



COVID-19 IMPACT ON CAR ACCIDENTS IN THE USA

September 2020
by Celina Plaza

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Background & Objective

02

Methodology

03

Findings

04

Key Takeaways

BACKGROUND



COVID-19's Stay-At-Home orders.

Countless negative effects.

....but also glimmers of positive effects:

Less cars on road =

- cleaner air
- clearer views
- more recreation

THE QUESTION

Did COVID-19's
stay-at-home orders affect
car accident
frequency or severity?

METHODOLOGY



Data Collection

3.5M US car accidents
2016-2020

+

Stay-At-Home dates by
state

46 variables



Cleaning & EDA

Addressing outliers &
null values

Bucketing categorical
values

Examining
distributions



State Analysis

Individual states'
car accident
frequency & severity
shifts during
Stay-At-Home orders



Modeling

Logistic Regression

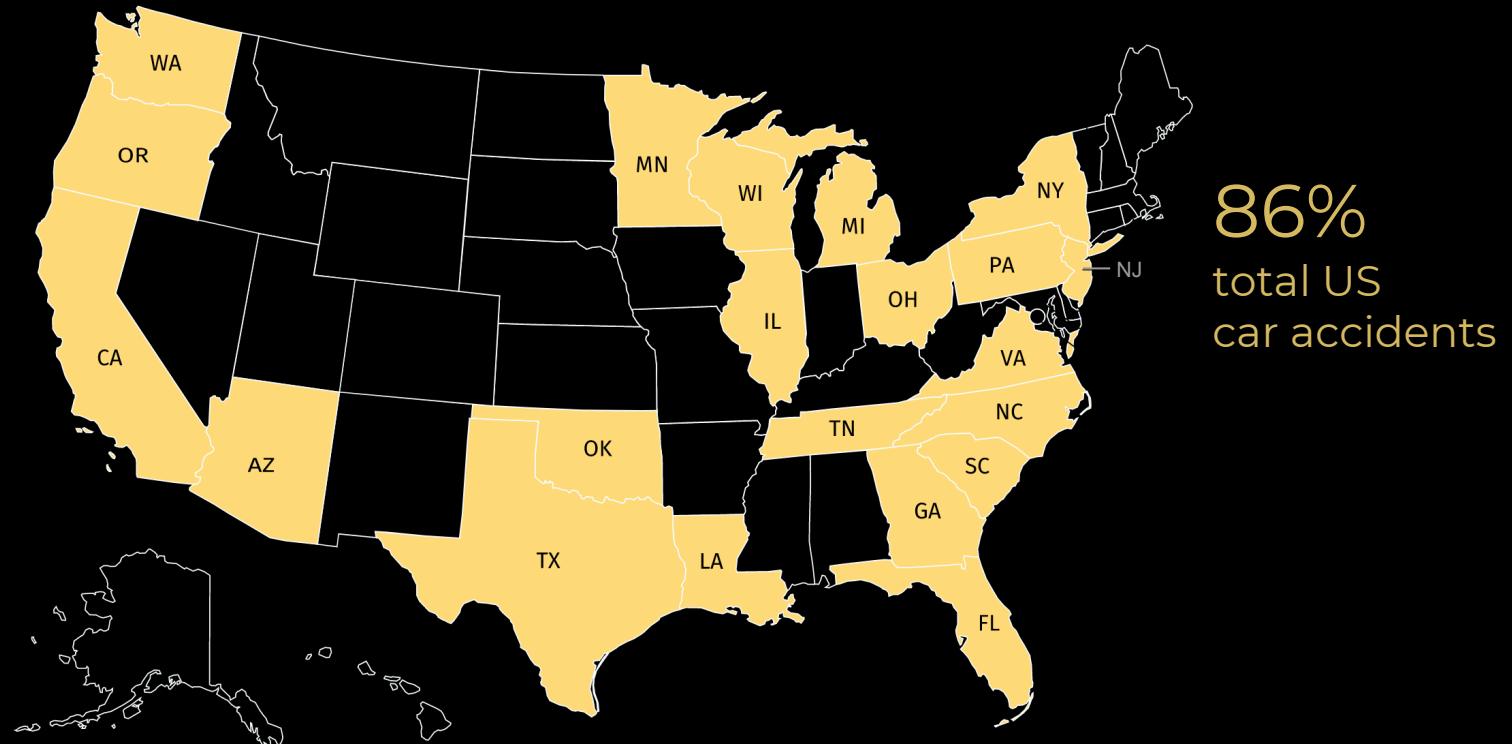
Random Forest

XGBoost

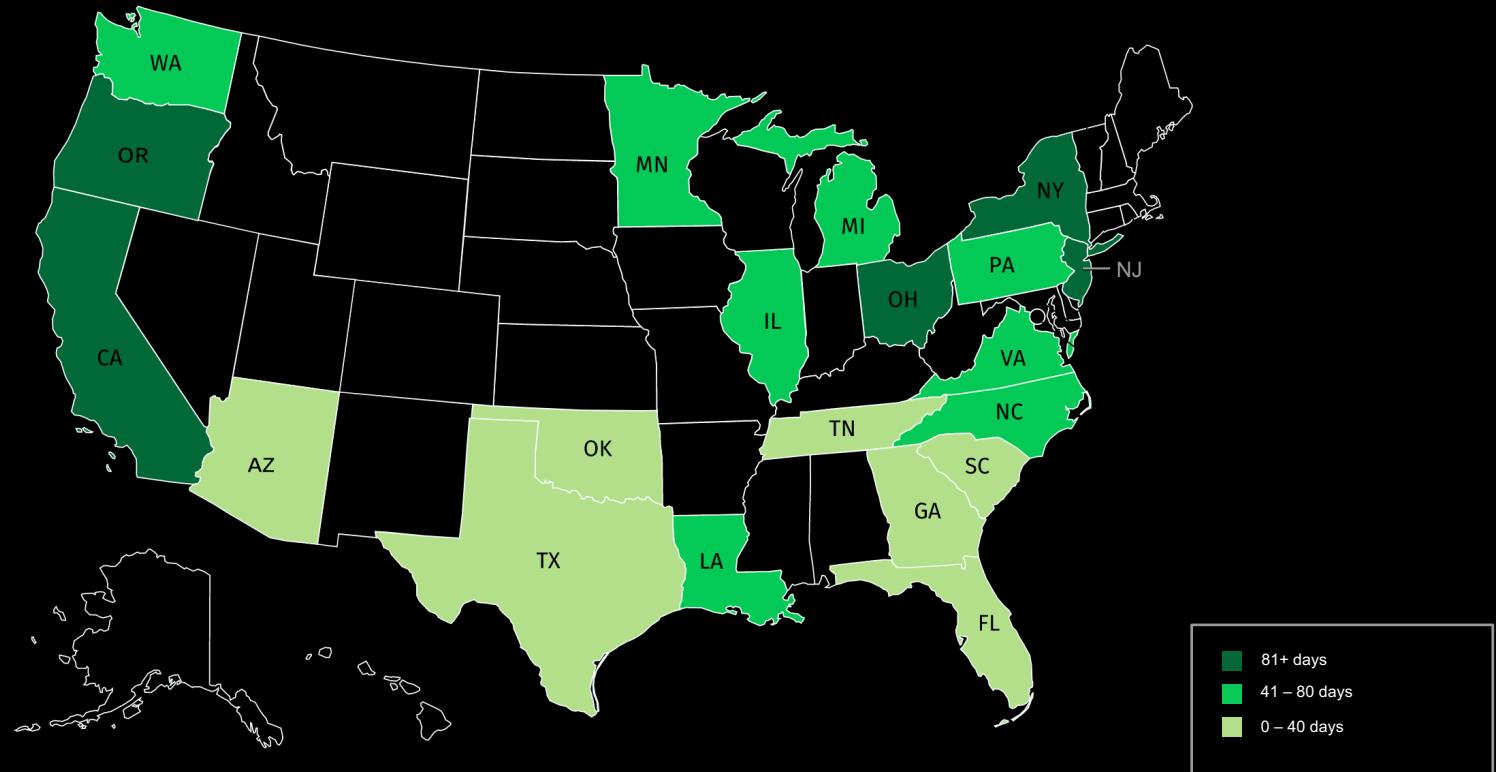


States' Stay-Home Period Analysis

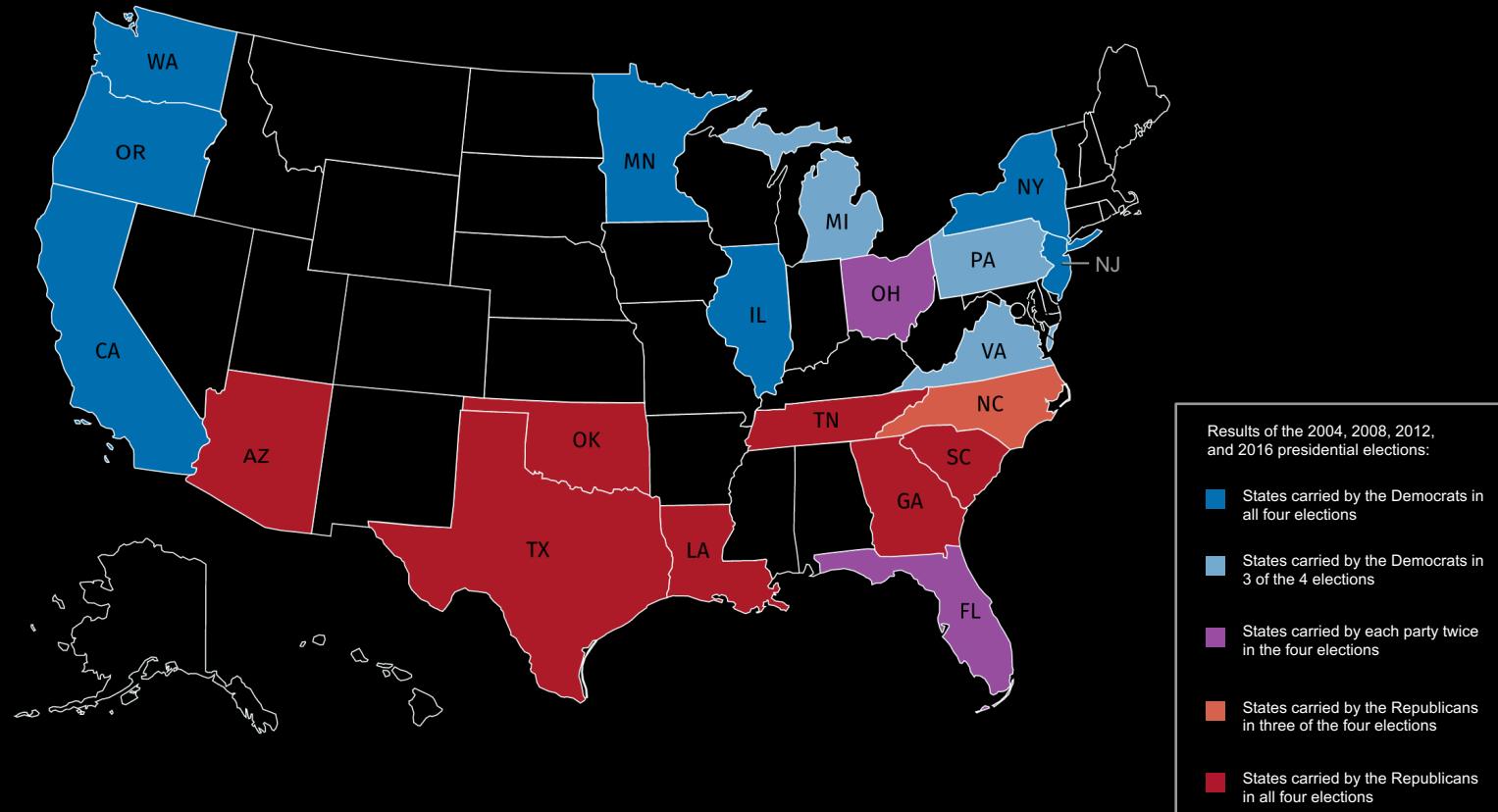
TOP 20 STATES WITH MOST CAR ACCIDENTS



TIME UNDER STAY-AT-HOME ORDERS



POLITICAL LEANING



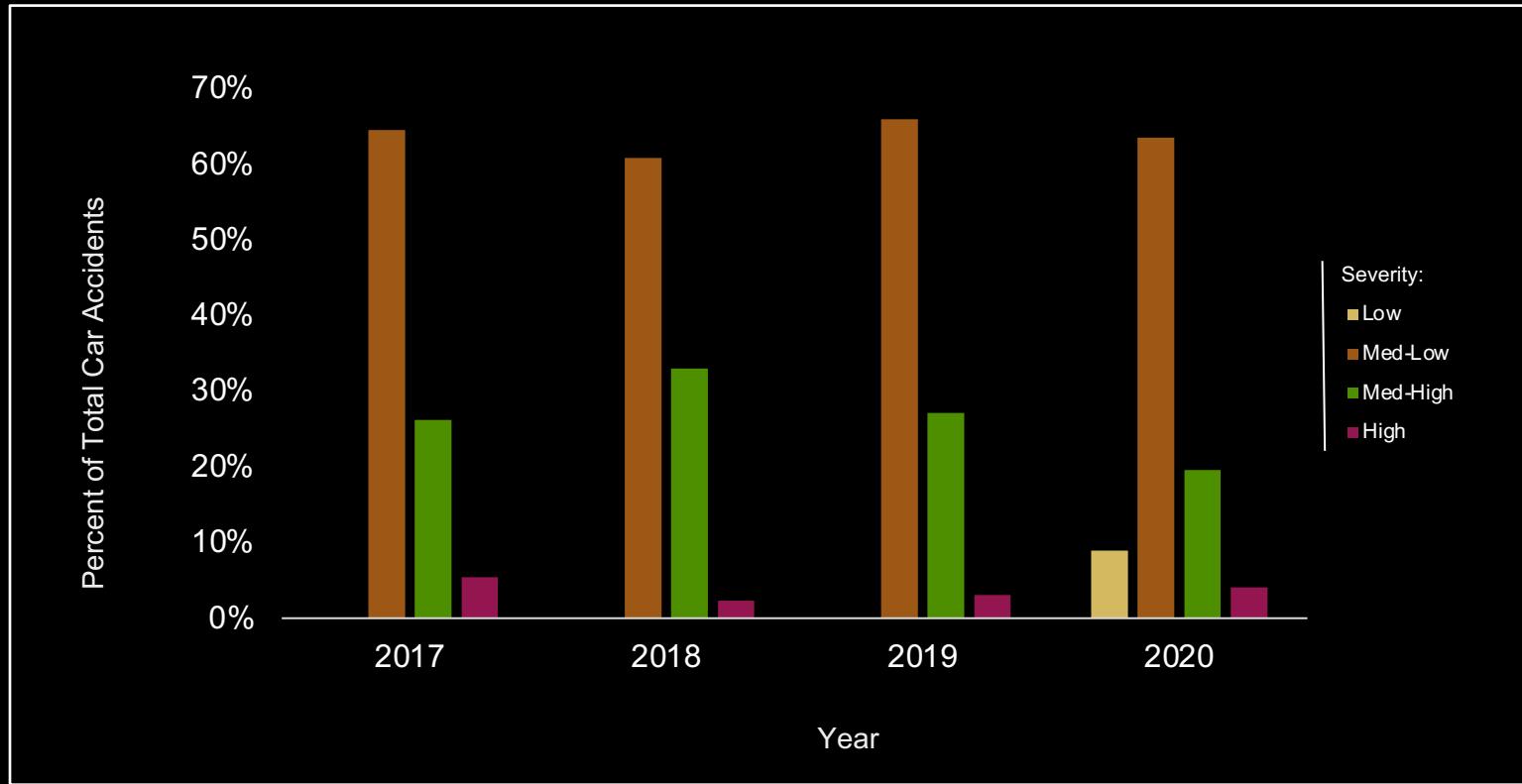
Severity

Ranked as :

- Low
- Medium-Low
- Medium-High
- High

AVERAGE SEVERITY RANK FOR TOP 20 STATES*

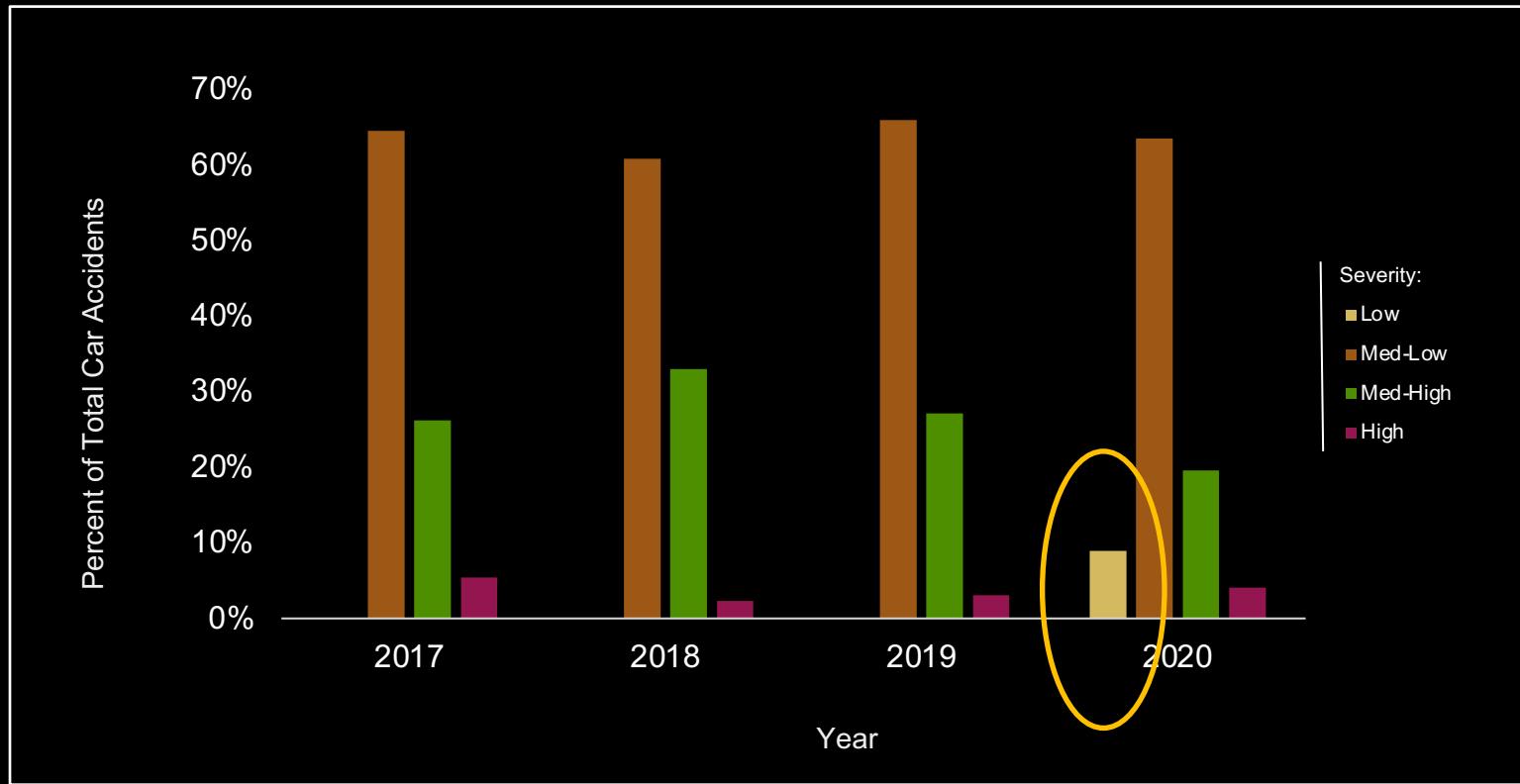
ACTUAL 'STAY-HOME' PERIOD 2020 COMPARED TO EQUIVALENT PERIOD YEARS PRIOR



*States weighted by number of accidents to total

AVERAGE SEVERITY RANK FOR TOP 20 STATES*

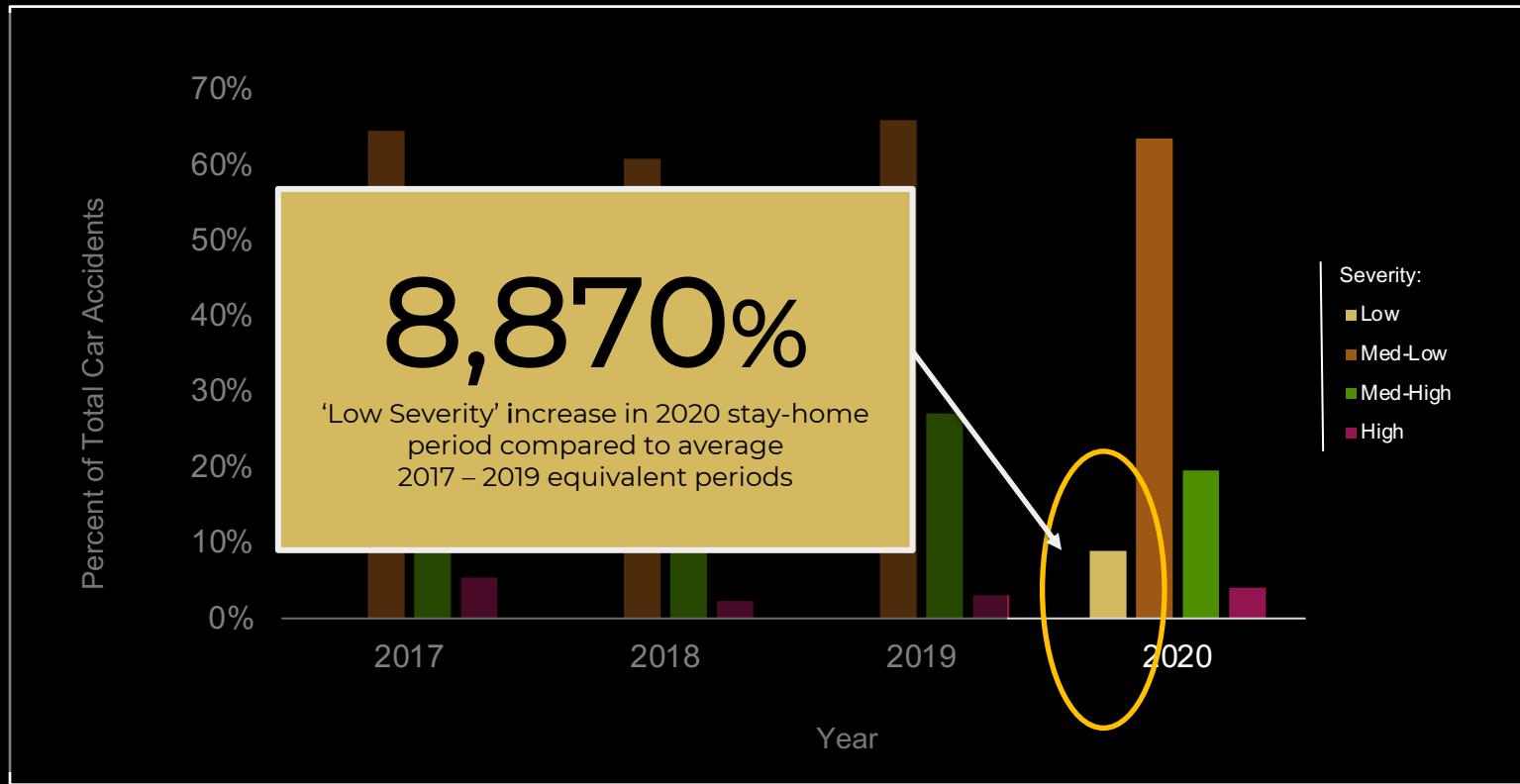
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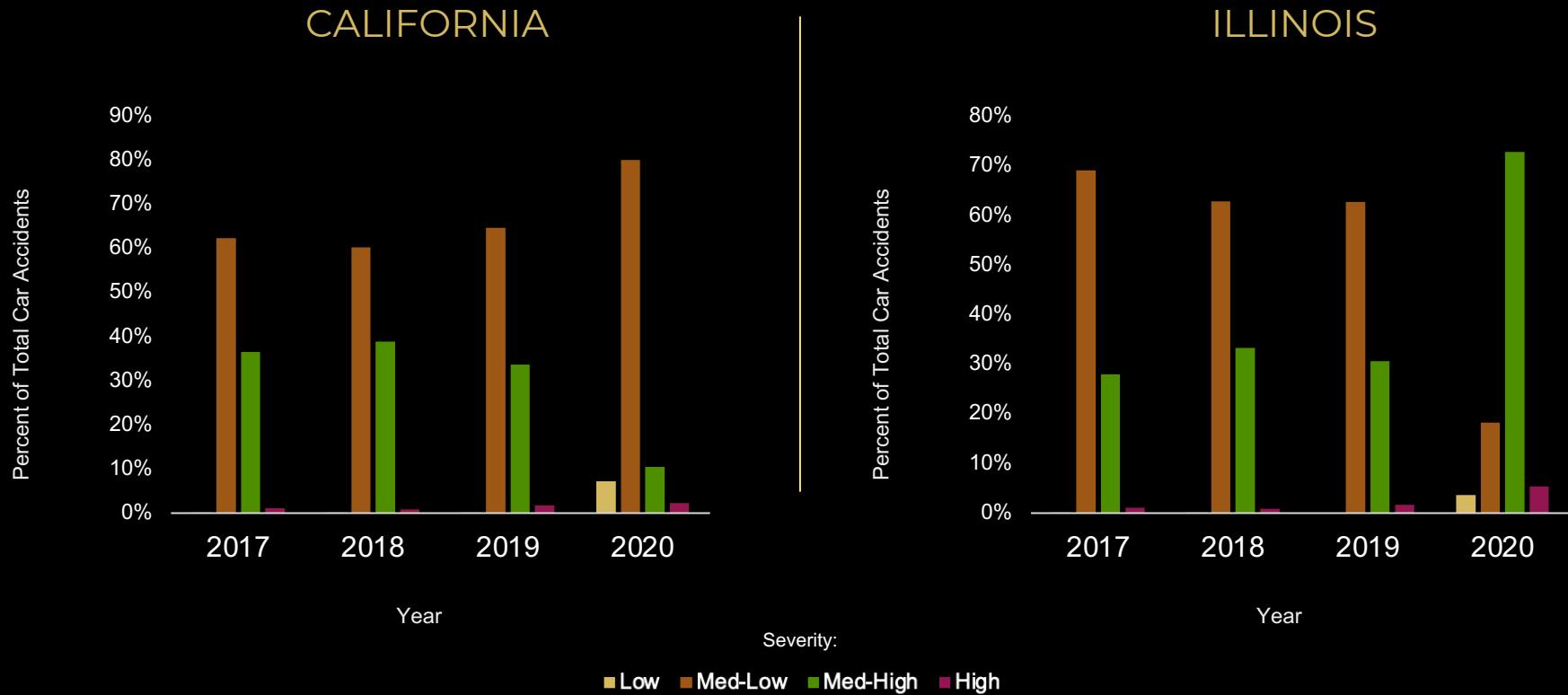
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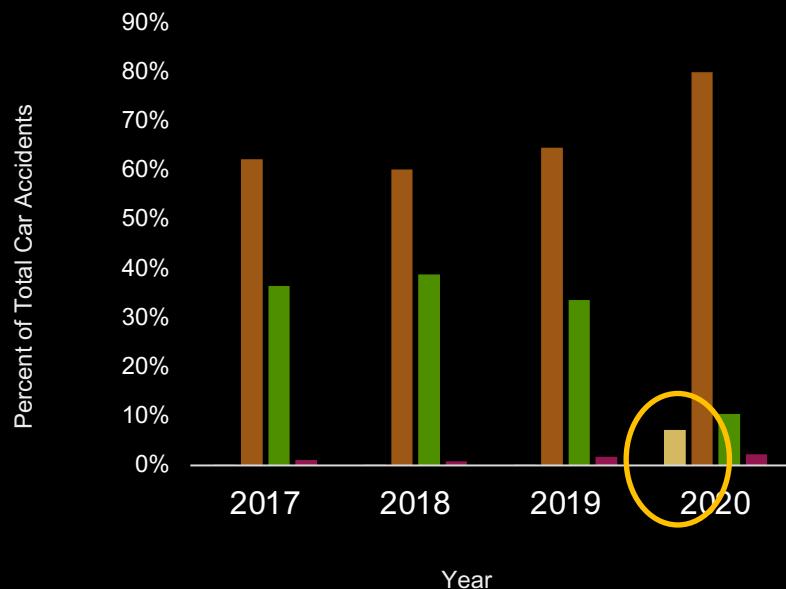
*States weighted by number of accidents to total

SEVERITY RANK BY STATE

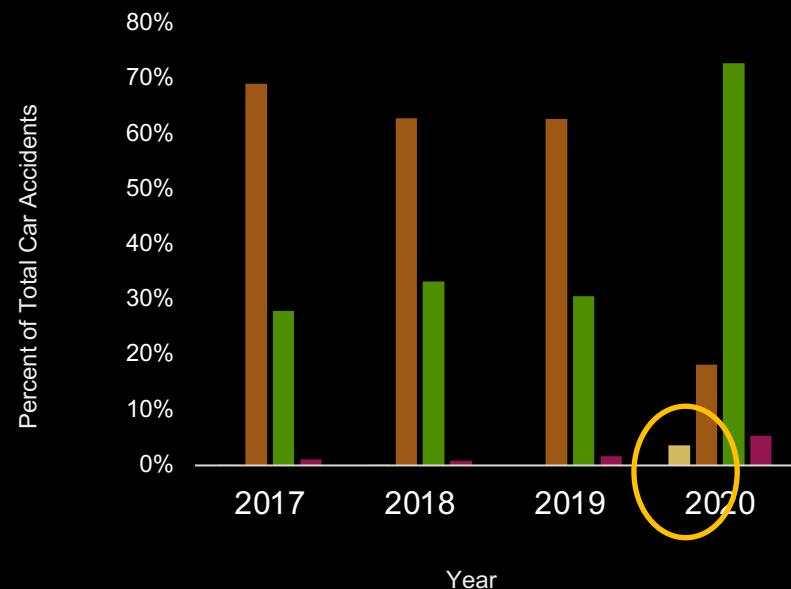


SEVERITY RANK BY STATE

CALIFORNIA



ILLINOIS



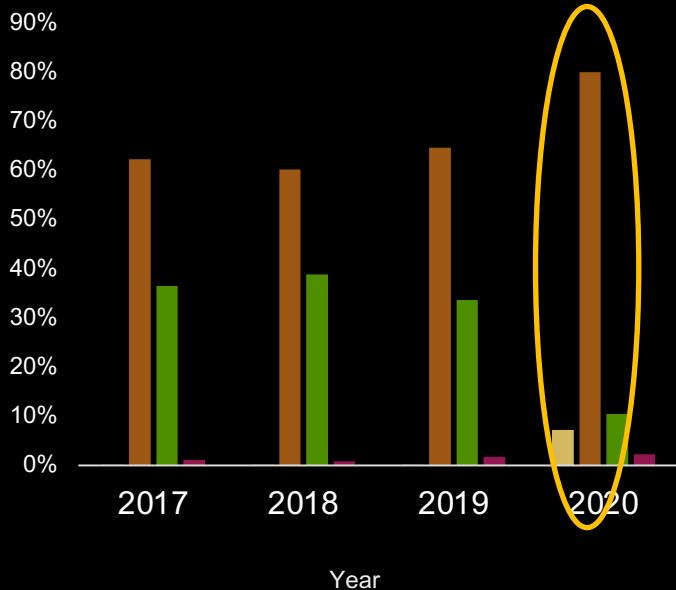
Severity:

■ Low ■ Med-Low ■ Med-High ■ High

SEVERITY RANK BY STATE

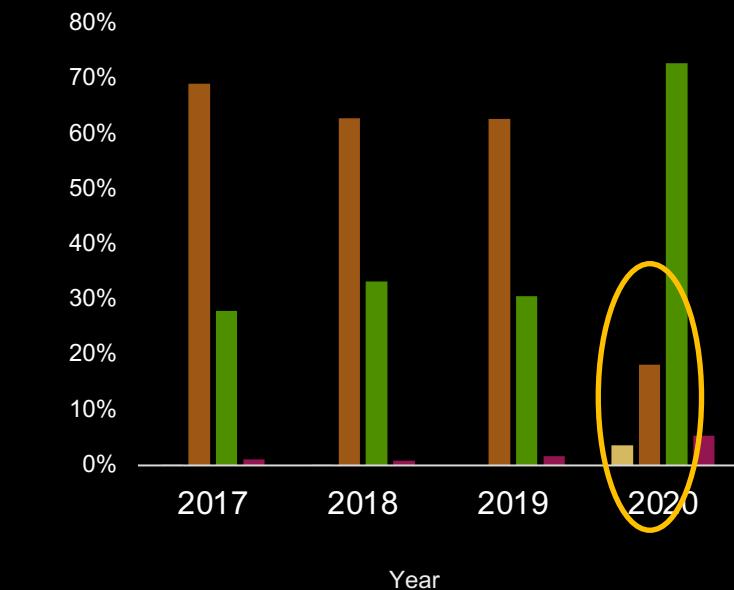
CALIFORNIA

Percent of Total Car Accidents



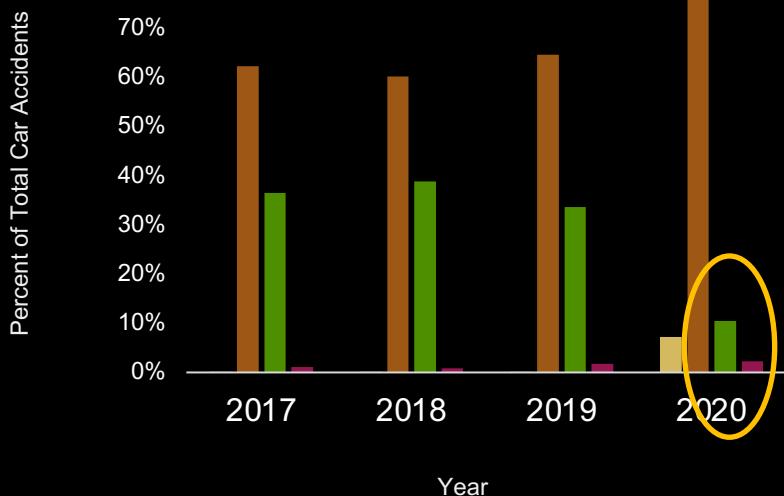
ILLINOIS

Percent of Total Car Accidents

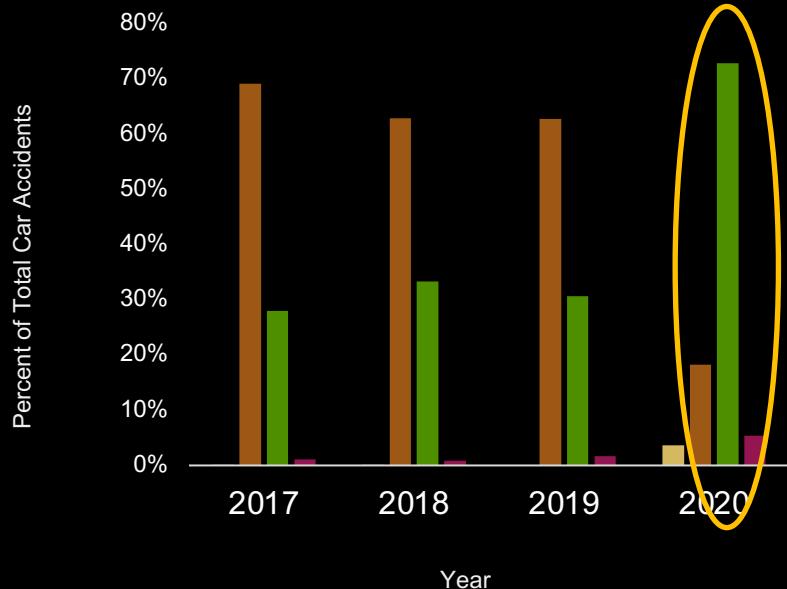


SEVERITY RANK BY STATE

CALIFORNIA



ILLINOIS



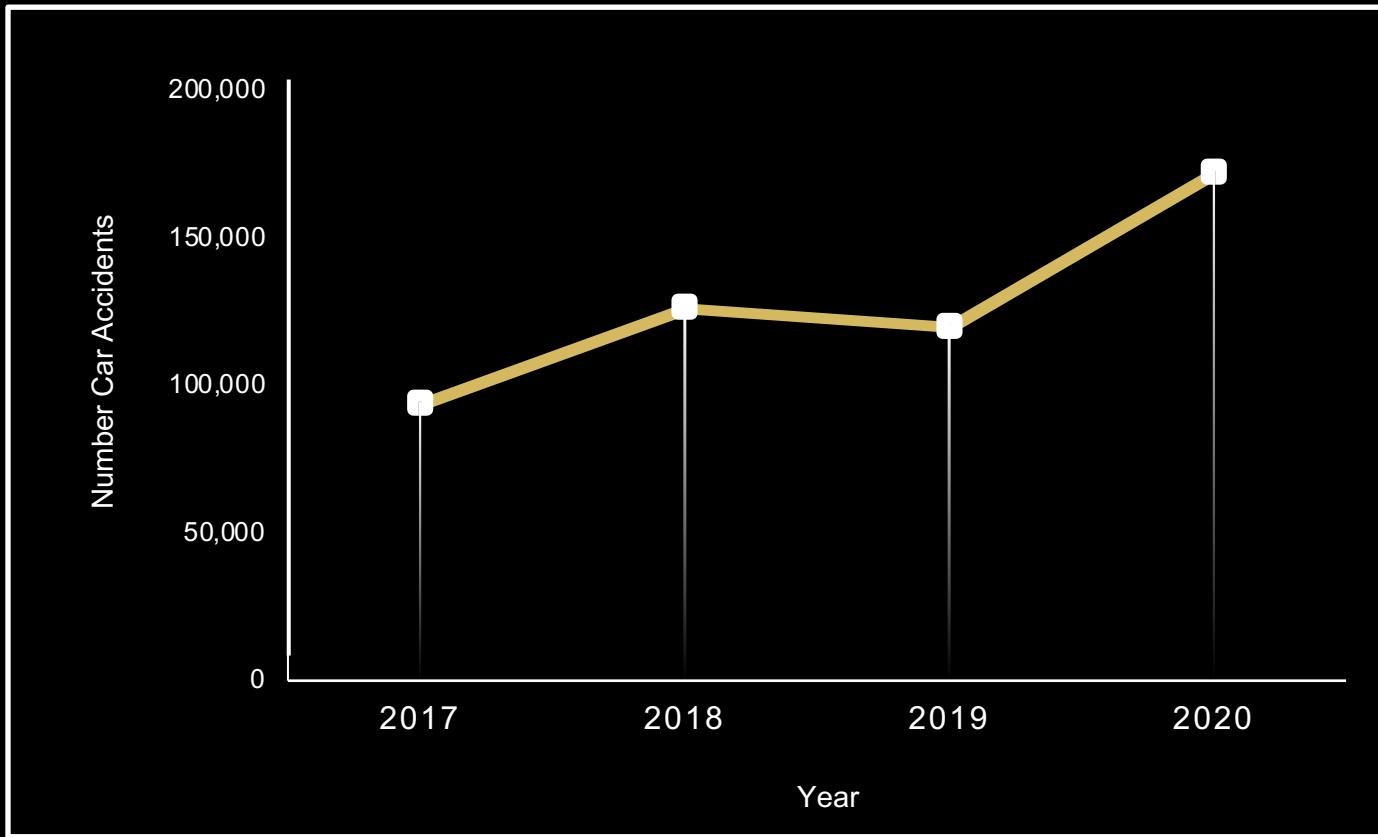
Severity:

■ Low ■ Med-Low ■ Med-High ■ High

Frequency

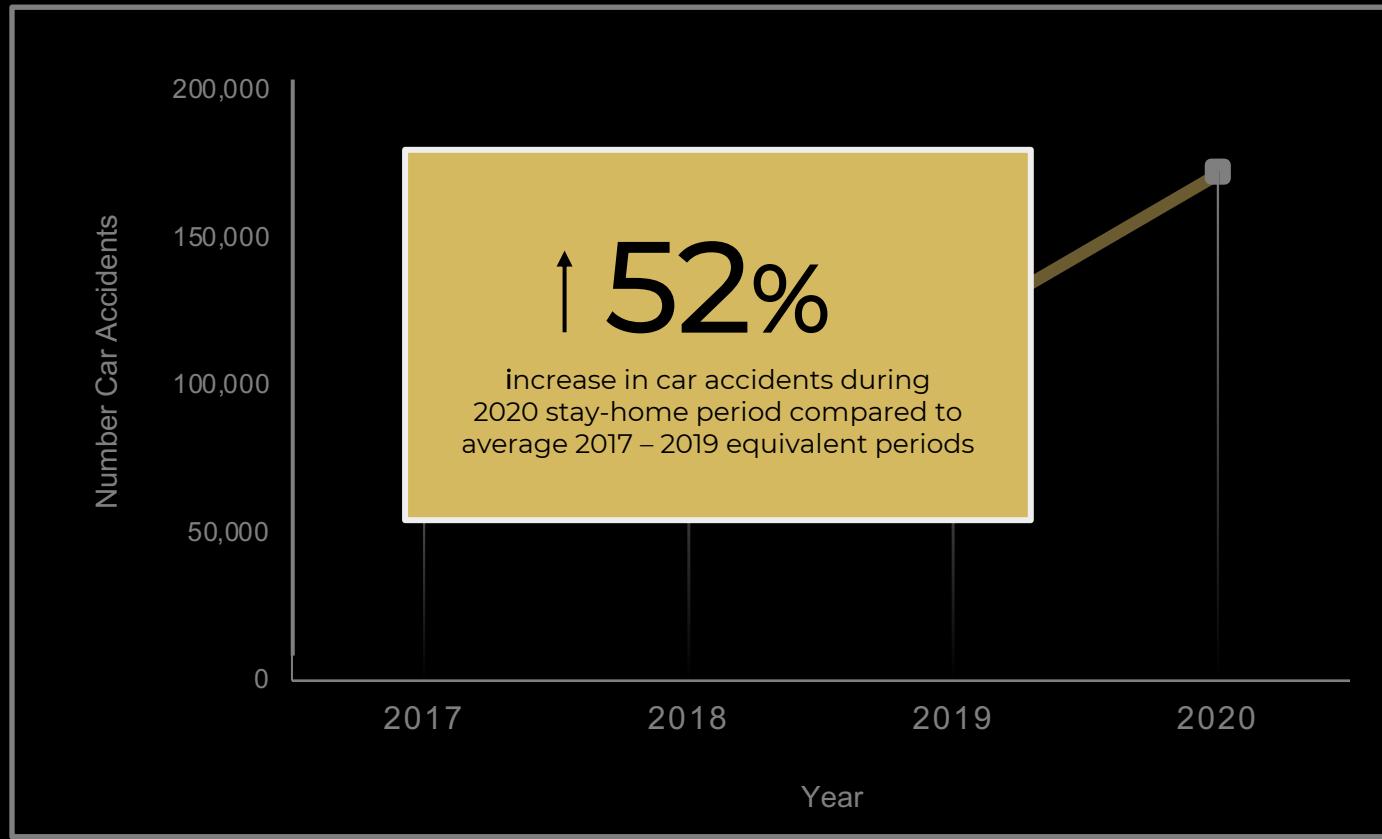
FREQUENCY OF CAR ACCIDENTS FOR TOP 20 STATES

ACTUAL 'STAY-HOME' PERIOD 2020 COMPARED TO EQUIVALENT PERIOD YEARS PRIOR



FREQUENCY OF CAR ACCIDENTS FOR TOP 20 STATES

ACTUAL 'STAY-HOME' PERIOD 2020 COMPARED TO EQUIVALENT PERIOD YEARS PRIOR



FREQUENCY BY STATE

CALIFORNIA

↑ 76%

Stay-Home 2020 period
vs. 2017-2019 average

TEXAS

↓ 37%

Stay-Home 2020 period
vs. 2017-2019 average

Level of Impact on Car Accidents' Severity



VARIABLES FOR PREDICTING SEVERITY RANK IN 2020

27 Variables Considered

- Weather Conditions (Snow, Rain, Fog, Clear, etc.)
- Day or Night
- Temperature
- Wind Speed
- Signs (stop sign, traffic light)
- Intersection w/Road (junction, railroad)
- In period of stay-home orders



MODELS TESTED:

Logistic Regression

Random Forest

XGBoost

THE MODEL WITH INSIGHTS WE WANT :

Logistic Regression

THE MODEL WITH INSIGHTS WE WANT :

Logistic Regression

Why?

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Logistic Regression

Why?

71.6% Accuracy

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Logistic Regression

Why?

71.6% Accuracy

We're interested in which direction the stay-at-home orders 'pull' the model
(i.e. coefficient positive or negative)

VARIABLES' IMPACT ON SEVERITY OF CAR ACCIDENT

LESS SEVERE



WEATHER:
Clear/Fair
Foggy/Hazy

SIGNAL PRESENCE:
Traffic Light

INTERSECTION TYPE:
Crossing

SPECIAL:
Under 'Stay-Home'
Orders



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Orders



WEATHER:
Rain/Thunderstorm
Snow/Hail

TIME OF DAY:
Nighttime

INTERSECTION TYPE:
Junction

TEMPERATURE:
Higher Temperature

SUMMARY OF FINDINGS

Did Stay-At-Home orders affect frequency or severity of car accidents?

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Findings indicate:

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Even when accounting for other 'evergreen' variables,
such as weather and time of day.

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Did Stay-At-Home orders affect frequency or severity of car accidents?

Findings indicate:

- Increase in frequency of accidents.
 - Decrease in severity of accidents.
Even when accounting for other 'evergreen' variables,
such as weather and time of day.
- Individual states can vary significantly in degree shifts in frequency and severity.

SUMMARY OF FINDINGS

Did Stay-At-Home orders affect frequency or severity of car accidents?

Findings indicate:

- Increase in frequency of accidents.
 - Decrease in severity of accidents.
Even when accounting for other 'evergreen' variables,
such as weather and time of day.
- Individual states can vary significantly in degree shifts in frequency and severity.

THANK YOU

Any Questions?



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Full project:

github.com/cecann10/covid-impact-car-accidents

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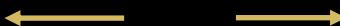
Appendix

FUTURE OPPORTUNITIES

- Deepen investigation into potential reasons why there was an increase in number of accidents during stay-home period
- Additional research to develop and test differences between states' results
- Further research on potential causes for increase in highest severity (level 4) for states during stay-home period
- Analyze post-stay-home period to see how quickly (if at all) frequency and severity returned to average levels

VARIABLES' IMPACT ON SEVERITY OF CAR ACCIDENT

LESS SEVERE



MORE SEVERE



WEATHER:
Clear/Fair
Foggy/Hazy

SIGNAL PRESENCE:
Traffic Light

INTERSECTION TYPE:
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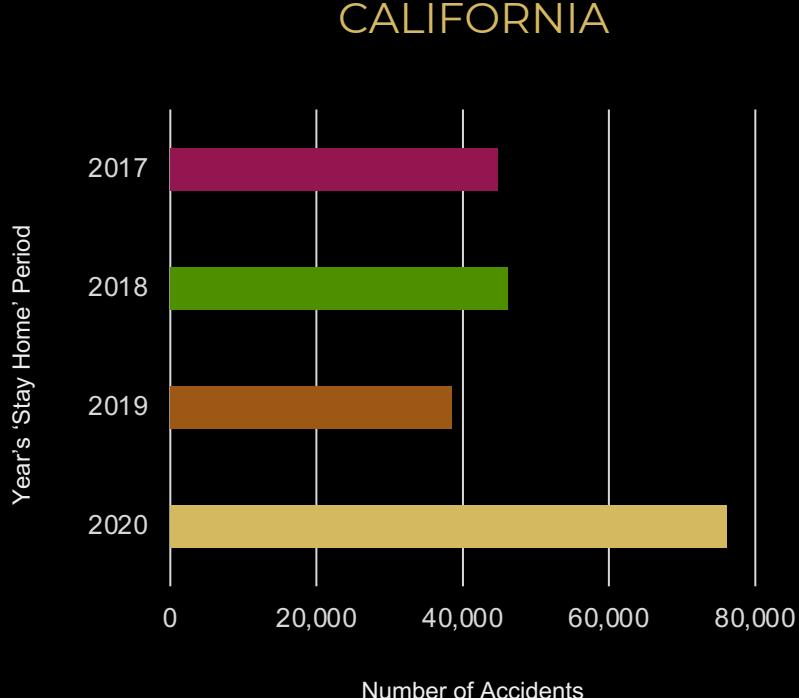
INTERSECTION TYPE:
Junction

TEMPERATURE:
Higher Temperature

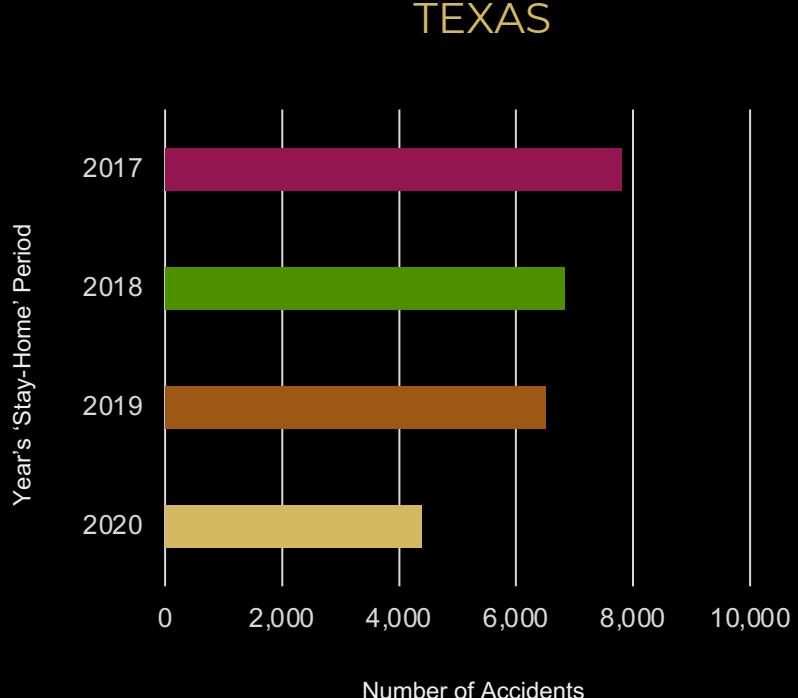
FREQUENCY BY STATE

■ 2017
■ 2018
■ 2019
■ 2020

CALIFORNIA



TEXAS



CALIFORNIA

Frequency		Severity					
Timeframe	Num_Accidents	Severity_Rank	TTL	Shut_Down	2019	2018	2017
Total	816790	1	0.71	7.20	0.01	0.02	0.06
Shut_Down	76131	2	70.61	80.00	64.69	60.23	62.30
2019	38440	3	27.65	10.54	33.61	38.90	36.52
2018	46203	4	1.04	2.27	1.69	0.85	1.11
2017	44799						

% Change 2020 vs. average 2017 - 2019:

76.44%

TEXAS

Frequency		Severity						
Timeframe	Num_Accidents	Severity_Rank	TTL	Shut_Down	2019	2018	2017	
Total	329264	1	0.32	6.40	0.03	0.03	0.03	
Shut_Down	4391	2	71.01	54.18	72.52	70.22	73.52	
2019	6496	3	27.23	34.50	25.94	28.64	25.27	
2018	6823	4	1.43	4.92	1.51	1.11	1.19	
2017	7809							

% Change 2020 vs. average 2017 - 2019:

-37.65%

FLORIDA

Frequency

Timeframe	Num_Accidents
Total	258000
Shut_Down	4941
2019	4623
2018	5023
2017	4256

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	1.17	17.63	0.00	0.00	0.07
2	64.15	58.23	65.35	62.45	70.32
3	31.23	20.50	29.12	35.24	27.68
4	3.46	3.64	5.54	2.31	1.93

% Change 2020 vs. average 2017 - 2019:

6.62%

SOUTH CAROLINA

Frequency

Timeframe	Num_Accidents
Total	173255
Shut_Down	4142
2019	4481
2018	5119
2017	455

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.07	0.56	0.02	0.02	0.22
2	79.28	90.56	77.15	76.40	81.98
3	19.98	8.16	21.85	23.36	14.95
4	0.68	0.72	0.98	0.21	2.86

% Change 2020 vs. average 2017 - 2019:

23.58%

NORTH CAROLINA

Frequency

Timeframe	Num_Accidents
Total	165956
Shut_Down	7641
2019	7539
2018	9659
2017	1530

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	1.09	8.17	0.04	0.03	0.00
2	83.79	75.71	85.30	85.11	91.18
3	13.28	12.75	12.20	13.72	4.18
4	1.84	3.38	2.45	1.14	4.64

% Change 2020 vs. average 2017 - 2019:

22.40%

NEW YORK

Frequency

Timeframe	Num_Accidents
Total	160803
Shut_Down	12442
2019	10586
2018	7933
2017	6319

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.45	4.55	0.02	0.04	0.03
2	59.73	55.33	66.75	54.00	55.15
3	35.37	31.43	30.35	42.28	39.42
4	4.44	8.70	2.88	3.68	5.40

% Change 2020 vs. average 2017 - 2019:

50.28%

PENNSYLVANIA

Frequency

Timeframe	Num_Accidents
Total	106748
Shut_Down	8576
2019	3633
2018	4344
2017	5510

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.21	1.59	0.00	0.05	0.05
2	73.73	65.64	67.96	67.31	80.34
3	20.72	26.38	26.26	28.13	13.03
4	5.35	6.40	5.78	4.51	6.57

% Change 2020 vs. average 2017 - 2019:

90.76%

ILLINOIS

Frequency

Timeframe	Num_Accidents
Total	99686
Shut_Down	5037
2019	3681
2018	3714
2017	4737

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.27	3.59	0.00	0.11	0.06
2	63.60	18.23	62.70	62.74	69.07
3	32.75	72.76	30.64	33.23	27.93
4	3.38	5.42	6.66	3.93	2.93

% Change 2020 vs. average 2017 - 2019:

24.55%

VIRGINIA

Frequency

Timeframe	Num_Accidents
Total	96069
Shut_Down	8207
2019	5175
2018	4123
2017	2255

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	1.81	15.36	0.04	0.00	0.00
2	53.75	58.60	58.28	43.39	49.53
3	38.70	20.32	35.83	51.52	41.55
4	5.74	5.71	5.86	5.09	8.91

% Change 2020 vs. average 2017 - 2019:

113.11%

MICHIGAN

Frequency

Timeframe	Num_Accidents
Total	95959
Shut_Down	2010
2019	3392
2018	4558
2017	4514

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.06	0.95	0.00	0.02	0.00
2	59.45	61.44	61.56	59.04	56.76
3	34.95	28.31	31.93	35.65	38.83
4	5.55	9.30	6.52	5.29	4.41

% Change 2020 vs. average 2017 - 2019:

-51.62%

GEORGIA

Frequency

Timeframe	Num_Accidents
Total	93611
Shut_Down	1469
2019	1930
2018	1755
2017	1422

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.43	7.49	0.00	0.00	0.00
2	41.58	47.45	45.70	39.03	32.42
3	50.03	37.58	45.91	54.02	59.92
4	7.96	7.49	8.39	6.95	7.67

% Change 2020 vs. average 2017 - 2019:

-13.71%

OREGON

Frequency

Timeframe	Num_Accidents
Total	90104
Shut_Down	9853
2019	7688
2018	2174
2017	433

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	1.40	12.29	0.03	0.00	0.00
2	86.27	77.07	89.93	63.29	55.20
3	8.96	5.99	7.19	31.83	10.39
4	3.37	4.65	2.85	4.88	34.41

% Change 2020 vs. average 2017 - 2019:

187.12%

MINNESOTA

Frequency

Timeframe	Num_Accidents
Total	81700
Shut_Down	3354
2019	2313
2018	2645
2017	535

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.05	0.36	0.00	0.11	0.00
2	65.35	77.61	61.05	38.26	87.85
3	34.03	21.14	37.74	61.17	10.65
4	0.57	0.89	1.21	0.45	1.50

% Change 2020 vs. average 2017 - 2019:

83.18%

ARIZONA

Frequency

Timeframe	Num_Accidents
Total	78584
Shut_Down	4919
2019	2777
2018	2610
2017	469

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	8.53	59.85	0.11	0.00	0.00
2	70.10	32.71	77.75	70.27	62.47
3	16.77	3.80	18.15	25.06	14.50
4	4.60	3.64	4.00	4.67	23.03

% Change 2020 vs. average 2017 - 2019:

152.00%

TENNESSEE

Frequency

Timeframe	Num_Accidents
Total	69895
Shut_Down	1614
2019	2324
2018	2124
2017	274

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	2.08	25.28	0.04	0.09	0.00
2	65.73	54.89	73.28	58.05	68.61
3	29.77	17.91	25.13	39.97	14.60
4	2.42	1.92	1.55	1.88	16.79

% Change 2020 vs. average 2017 - 2019:

2.54%

WASHINGTON

Frequency

Timeframe	Num_Accidents
Total	68541
Shut_Down	2461
2019	2647
2018	3627
2017	2572

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.77	13.45	0.00	0.03	0.08
2	60.88	62.29	56.14	61.04	59.84
3	33.90	19.42	37.21	35.18	36.00
4	4.44	4.84	6.65	3.75	4.08

% Change 2020 vs. average 2017 - 2019:

-16.54%

OHIO

Frequency

Timeframe	Num_Accidents
Total	66137
Shut_Down	5805
2019	2594
2018	3188
2017	2211

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.80	6.61	0.00	0.03	0.00
2	62.17	73.21	59.56	52.63	58.48
3	28.58	12.49	34.58	36.89	26.37
4	8.45	7.68	5.86	10.45	15.15

% Change 2020 vs. average 2017 - 2019:

117.88%

LOUISIANA

Frequency

Timeframe	Num_Accidents
Total	61512
Shut_Down	2683
2019	2946
2018	3938
2017	211

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	2.05	21.21	0.10	0.10	0.00
2	76.57	49.24	78.17	81.82	65.88
3	19.38	24.67	19.79	16.66	9.48
4	2.00	4.88	1.93	1.42	24.64

% Change 2020 vs. average 2017 - 2019:

13.45%

OKLAHOMA

Frequency

Timeframe	Num_Accidents
Total	59972
Shut_Down	1960
2019	2938
2018	2560
2017	136

Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.12	0.36	0.03	0.04	0.00
2	89.32	83.88	92.41	90.20	78.68
3	9.82	15.36	7.35	9.34	5.88
4	0.73	0.41	0.20	0.43	15.44

% Change 2020 vs. average 2017 - 2019:

4.37%

NEW JERSEY

Frequency

Timeframe	Num_Accidents
Total	59052
Shut_Down	4724
2019	3932
2018	4361
2017	3642

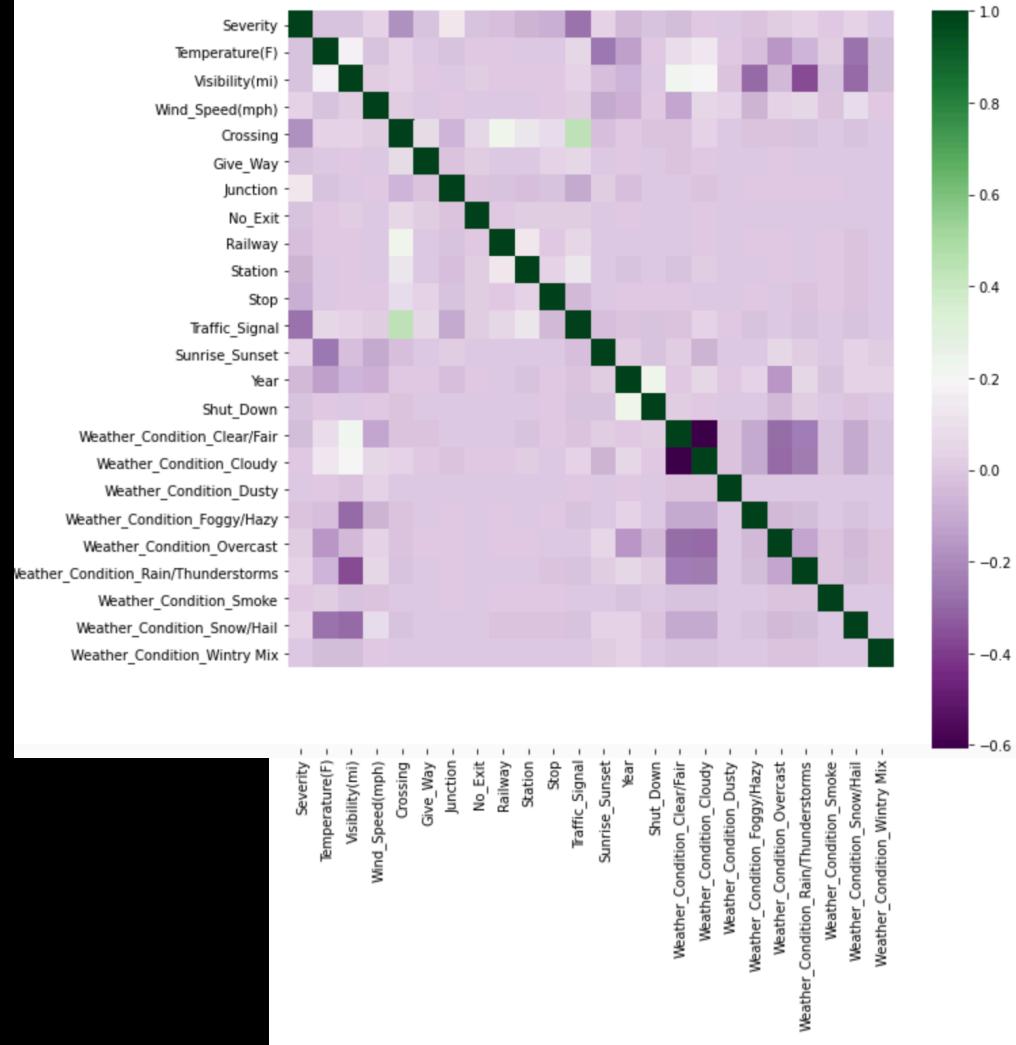
Severity

Severity_Rank	TTL	Shut_Down	2019	2018	2017
1	0.16	1.44	0.08	0.05	0.05
2	66.31	48.65	68.79	62.88	68.62
3	27.16	32.66	25.38	32.22	26.39
4	6.38	17.25	5.75	4.86	4.94

% Change 2020 vs. average 2017 - 2019:

18.74%

CORRELATION MAP



SELECTED MODEL: LOGISTIC REGRESSION

```
Training Accuracy Score for LR20: 0.715304719843187  
Validation Accuracy Score for LR20: 0.7160529975843642  
Test Accuracy Score for LR20: 0.7162307241850479
```

```
Training F1 Score for LR20: 0.10260223048327137  
Validation F1 Score for LR20: 0.10215261168119744  
Test F1 Score for LR20: 0.10345359235275979
```

```
Confusion matrix for LR20 Model:  
[[28683  493]  
 [11137  671]]
```

LR20 Model Coefficients	
Weather_Condition_Rain/Thunderstorms	0.092472
Sunrise_Sunset	0.055929
Traffic_Signal	-0.689362
Weather_Condition_Snow/Hail	0.036905
Weather_Condition_Foggy/Hazy	-0.059993
Shut_Down	-0.050860
Crossing	-0.345031
Temperature(F)	0.064454
Weather_Condition_Clear/Fair	-0.097203
Junction	0.158865

```
INTERCEPT for LR20 Model:  
[-1.09186865]
```

SELECTED MODEL: LOGISTIC REGRESSION (continued)

