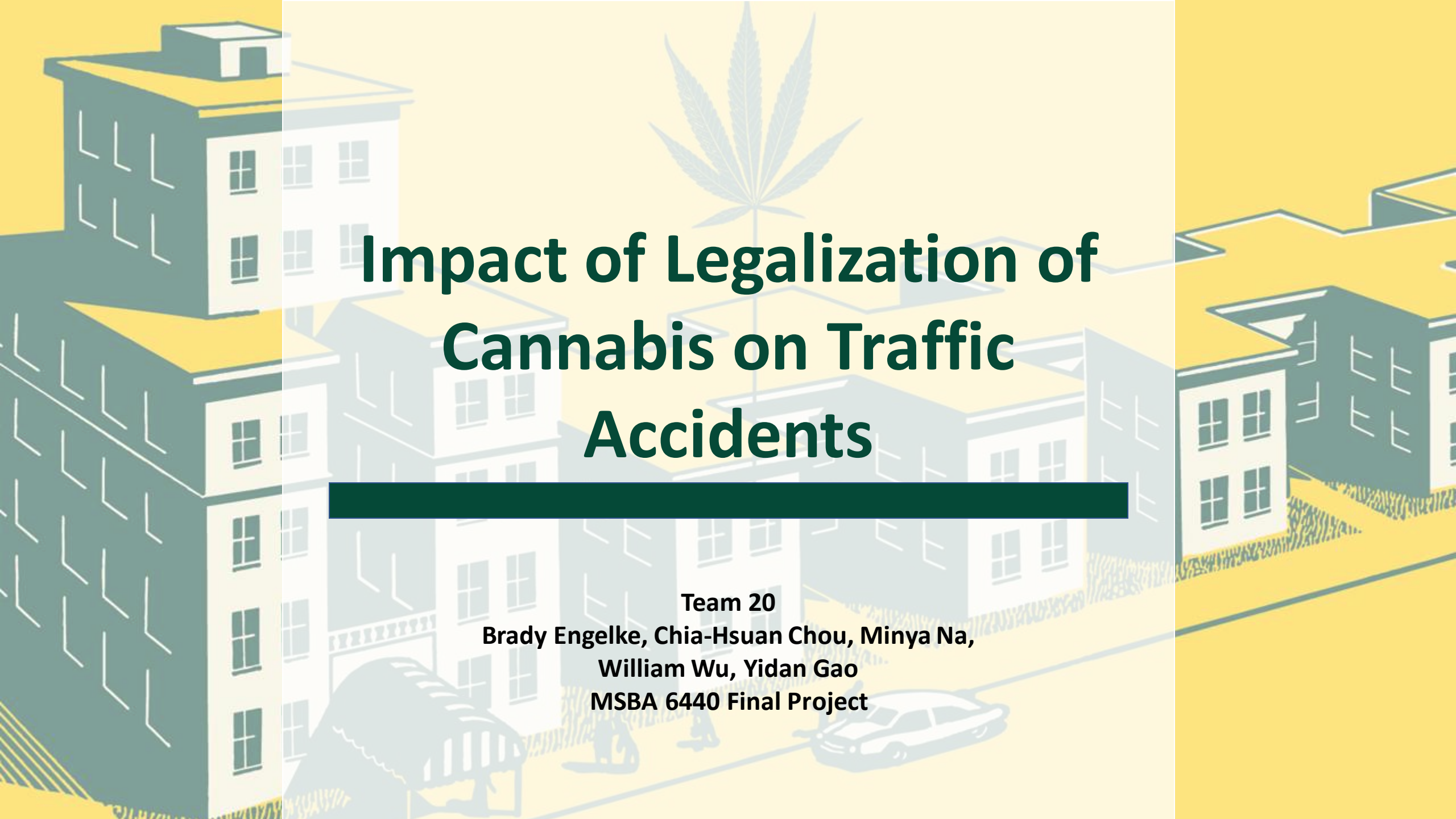

Impact of Legalization of Cannabis on Traffic Accidents

Team 20
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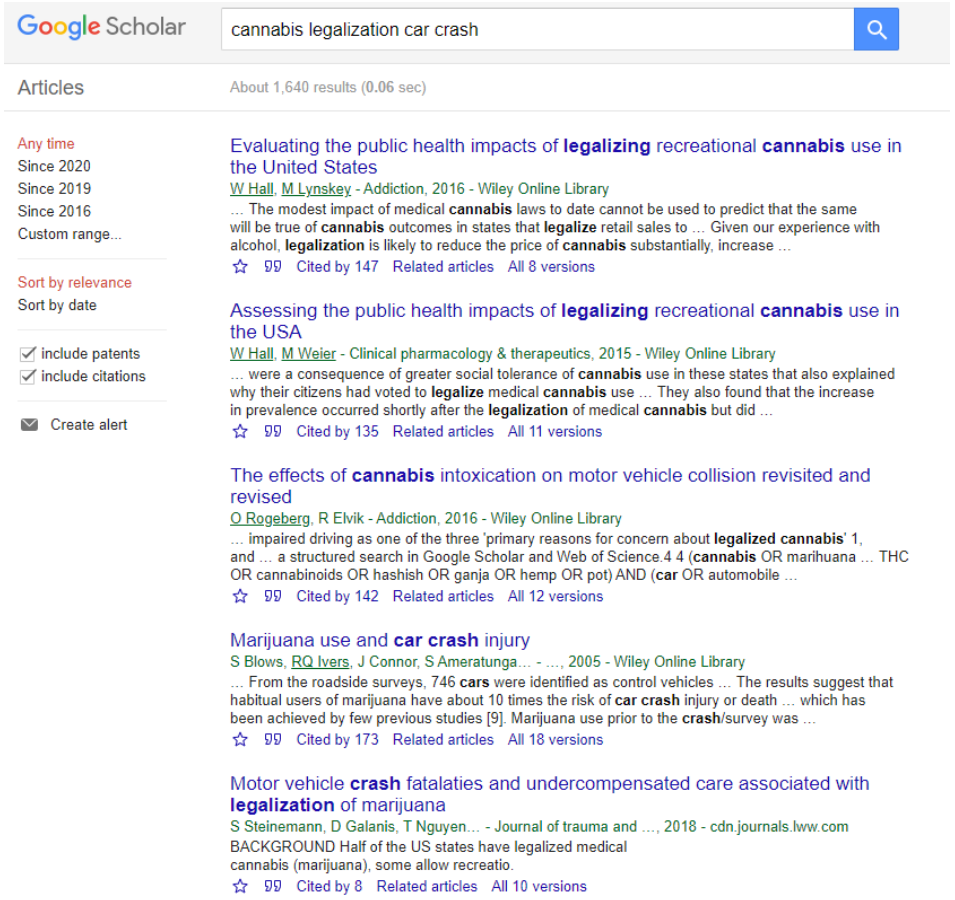
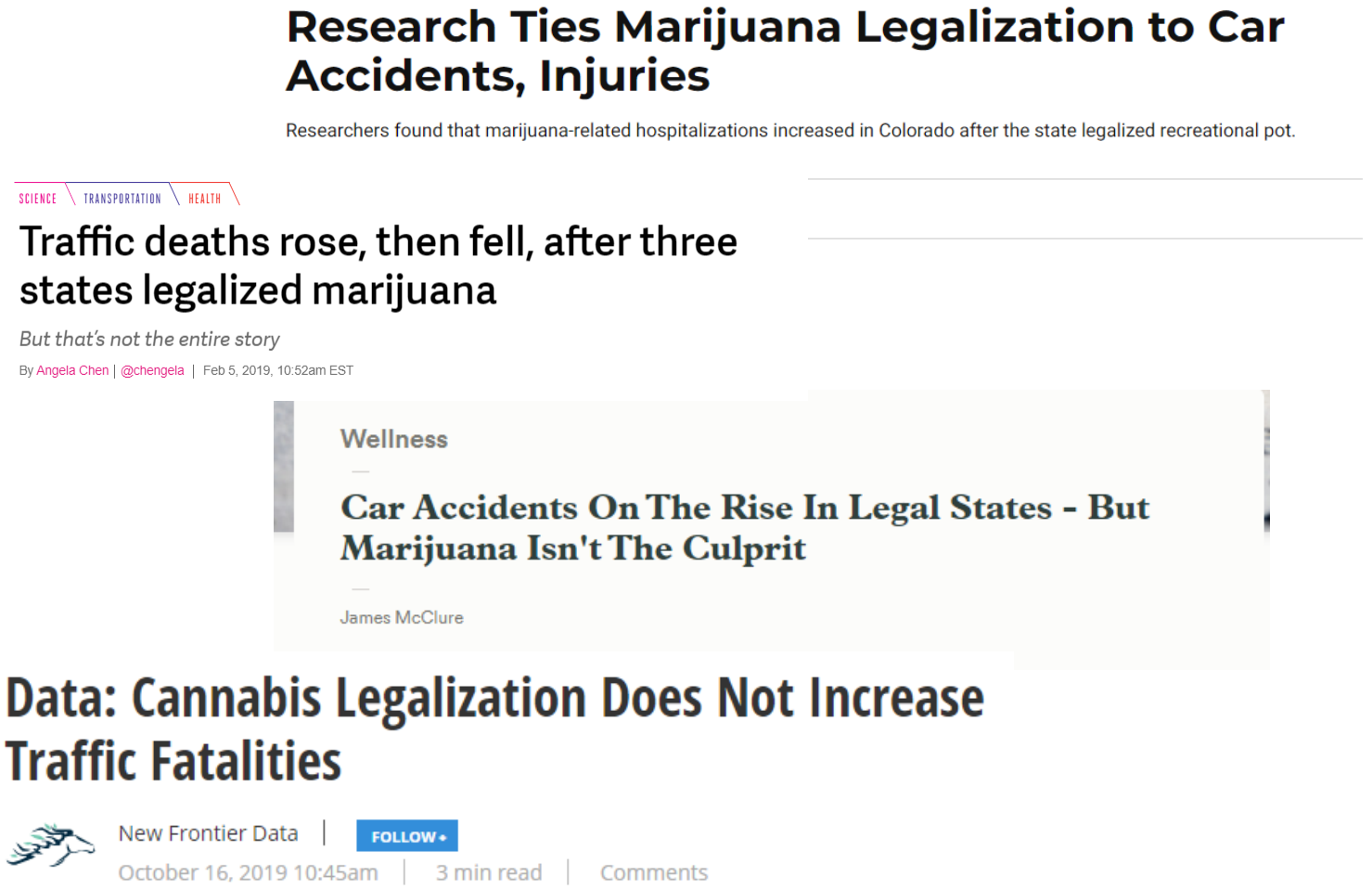
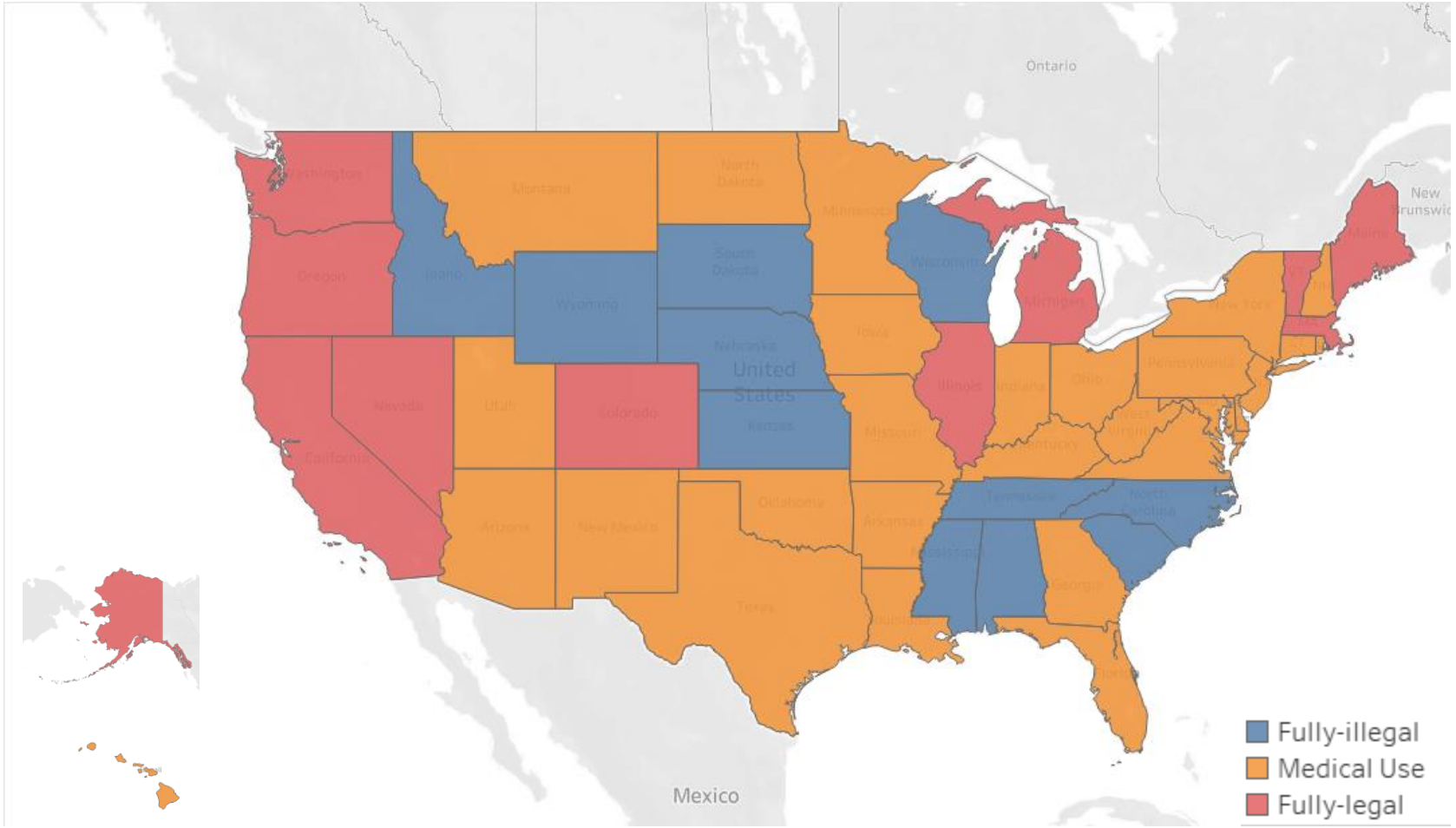
MSBA 6440 Final Project

Researchers Have Yet to Reach a Definitive Conclusion on Marijuana's Role in Car Accidents





11 States have Legalized Recreational Cannabis, 28 Allow Medical Use, and 11 States Strictly Prohibit Any Use

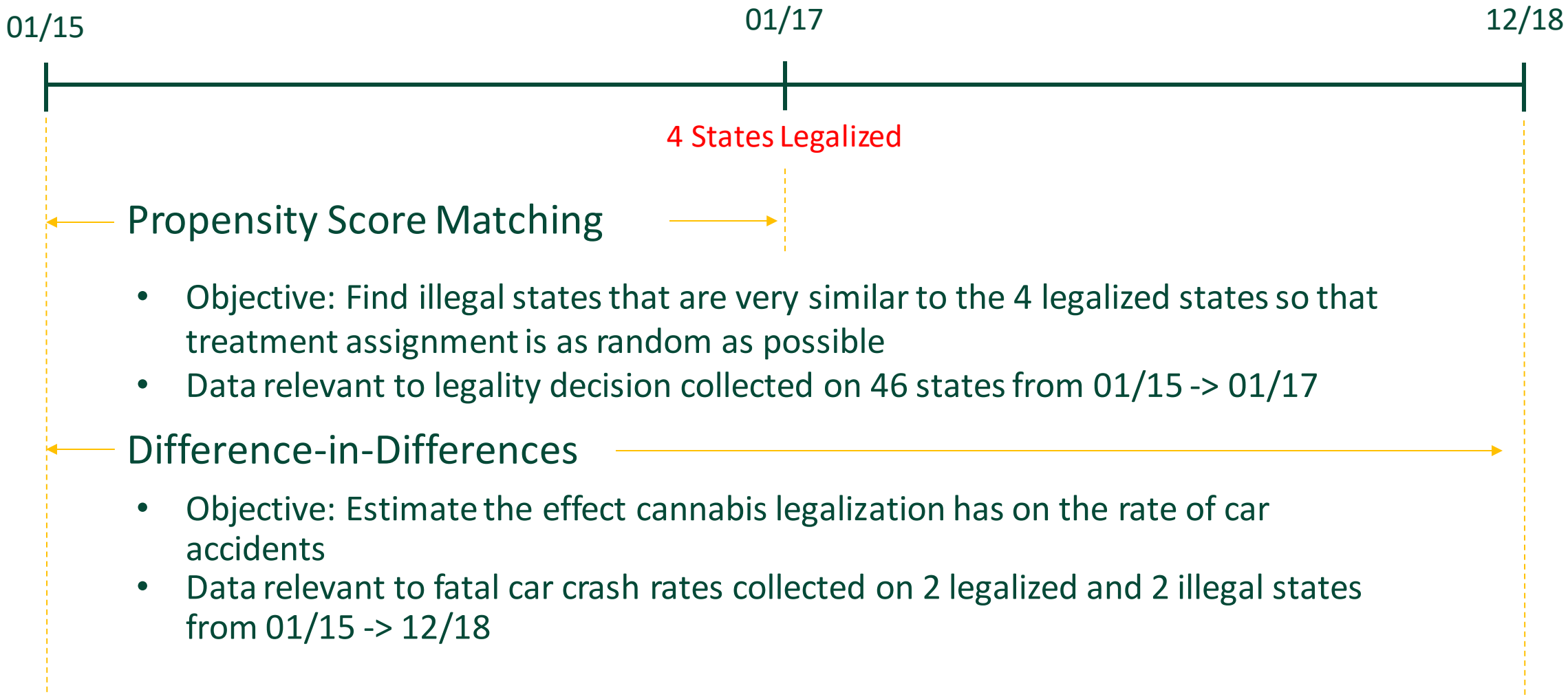


For states that have legalized cannabis, has that decision causally affected the rate of car accidents?

Agenda

- Experimental Design
- Propensity Score Matching
- Difference-in-Differences
- Threats to Causal Inference
- Future Improvements

Experimental Design



Propensity Score Matching

- Objective: Find illegal states that are very similar to the 4 legalized states so that treatment assignment is as random as possible
- Data relevant to legality decision collected on 46 states from 01/15 -> 01/17

Difference-in-Differences

- Objective: Estimate the effect cannabis legalization has on the rate of car accidents
- Data relevant to fatal car crash rates collected on 2 legalized and 2 illegal states from 01/15 -> 12/18

Propensity Score Matching

Dependent Variable

- Legality (1 = legalized, 0 = illegal)

Independent Variables

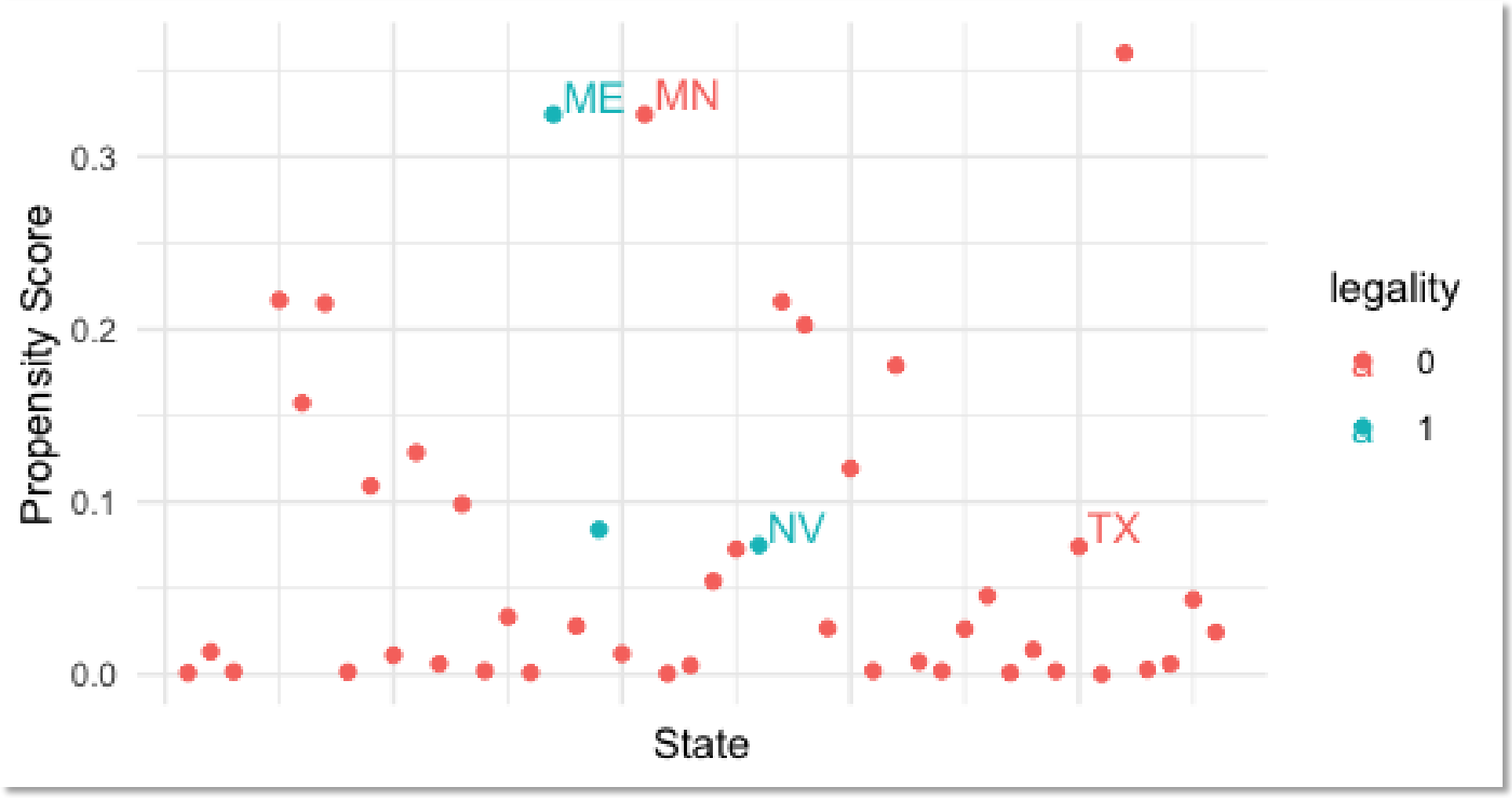
- Average Age
- Political Party
- Proportion of Population - Male
- Number of Prisoners
- Yearly Taxes / Yearly Revenue
- Average Alcohol Consumption Rate
- Population Density

Include all control variables that determine legalization decision

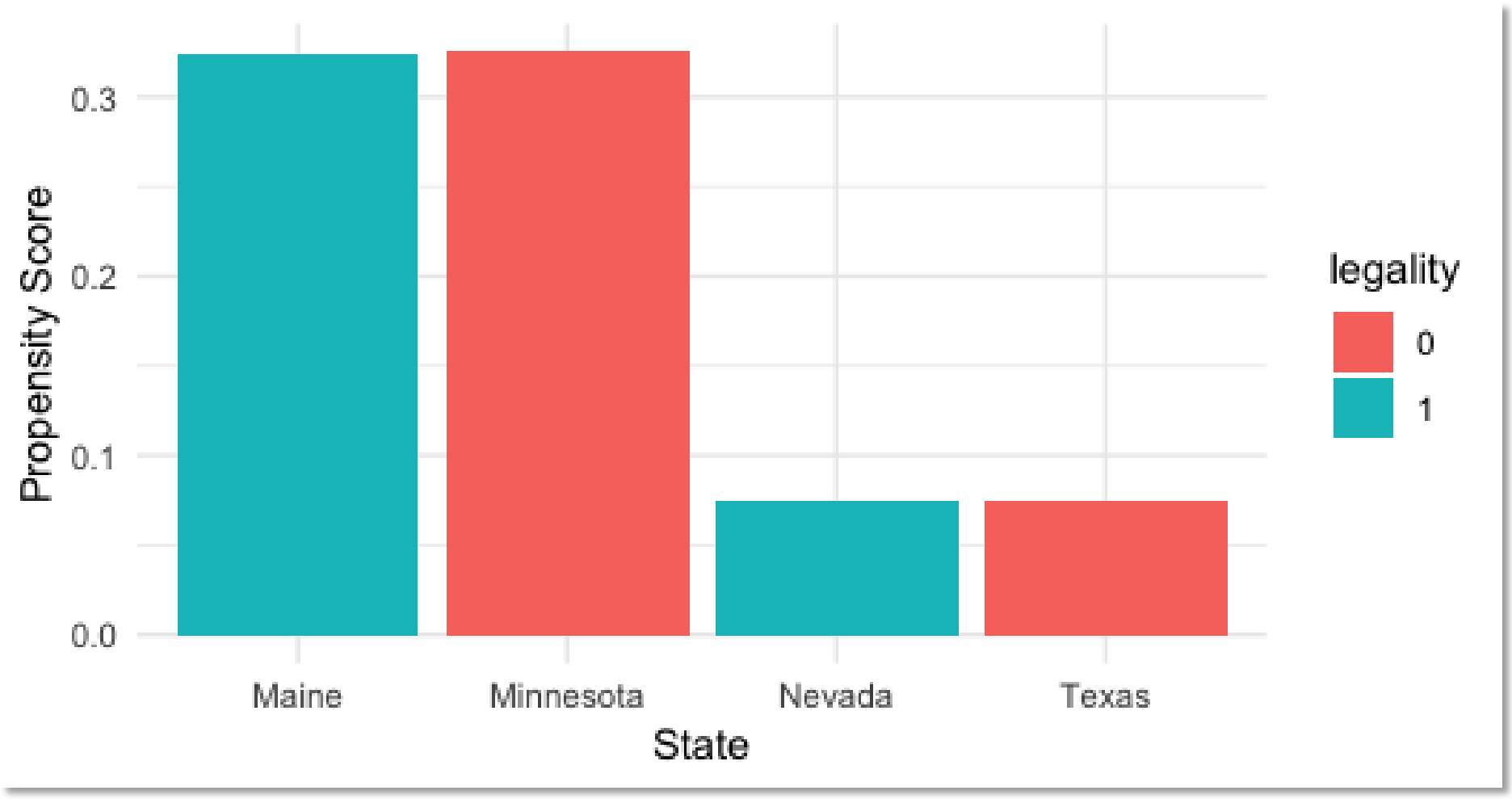
Minimize differences in propensity scores of treatment and control

```
matchit(legality ~ age + pp + prop_male + ps + rev_ratio + beverage + population_density,
        data = master_pre, method = "nearest", distance = "logit",
        caliper = 0.01, replace = FALSE, ratio = 1)
```

Before Matching



After Matching



Difference-in-Differences

Assumptions

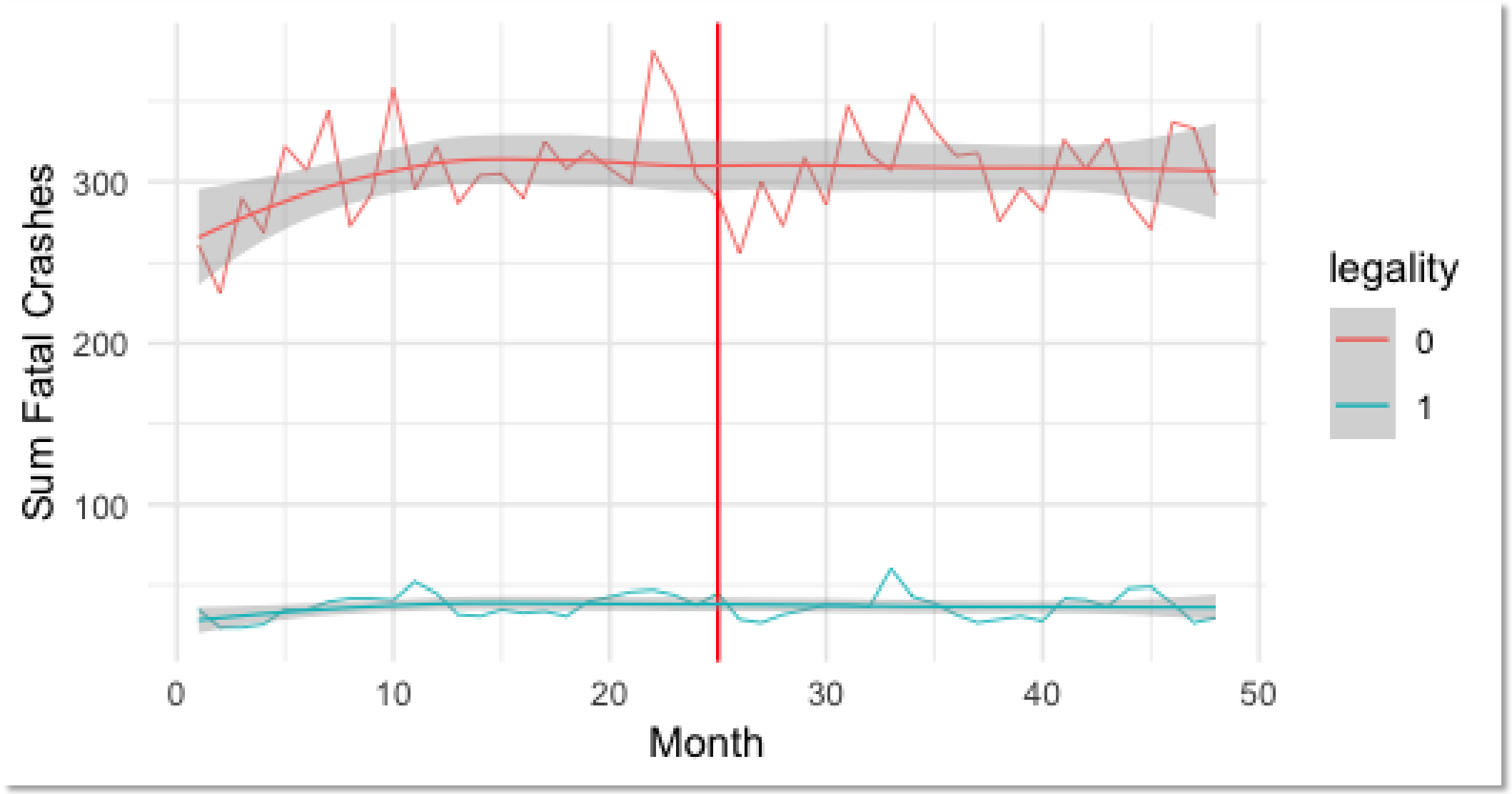
Model Specification

Results

Difference-in-Differences: Assumptions

1. Fatal car accident rates across treatment & control states follow a parallel trend
2. After effective date of legalization, there are no unobserved time-variant factors unique to either the control or treatment group
3. Illegal states are not influencing the legalized states

Differences in Difference: Parallel Trend



Difference-in-Differences: Model Specification

Dependent Variable

- Number of Fatal Car Accidents per Month

Independent Variables

- Legality (1 = legalized, 0 = illegal)
- Before & After Legalization Effective Date (2017 Jan)
- Highway Expenses Ratio (Highway Expense / Total Area)

```
plm(fatal_crashes ~ after + treatment + hw_expense_ratio + after * treatment, data = crashes,
    effect = 'individual', index = 'state', model = 'within')
```

Difference-in-Differences: Results

- There is a 50% chance that we would obtain results at least as extreme as what we observed if in fact there is no causal relationship between cannabis legalization and fatal crashes

- We did not obtain evidence to conclude that there is a relationship between cannabis legalization and car crash

```
Coefficients:
                  Estimate Std. Error t-value Pr(>|t|)
after1           -0.054309   2.881792 -0.0188   0.9850
hw_expense_ratio  1.175793   0.592803  1.9834   0.0488 *
after1:treatment1 -2.932078   4.300600 -0.6818   0.4962
```

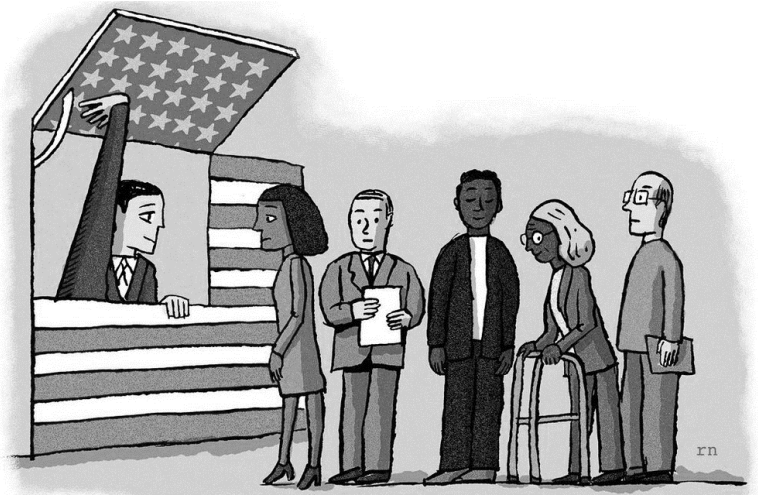
Difference-in-Differences: Other Approaches

1. Weather (Condition) Data
   - Tradeoff between longer and shorter experimental window
   - Less accurate estimations because of small dataset with more variables

2. Percentage increases in fatal car crashes
   - log transformation
   - Making car crashes more comparable, no significant change in results

3. Drop Texas and Nevada from dataset
   - No significant change in results

Threats to Causal Inference



Organic Limitations

- Difficult to predict probability of legality
- Difficult to measure how long it takes for cannabis-impaired driving to manifest after legalization
- Disproportional sample size in treatment & control group

Data Availability

- Don't have data directly linked to cannabis-impaired driving
- Including more variables limits the time span of experiment e.g. no alcohol consumption data for 2018 to put into DiD

Interference

- People are likely to travel from other states to buy cannabis, leading to a boost in overall traffic in legalized states

Future Improvements

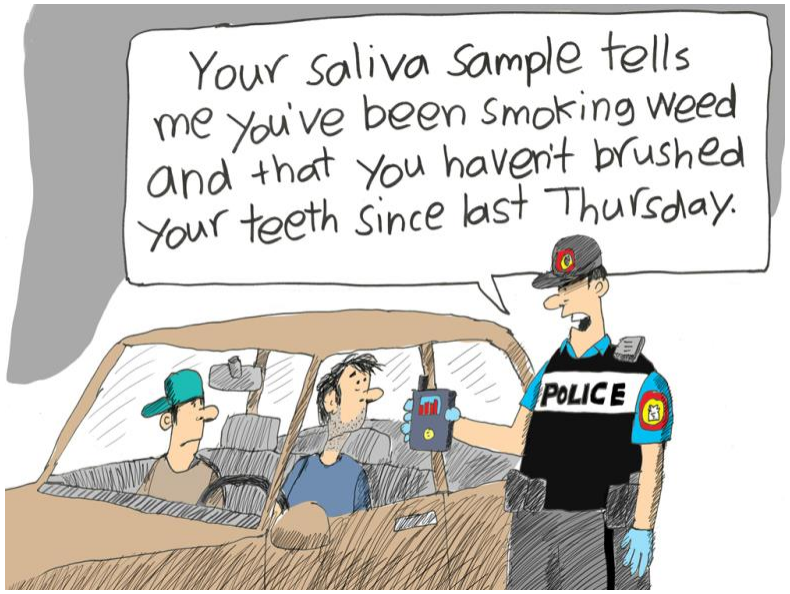
Find a better target variable

- Find total crash data which would detect smaller variation in the treatment effect

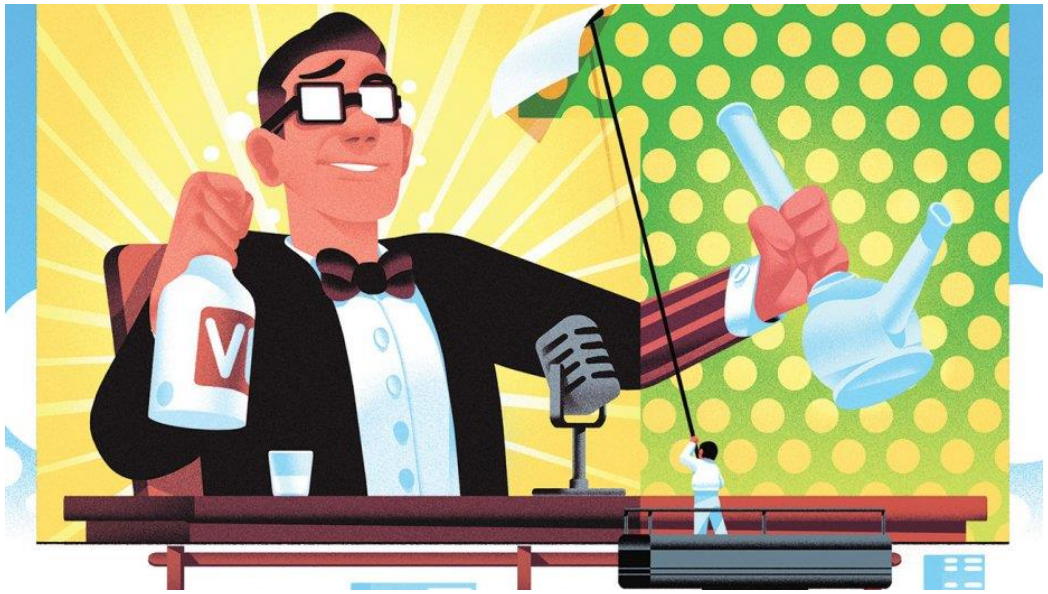
Control for more variables in the Difference-in-Differences regression

- Vehicle registration data to improve upon the population density metric
- Weather data independent of fatal car crashes

If Future Studies Find Significant Results,



Motivate research on effective cannabis breathalyzers



Inform policy for non-legalized states

Questions?

Thank you!