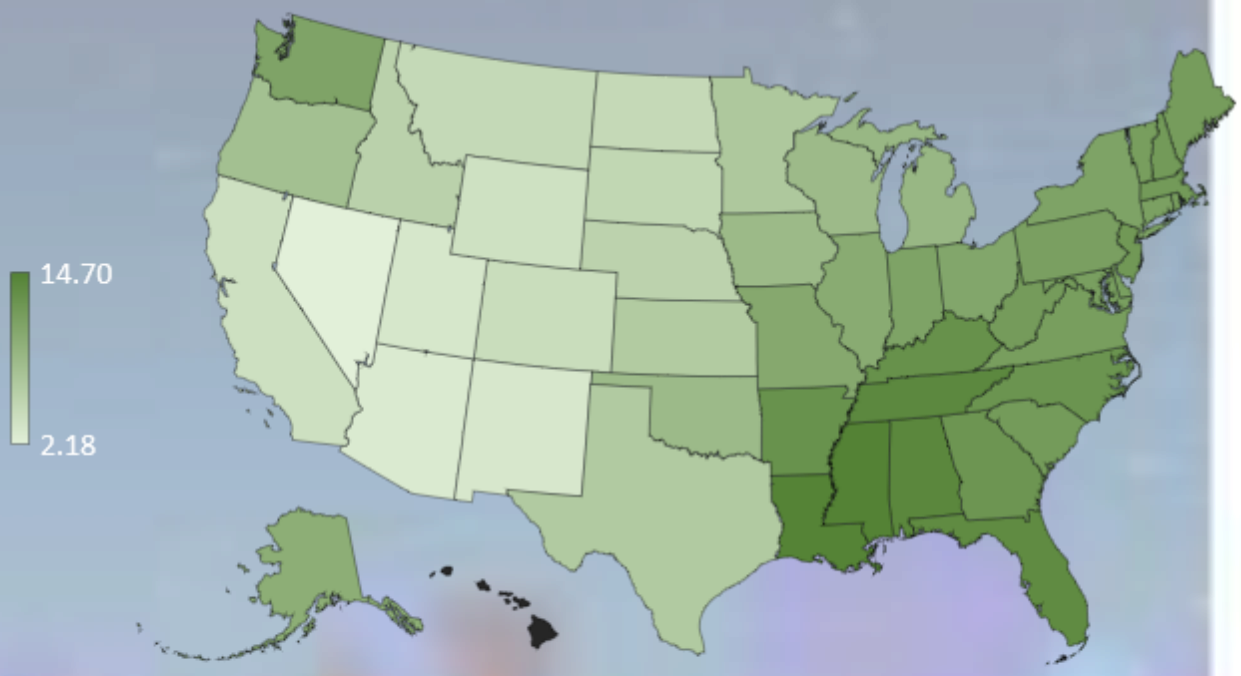


Explanations for Precipitation Effect

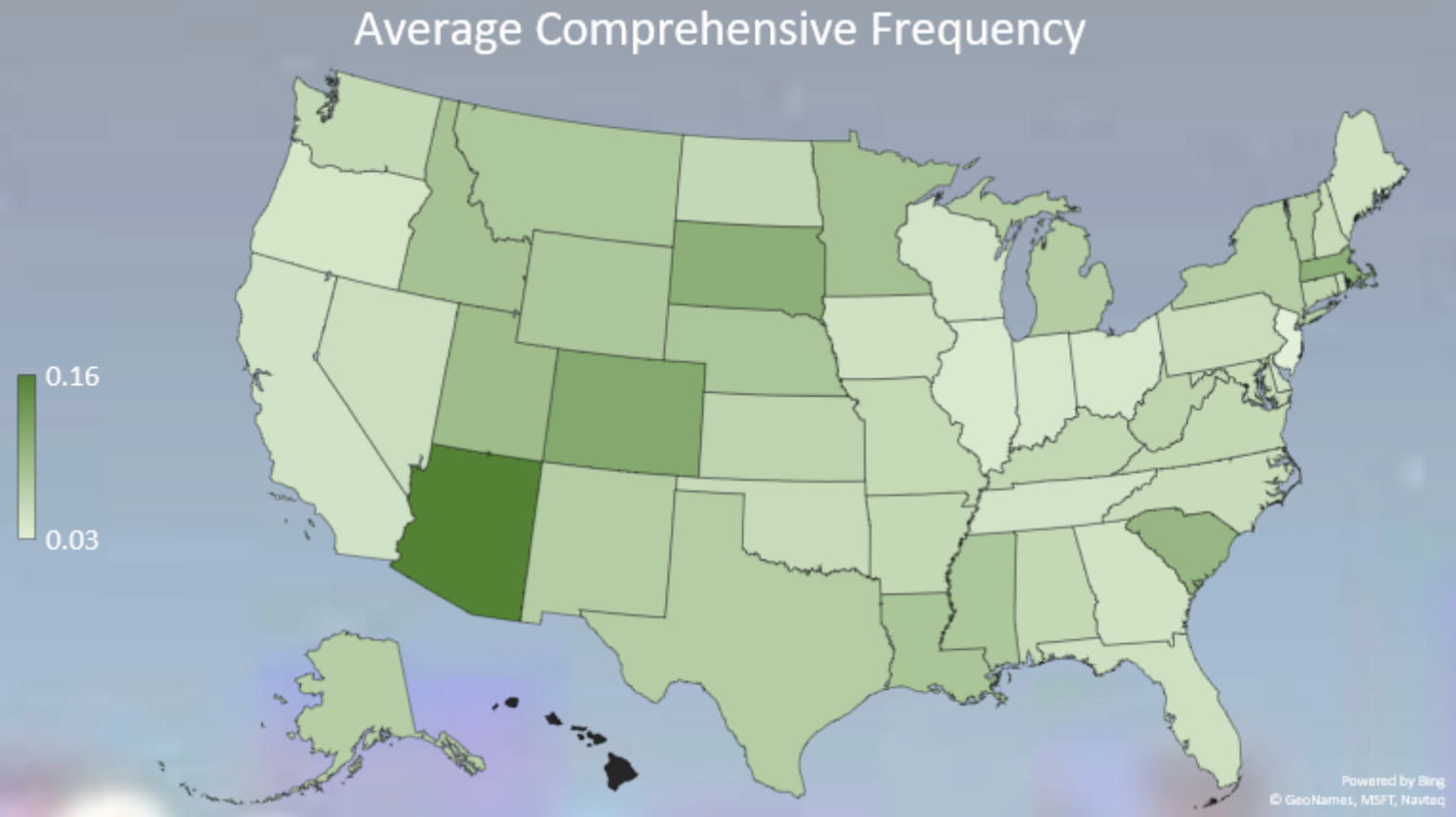
Average Comprehensive Frequency



Average Annual Precipitation



Hail


Average Comprehensive Frequency
0.16
0.03
Powered by Bing
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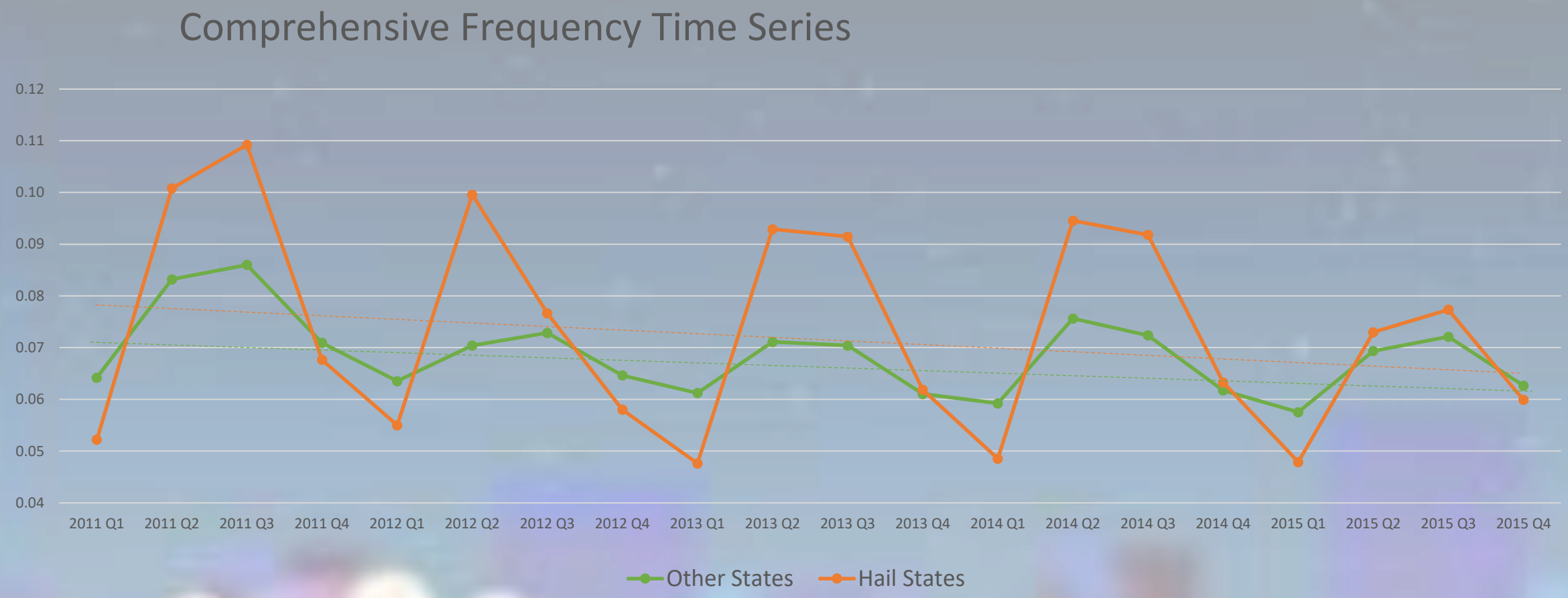
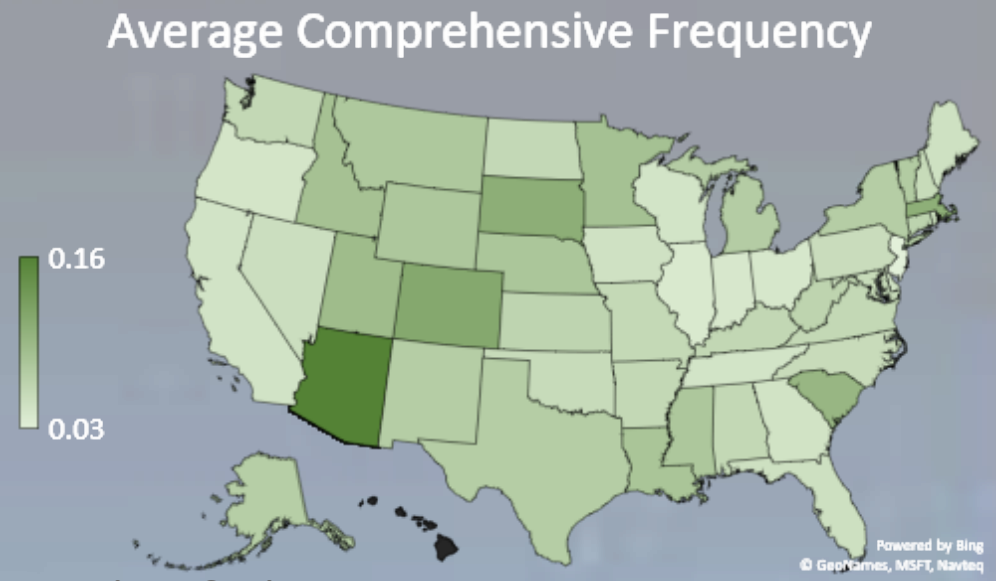
Hail

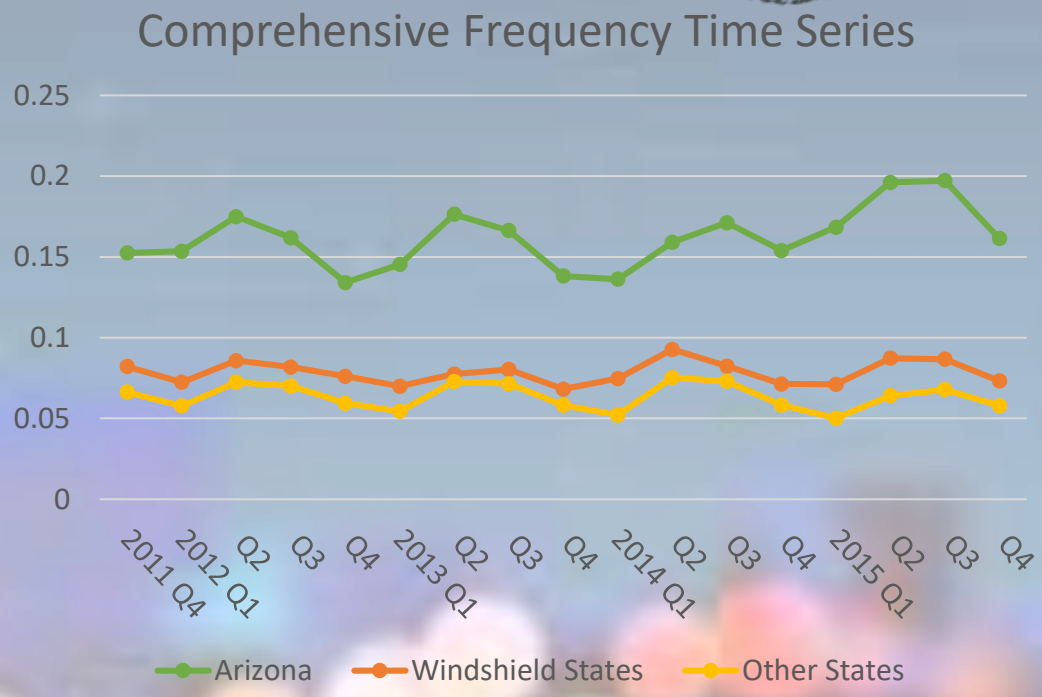

Comprehensive Frequency Time Series
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
2011 Q1
2011 Q2
2011 Q3
2011 Q4
2012 Q1
2012 Q2
2012 Q3
2012 Q4
2013 Q1
2013 Q2
2013 Q3
2013 Q4
2014 Q1
2014 Q2
2014 Q3
2014 Q4
2015 Q1
2015 Q2
2015 Q3
2015 Q4
Other States
Hail States

Windshield Replacement

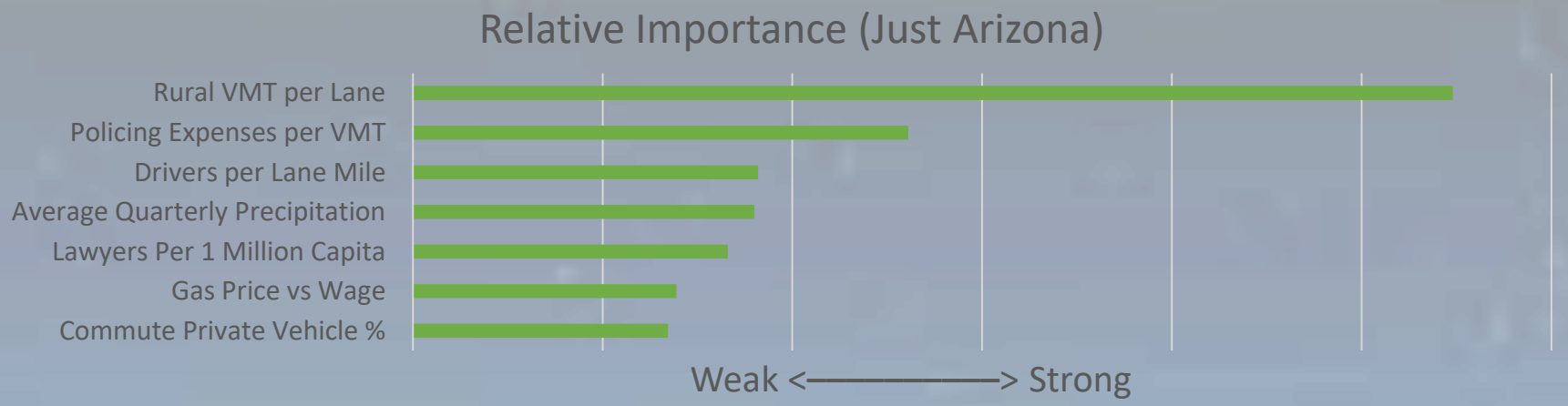
With varying conditions, 8 states mandate zero-deductible windshield replacement:

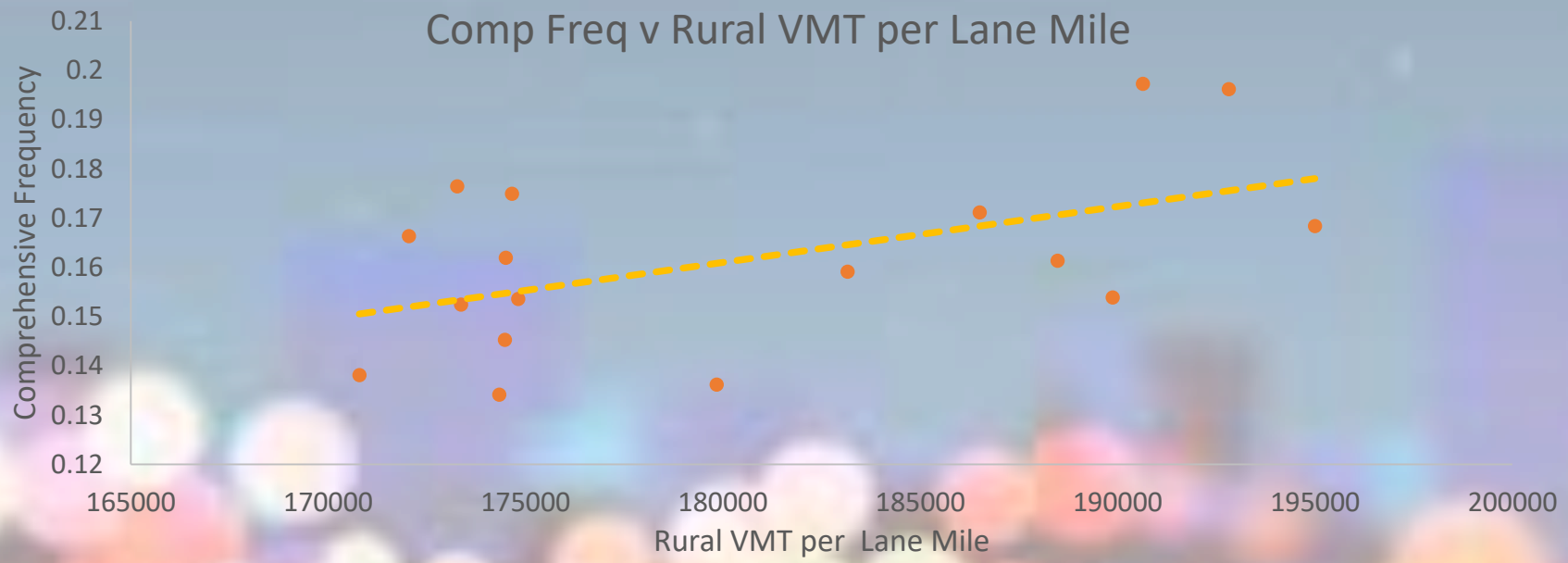
1. Arizona
2. Connecticut
3. Florida
4. Kentucky
5. Massachusetts
6. Minnesota
7. New York
8. South Carolina



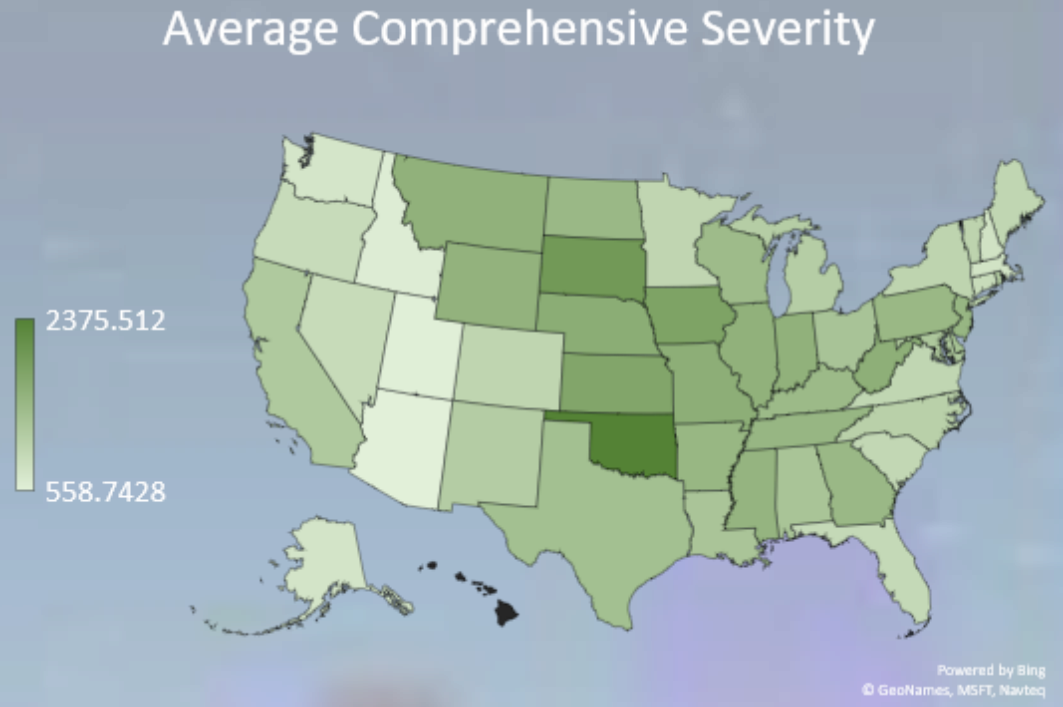


Arizona– An Outlier

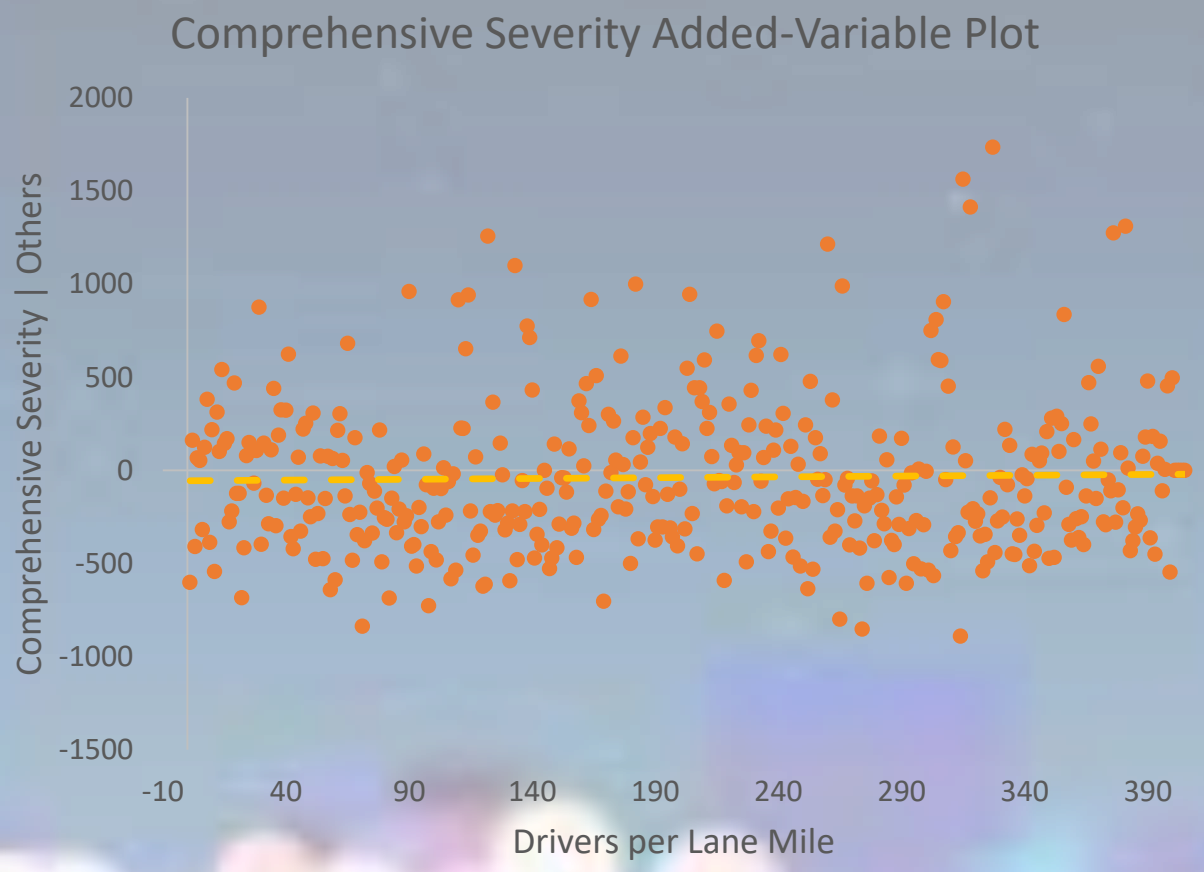


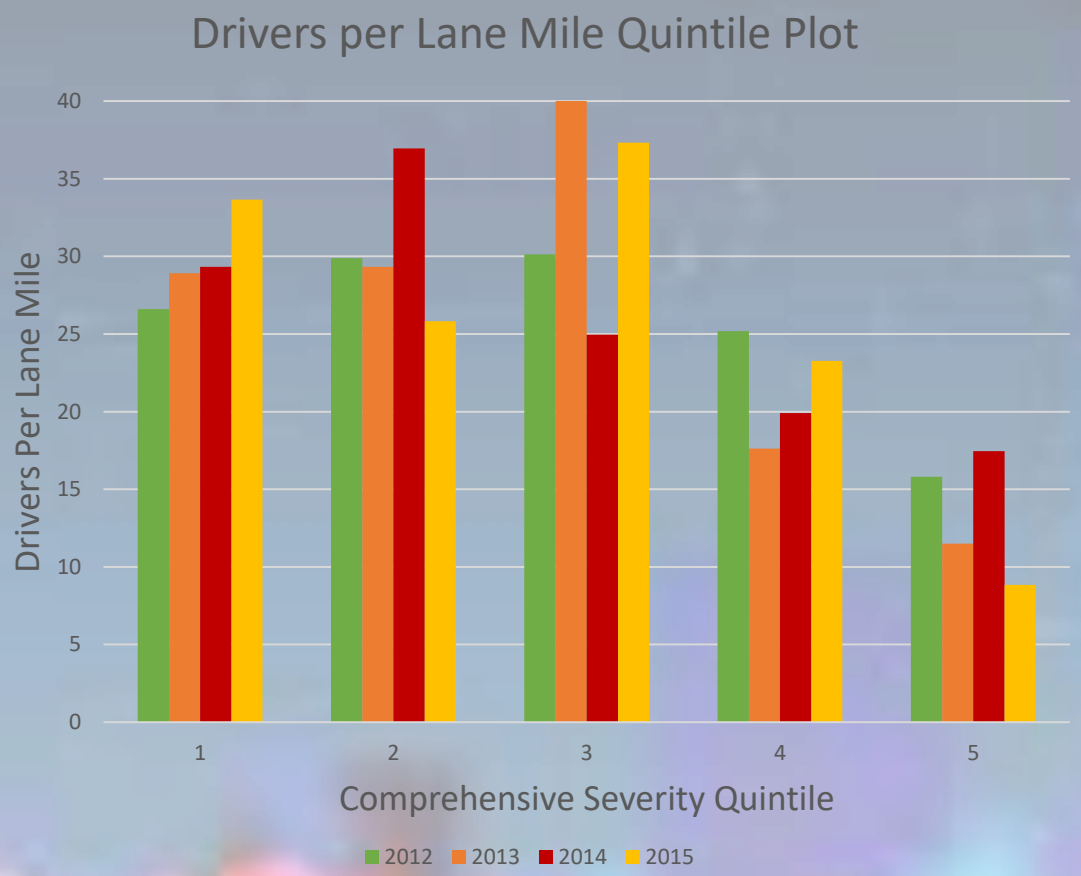


Severity Drivers

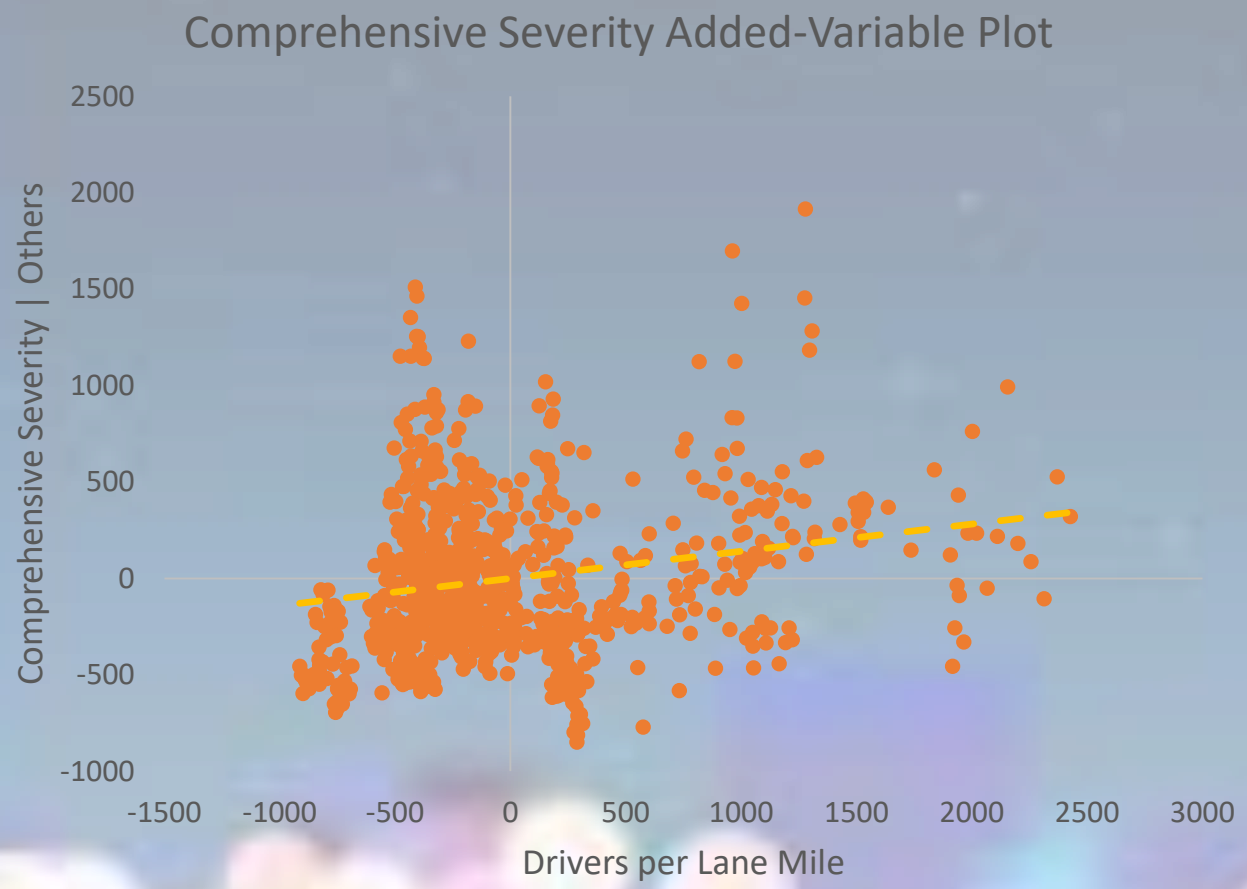


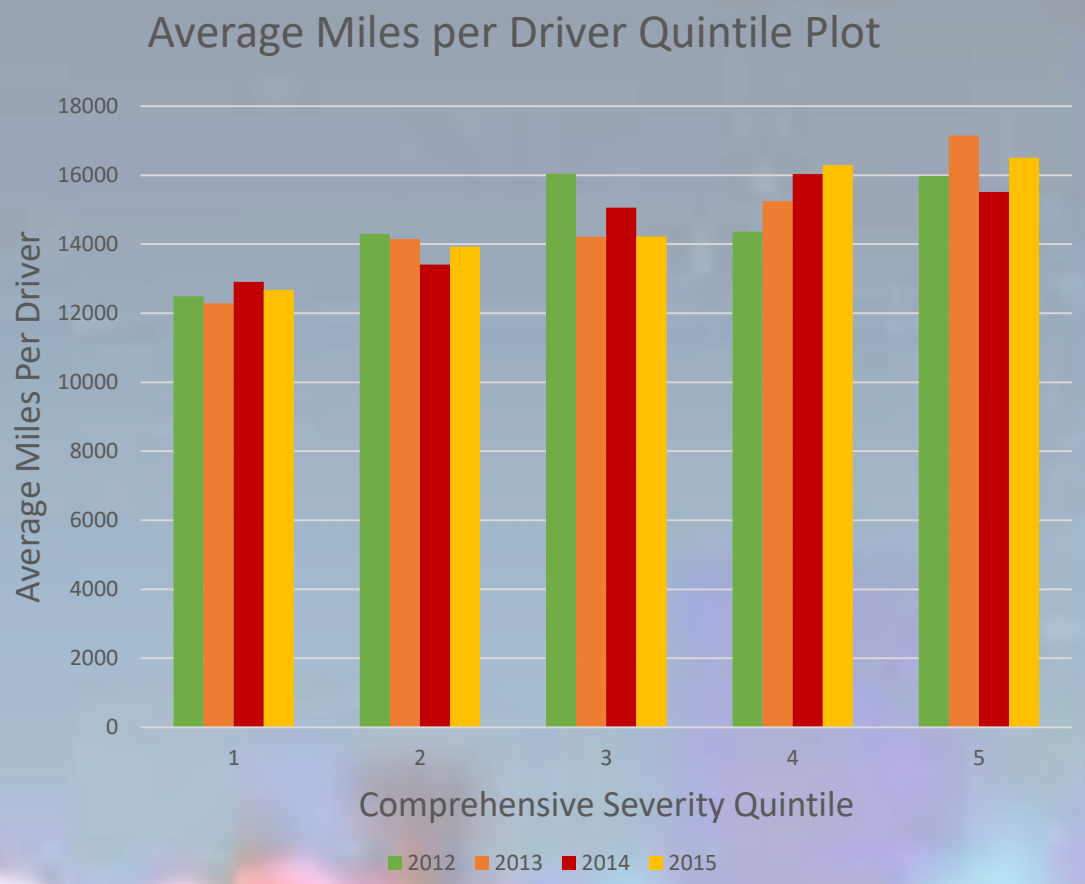
Drivers per Lane Mile





Average Miles per Driver

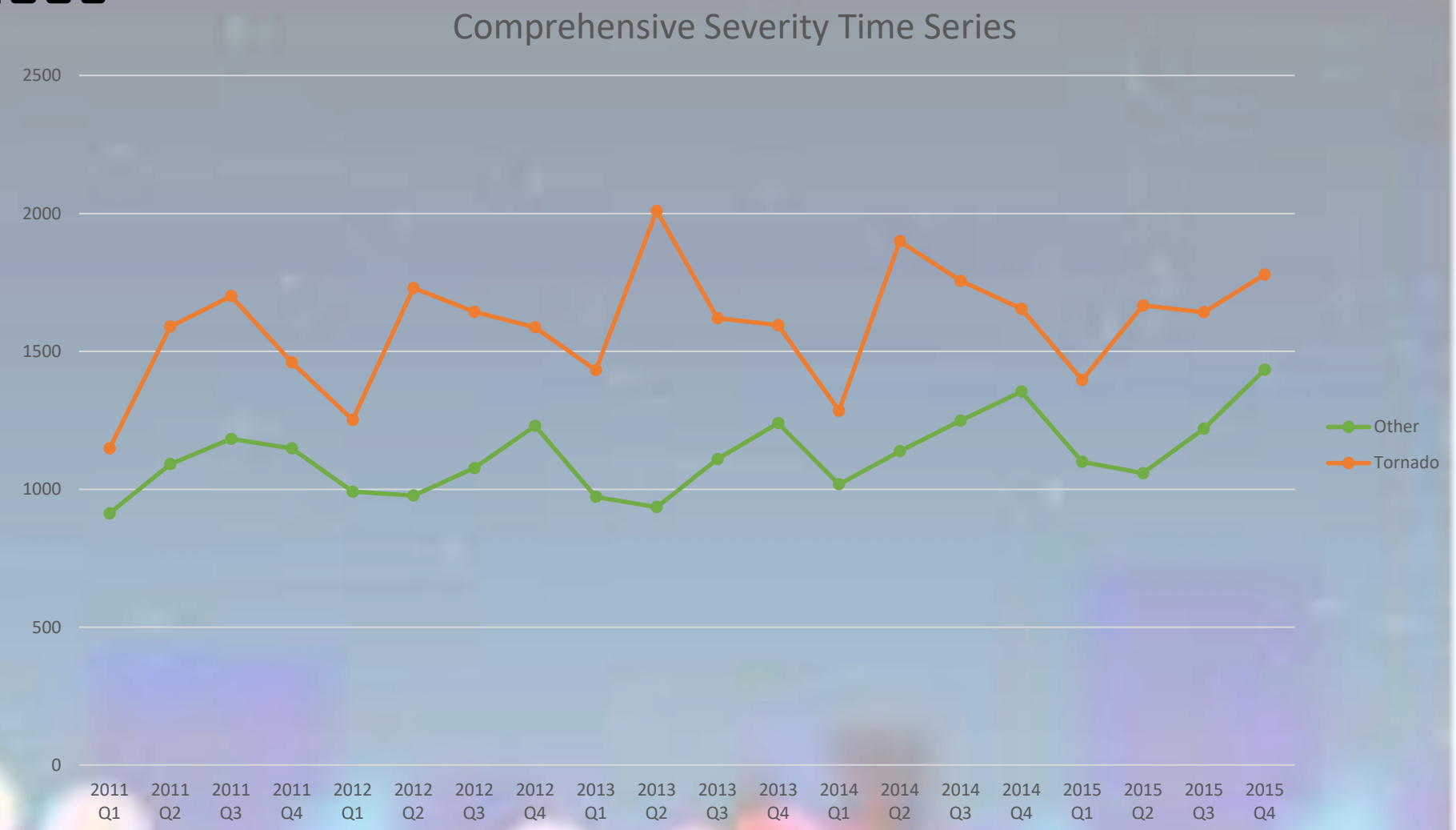




Tornadoes

"Tornado states:"

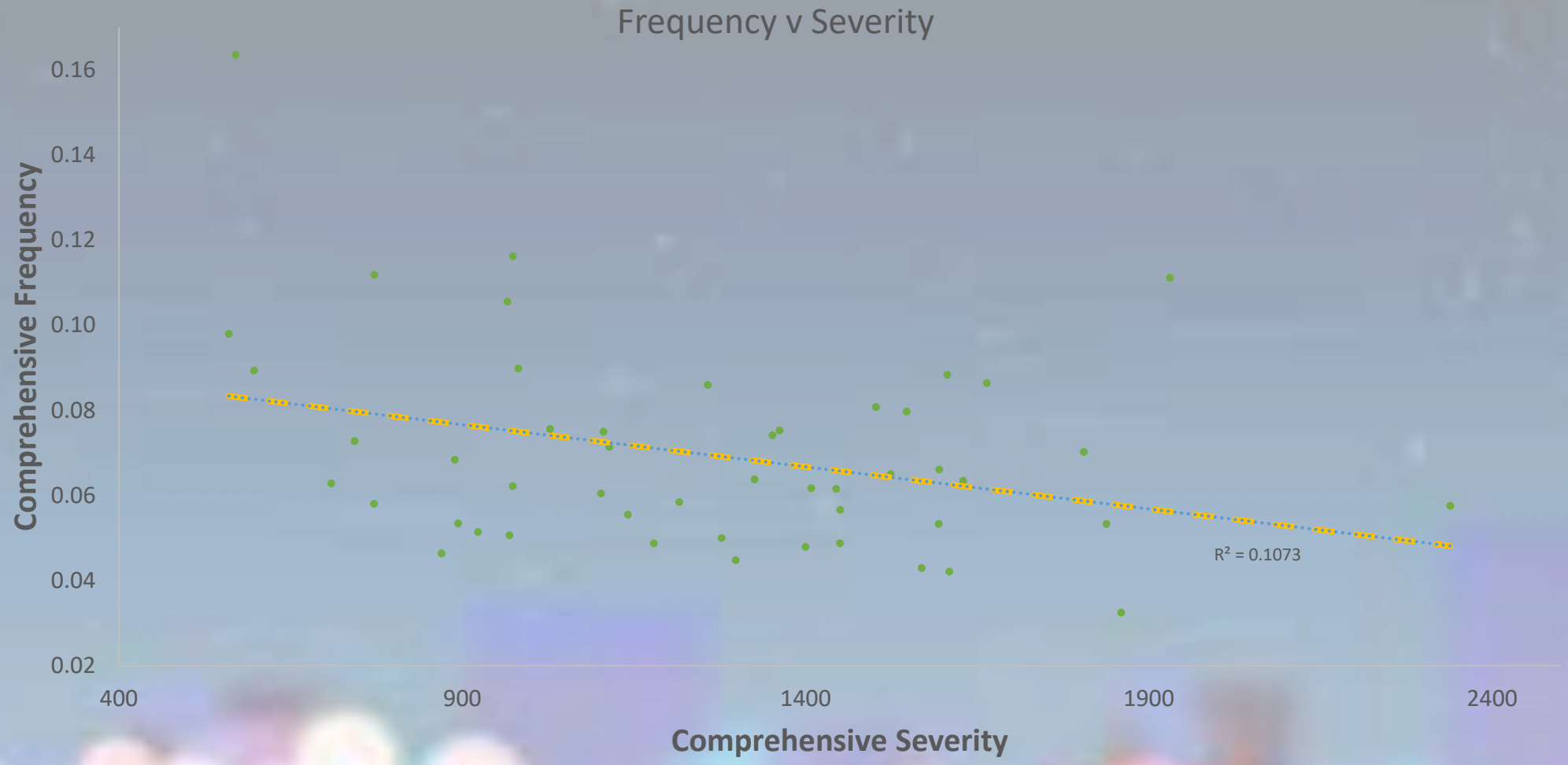
- Delaware
- Florida
- Illinois
- Indiana
- Iowa
- Kansas
- Louisiana
- Mississippi
- Missouri
- Nebraska
- Oklahoma
- South Dakota
- Texas



Other Potential Drivers

- Other natural disasters
  - Hurricanes
  - Flooding
  - Earthquakes
- Theft
- Wildlife accidents

Frequency v Severity



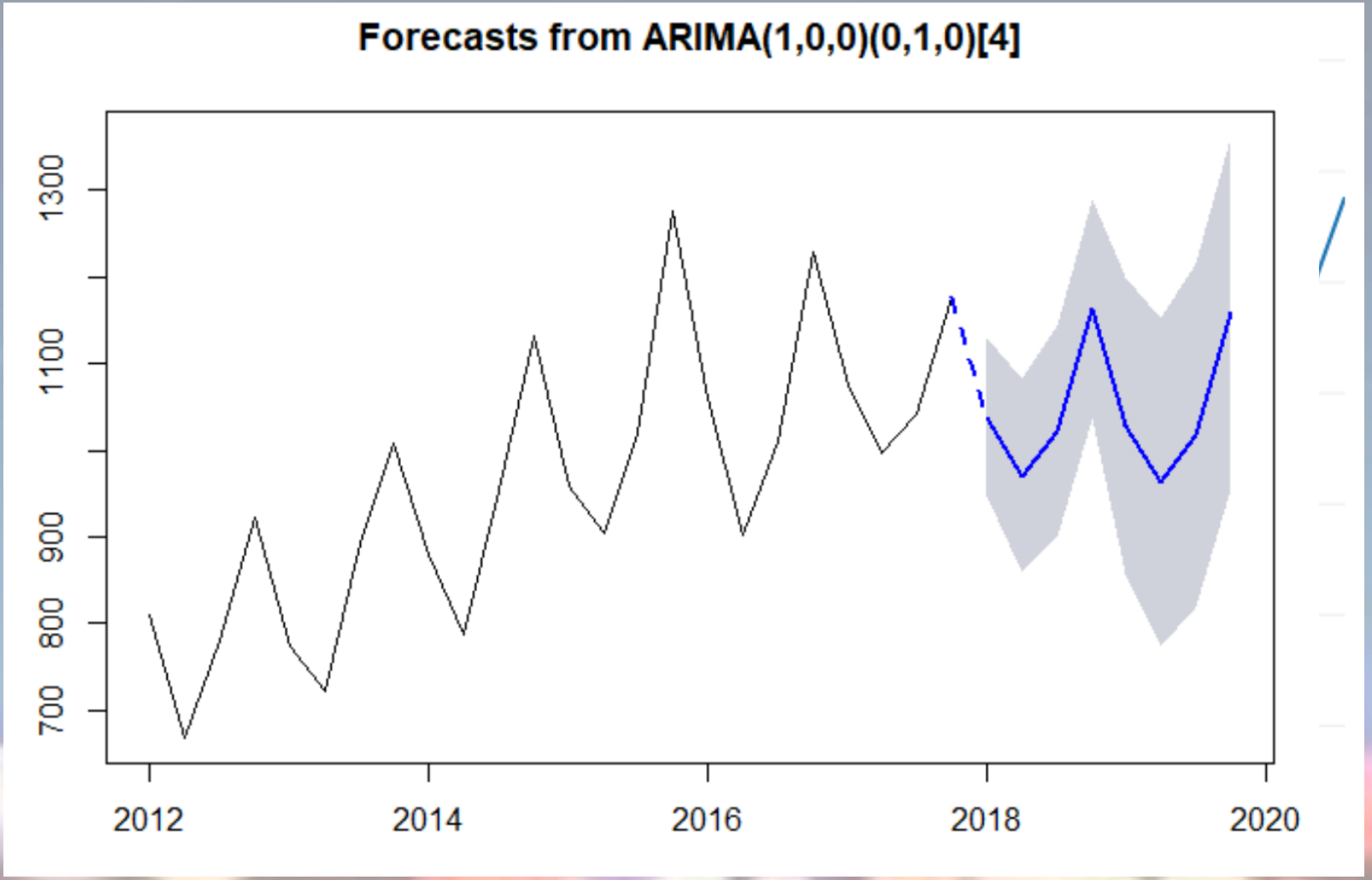
Summary

- Comprehensive frequency
  - Quarterly precipitation has negative effect
  - Hail
  - Zero-deductible windshield replacement
  - Arizona is an extreme case
- Comprehensive severity
  - Drivers per lane mile
  - Average miles per driver
  - Natural disasters
    - Tornadoes
    - Floods, hurricanes, and others
- Frequency and severity are negatively correlated

Trends

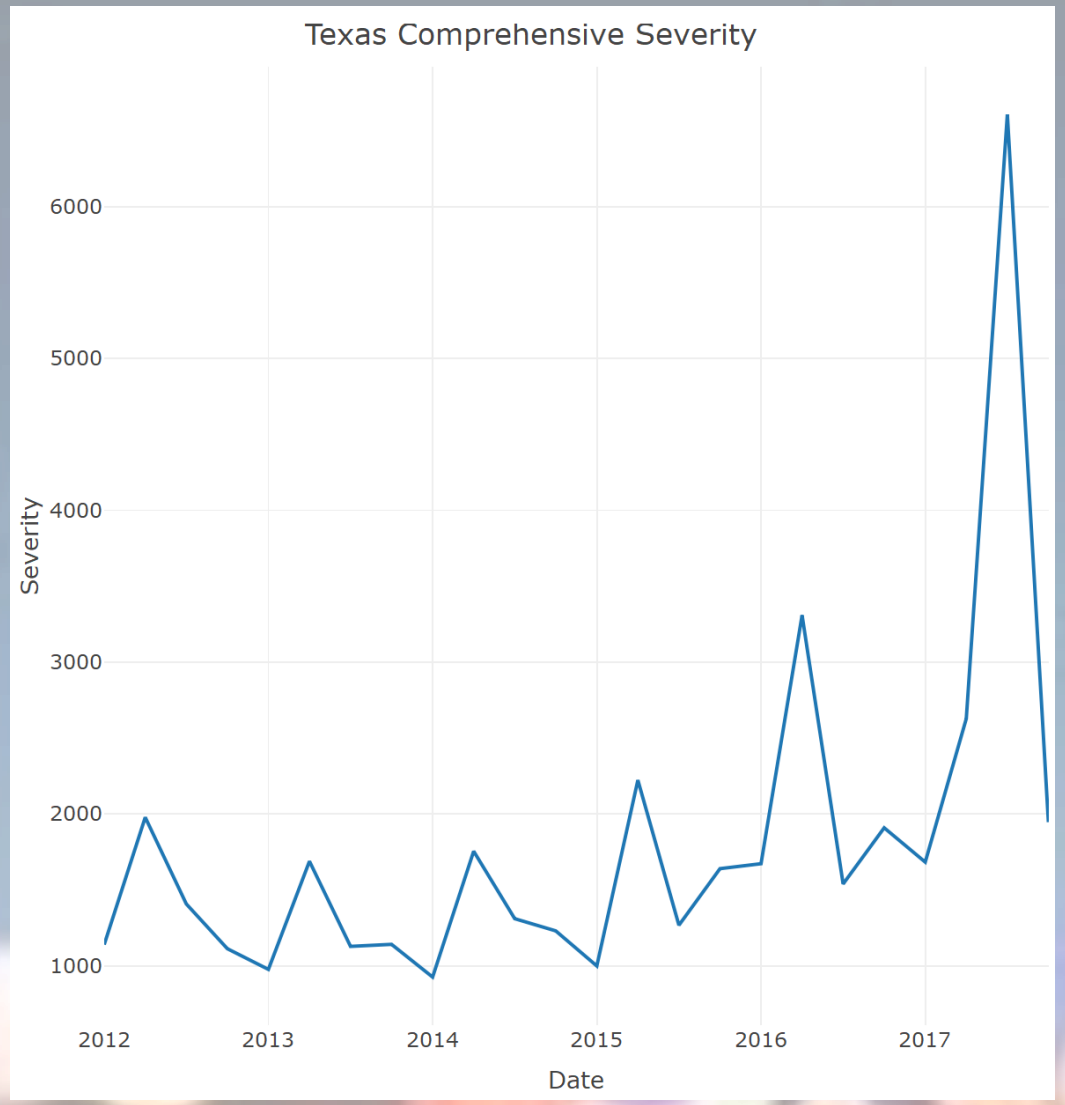
- Analyze how auto insurance trends change over time
- Identify extreme values in Q4-2017
- Identify possible reasons for changes
- Looking ahead

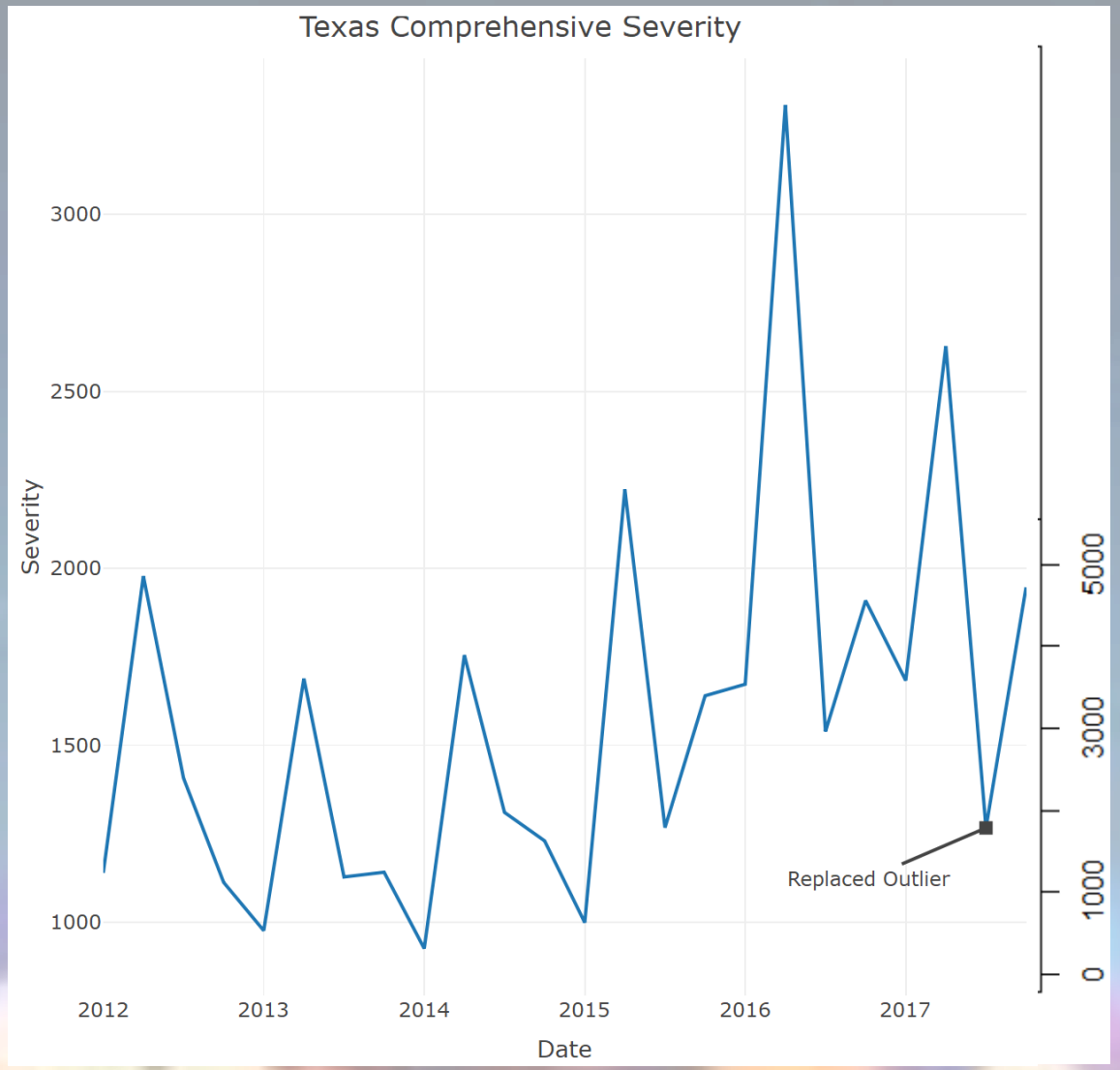
ARIMA



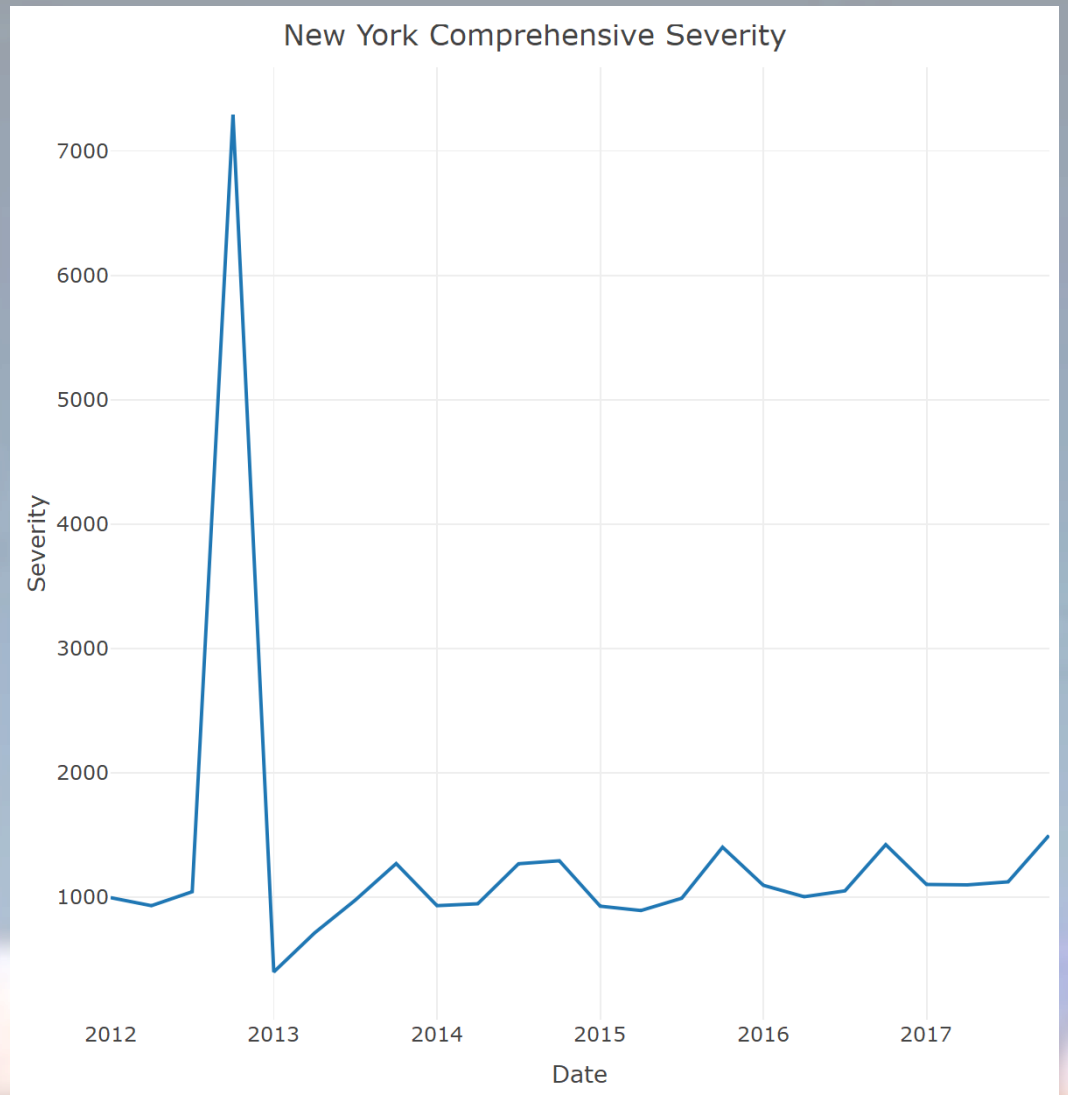
- Auto Regressive Integrated Moving Average
- Forecast time series data

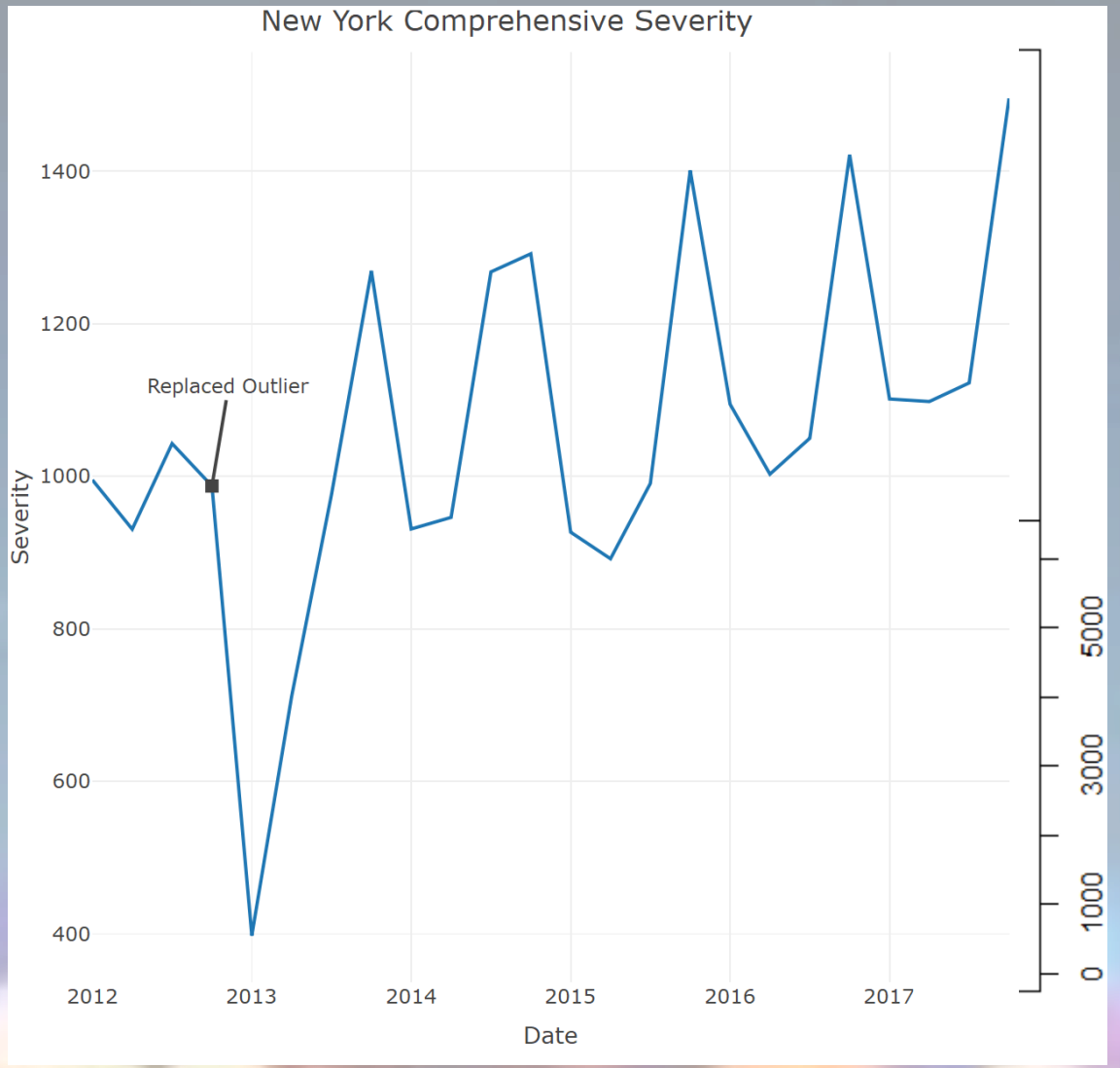
Outlier Detection and Removal



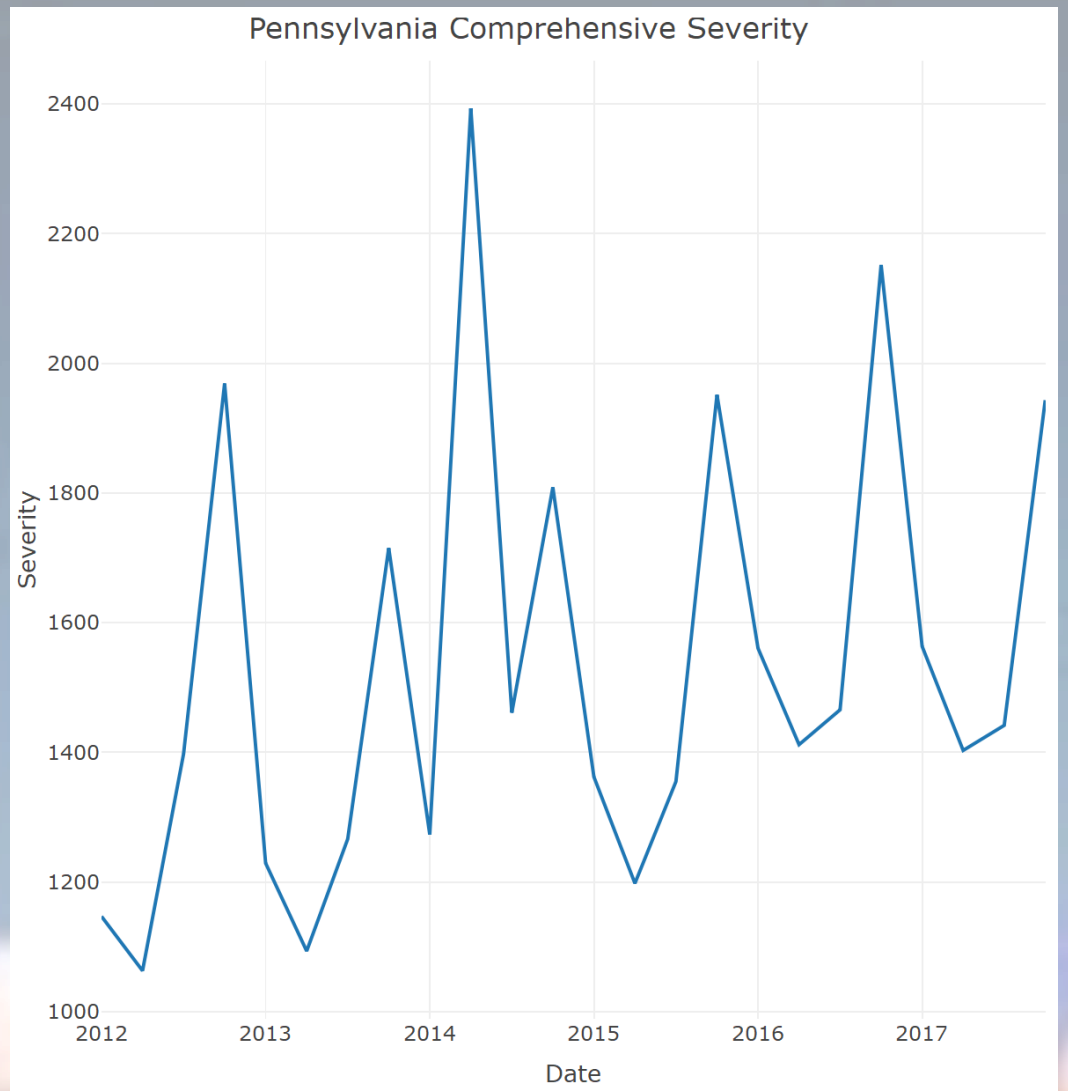


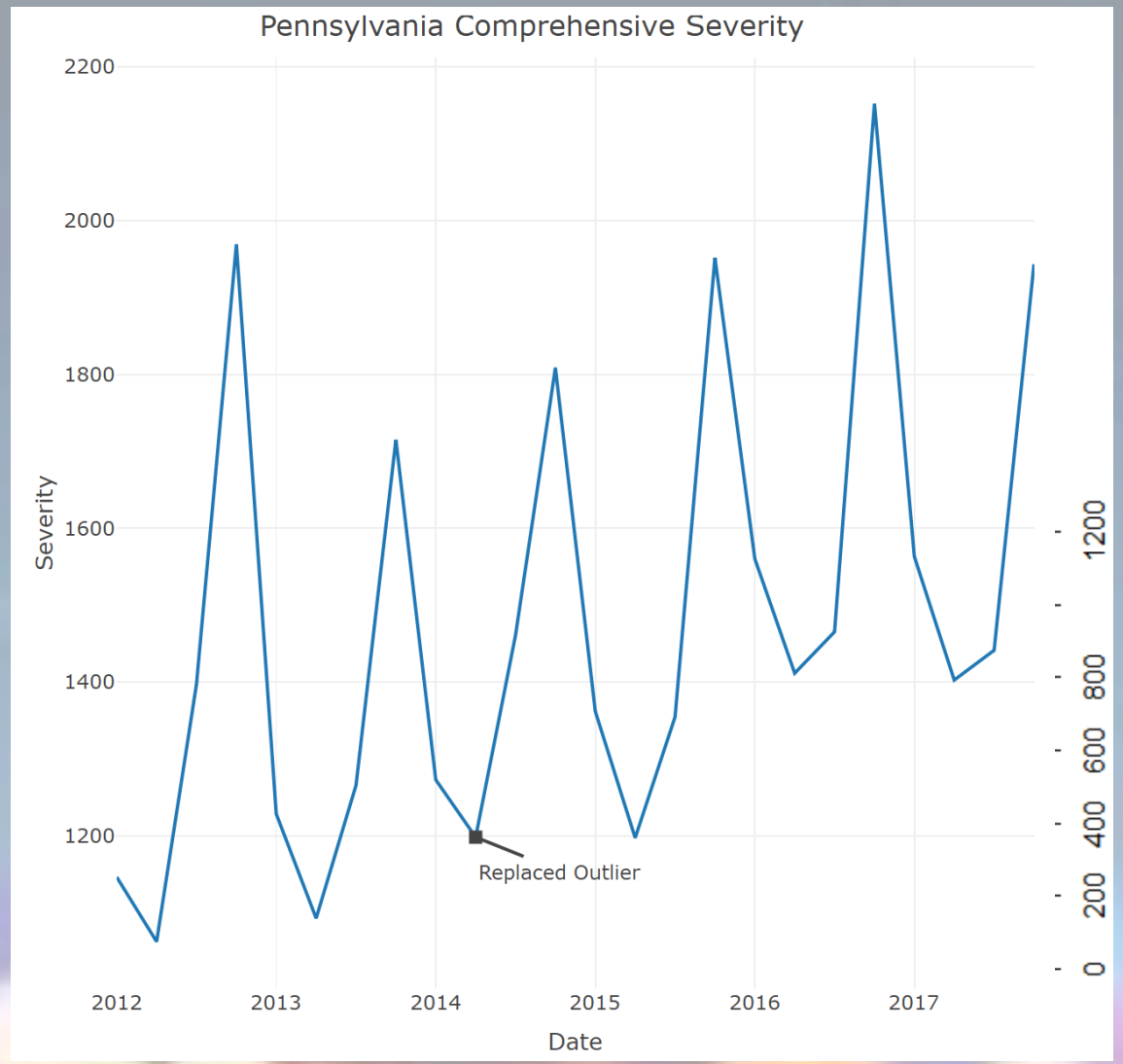
Outlier Detection and Removal



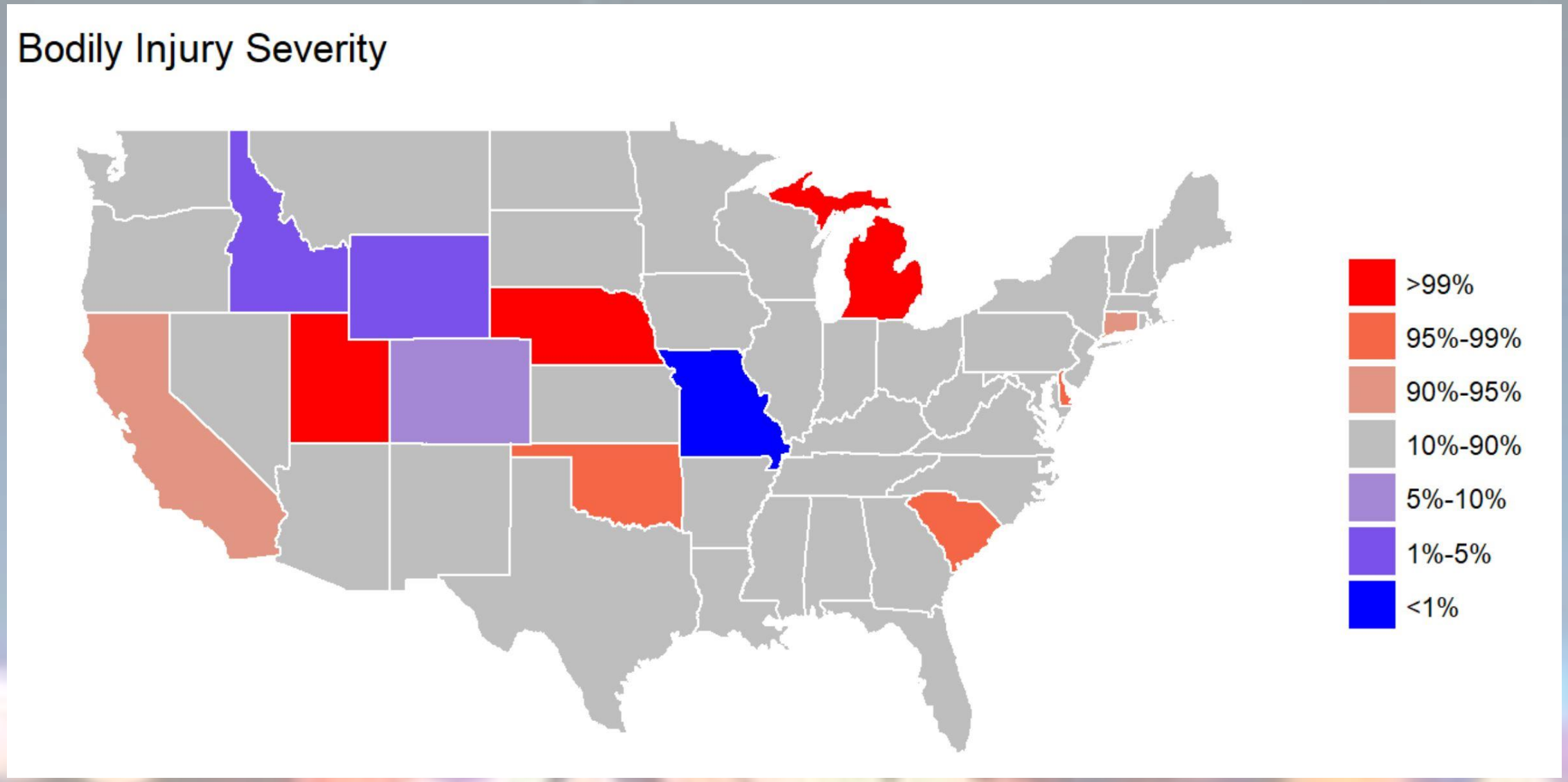


Outlier Detection and Removal

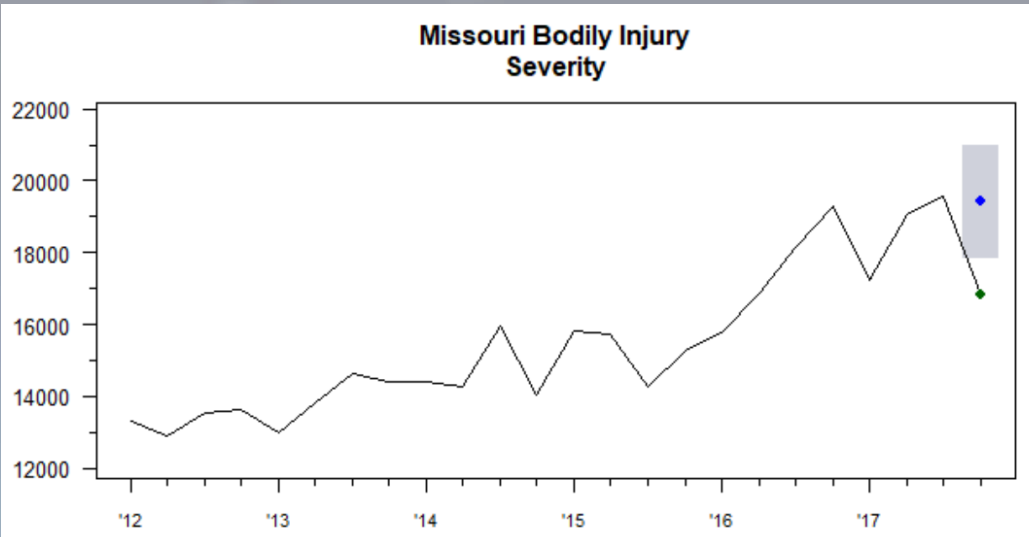


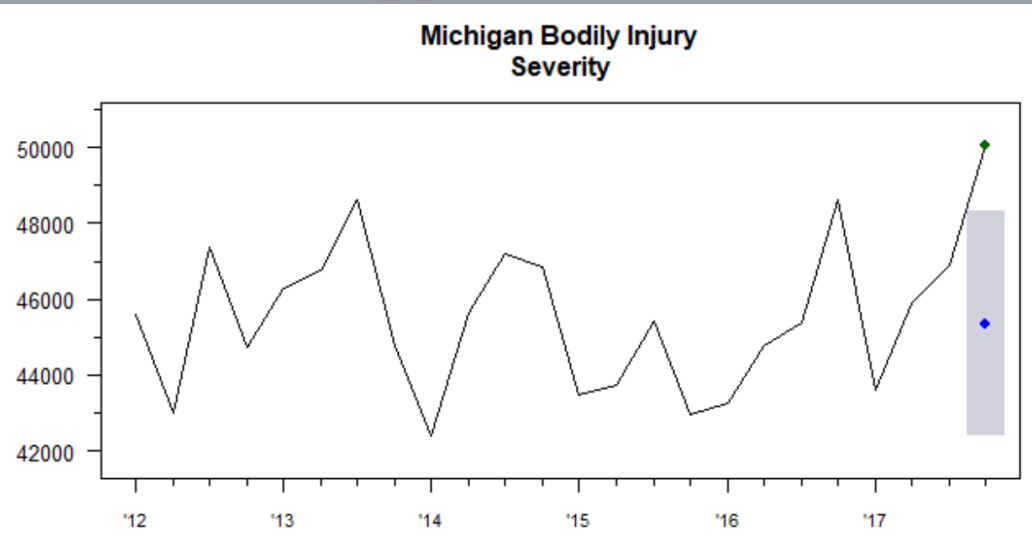


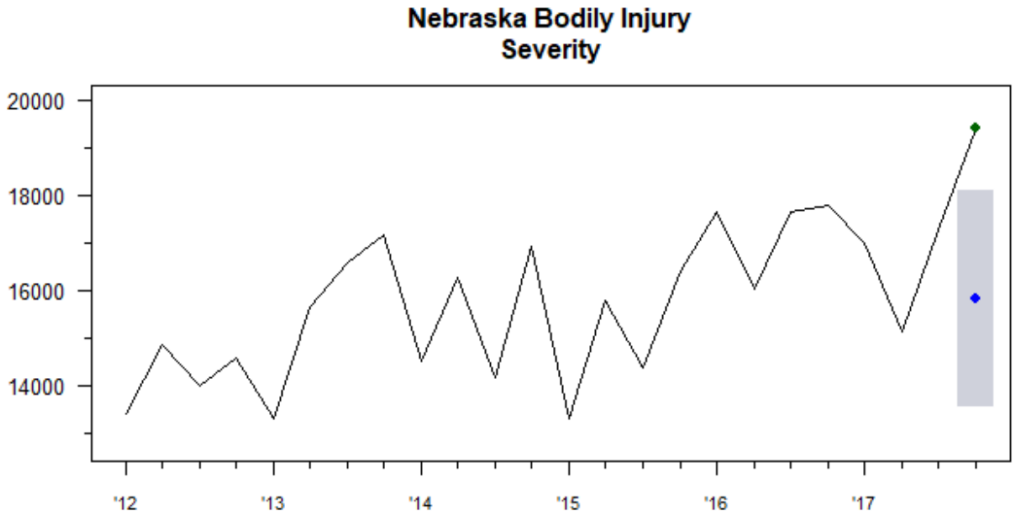
Predicting 2017-Q4

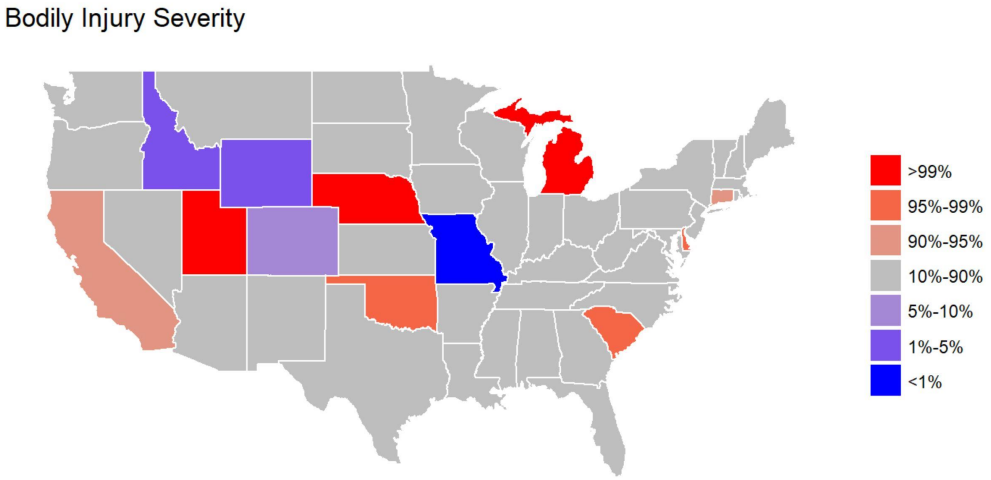


Predicting 2017-Q4

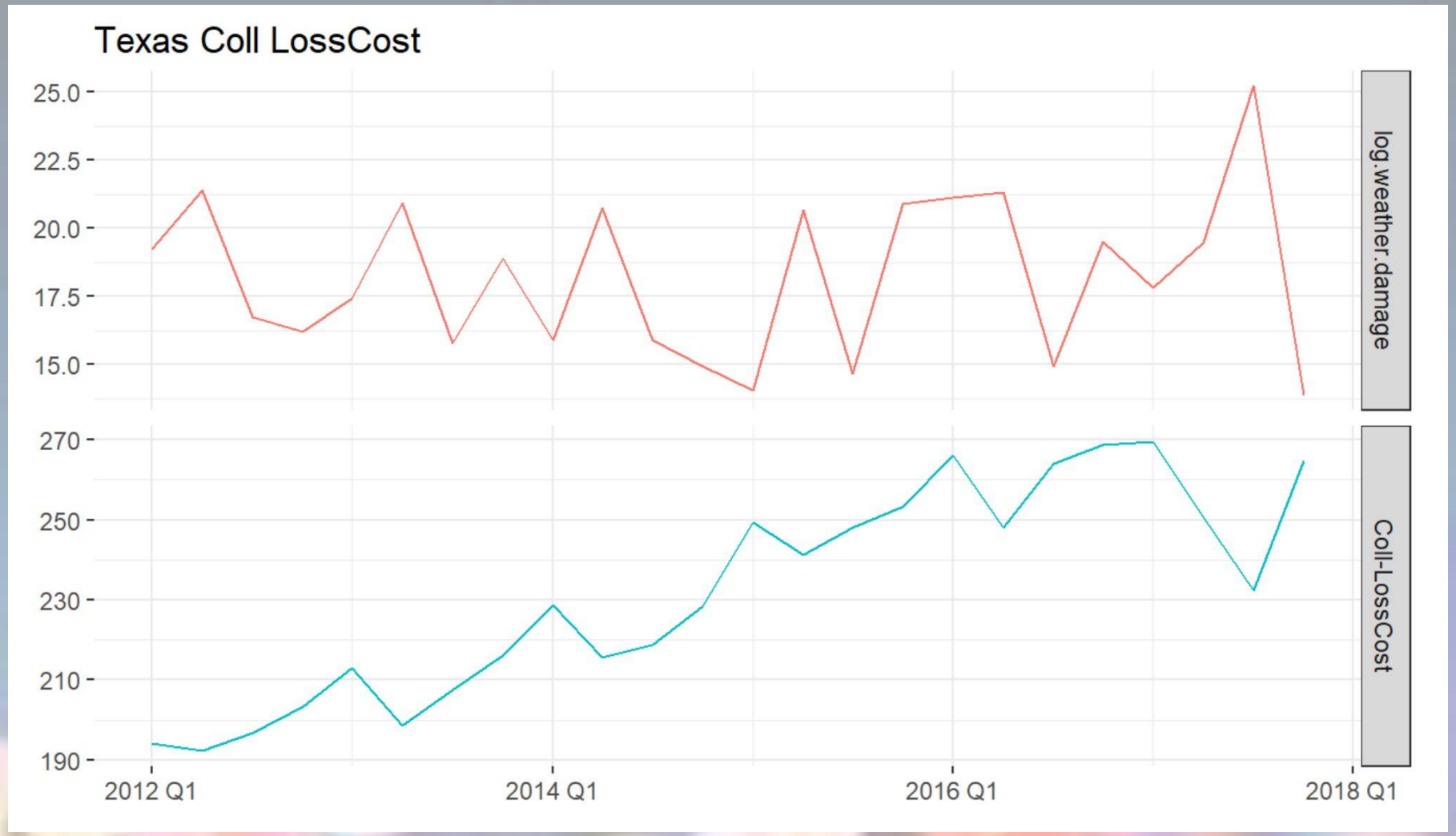








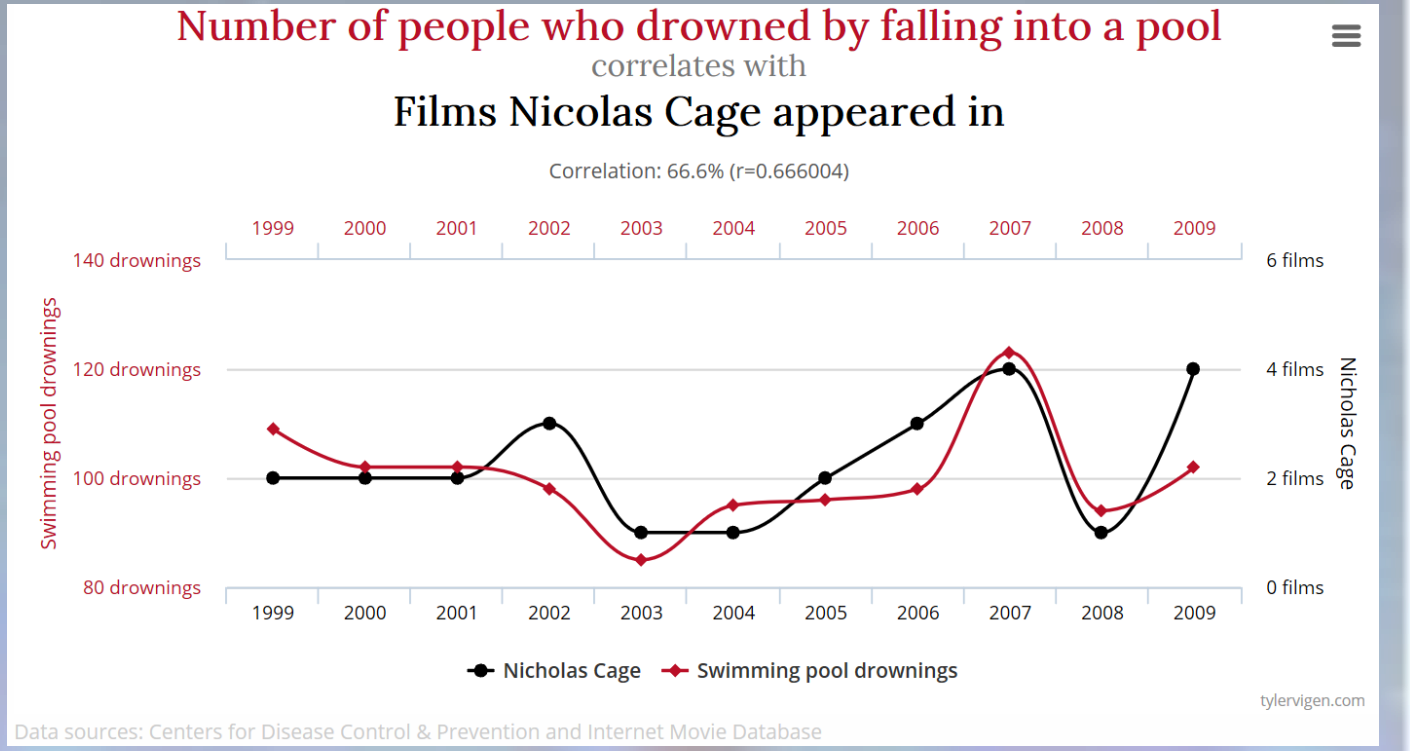
Weather Correlations



Looking Ahead

Applications

Caveats



Thank You

- Questions?
- Comments?