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# Statistics Final Project Presentation

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# Topic

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Has the penalty modification of drunk driving been effective in reducing its incident rate in Taiwan?

# Motivation



# Data Collection

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- National Police Agency, MOI
- Ministry of Transport

統計期,取締件數,取締件數每十萬人,移送法辦件數,移送法辦每十萬人,事故件數,事故件數每十萬人,死亡人數,死亡人數每十萬人,受傷人數,受傷人數每十萬人
102年 10月,"10,691",45.77 , "6,477",27.73,,,,,
102年 11月,"10,286",44.02 , "6,136",26.26,,,,,
102年 12月,"8,774",37.54 , "5,336",22.83,,,,,
103年 1月,"13,077",55.95 , "7,989",34.18,"1,346",5.76,51,0.22,"1,673",7.16
103年 2月,"9,378",40.12 , "5,454",23.33,"1,053",4.50,42,0.18,"1,322",5.65
103年 3月,"10,103",43.22 , "5,856",25.05,"1,140",4.88,39,0.17,"1,443",6.17
103年 4月,"9,701",41.49 , "5,324",22.77,"1,184",5.06,40,0.17,"1,476",6.31
103年 5月,"9,931",42.46 , "4,979",21.29,"1,069",4.57,37,0.16,"1,355",5.79
103年 6月,"9,315",39.82 , "4,919",21.03,"1,066",4.56,38,0.16,"1,340",5.73
103年 7月,"9,250",39.54 , "5,729",24.49,"1,142",4.88,43,0.18,"1,484",6.34
103年 8月,"9,450",40.38 , "6,158",26.31,"1,152",4.92,48,0.21,"1,471",6.28
103年 9月,"10,047",42.93 , "5,753",24.58,"1,156",4.94,50,0.21,"1,479",6.32
103年 10月,"9,504",40.59 , "5,673",24.23,"1,193",5.10,52,0.22,"1,519",6.49
103年 11月,"7,850",33.52 , "4,944",21.11,"1,137",4.85,35,0.15,"1,494",6.38
103年 12月,"7,647",32.65 , "4,994",21.32,"1,184",5.05,59,0.25,"1,507",6.43
104年 1月,"9,090",38.79 , "6,318",26.96,"1,127",4.81,47,0.20,"1,424",6.08
104年 2月,"11,298",48.19 , "5,971",25.47,"1,029",4.39,35,0.15,"1,310",5.59

## Data

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Divide the data into four period according to the amendment of laws

Period 1 (96~102/2): This period focused on increased penalties, including fines ranging from NT\$15,000 to NT\$60,000, and jail sentences of up to two years for offenders. Penalties for fatal accidents ranged from one to seven years of imprisonment, while severe injuries led to sentences of six months to five years.

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## Data

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Period 2 (102/3 ~ 108/6): This period involved the removal of some penalties, with the introduction of new fines (NT\$15,000 to NT\$90,000) and a clearer alcohol limit. Drivers with a BAC over 0.15 were penalized, and those with a BAC over 0.25 faced criminal charges. Penalties for fatal accidents were increased to three to ten years of imprisonment for fatal accidents, and one to seven years for severe injuries.

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## Data

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Period 3 (108/7 ~ 111/02): This period saw higher fines for repeat offenders, including a maximum fine of NT\$120,000 for car drivers and NT\$90,000 for motorcycle drivers. Additionally, new laws were introduced to enforce alcohol locks, mandatory treatment, and collective liability for drivers. A repeat offense leading to death could result in life imprisonment or a sentence of over five years.

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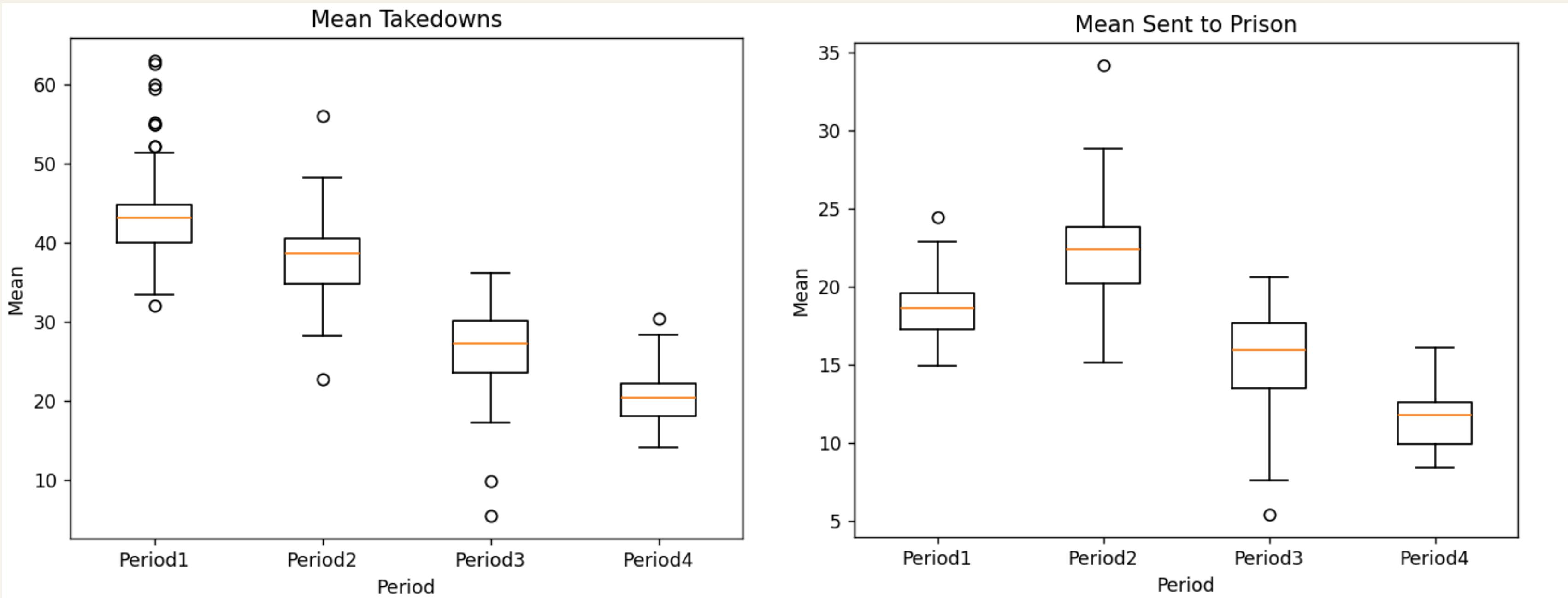
## Data

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Period 4 (111/3 ~ 113/9): The period extended the repeat offender penalty timeframe from five years to ten years, with higher fines for those exceeding certain BAC levels. New rules also included the public release of names and photos of repeat offenders.

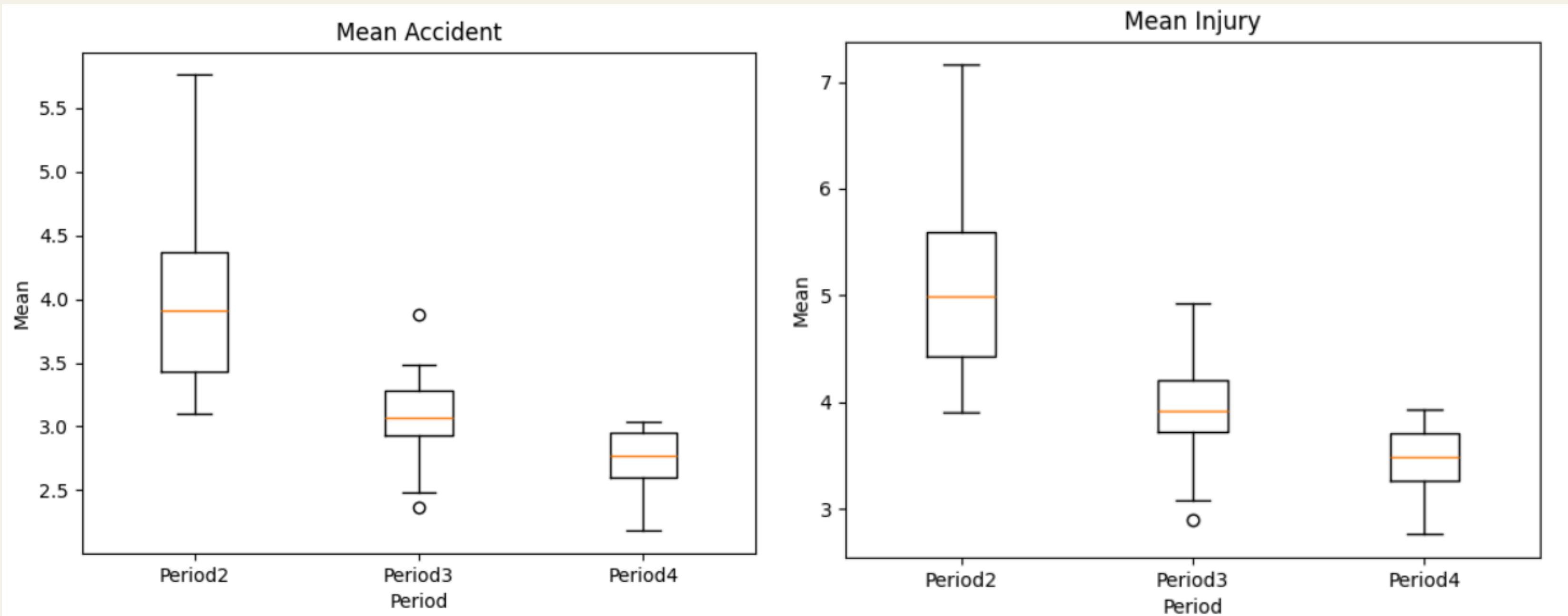
# Descriptive Data

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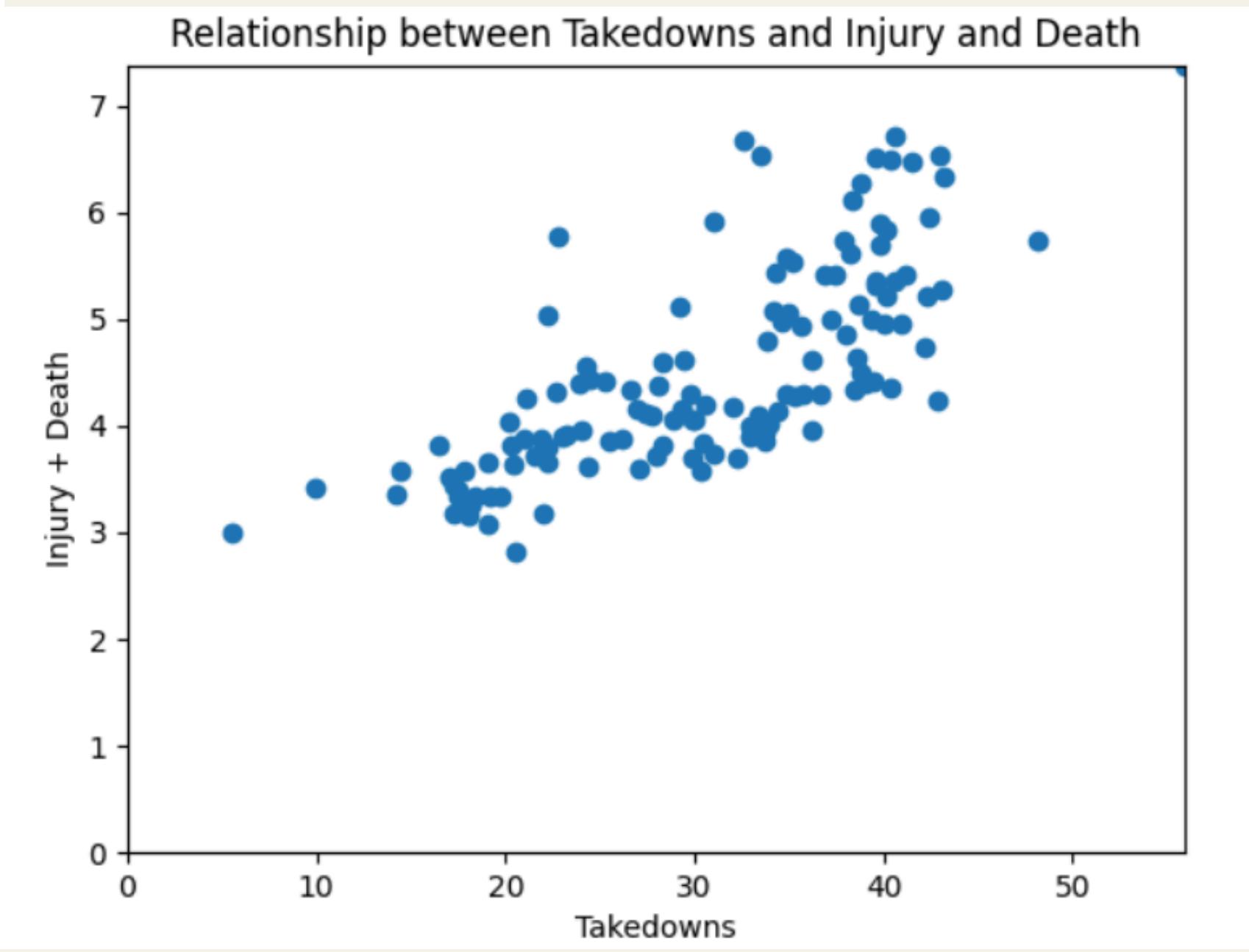
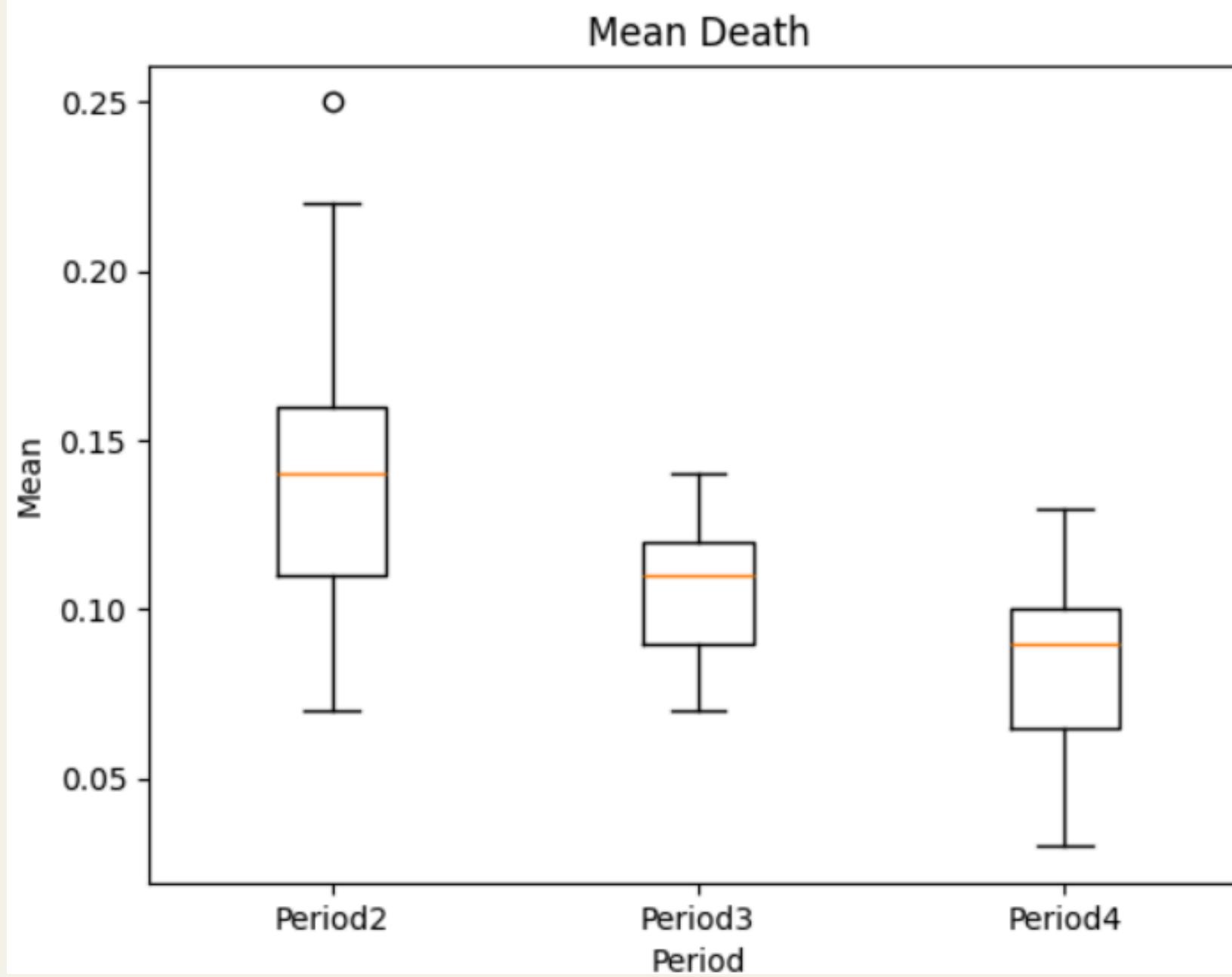
# Descriptive Data

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# Descriptive Data

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# Hypothesis

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- H1: The amendment of laws are effective in reducing takedowns
  - H2: The amendment of laws are effective in reducing imprisonment
  - H3: The amendment of laws are effective in reducing accidents
  - H4: The amendment of laws are effective in reducing injury
  - H5: The amendment of laws are effective in reducing death
  - H6: There is a negative relationship between number of takedowns and the sum of injuries and death.
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# Statistical test

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- ANOVA / Paired T-test with bonferroni correction
  - each period is a collection of multiple samples (monthly data)

# Result

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- H1: The amendment of laws are effective in reducing takedowns

```
takedowns anova  
F: 158.0403667105012  
F critical: 2.6478014150542575  
p-value: 1.1102230246251565e-16
```

```
takedowns t-test  
1-2 p-value: 4.375682705060058e-09  
1-2 Upper bound pair1: 8.21376194010675  
1-2 Lower bound pair1: 3.2854130243313753  
1-3 p-value: 0.0  
1-3 Upper bound pair2: 20.87014926599172  
1-3 Lower bound pair2: 14.448499382656943  
1-4 p-value: 0.0  
1-4 Upper bound pair3: 26.251392394328274  
1-4 Lower bound pair3: 19.75661109303007  
2-3 p-value: 0.0  
2-3 Upper bound pair4: 15.106608644674898  
2-3 Lower bound pair4: 8.712865039535638  
2-4 p-value: 0.0  
2-4 Upper bound pair5: 20.487954850905304  
2-4 Lower bound pair5: 14.020873672014913  
3-4 p-value: 0.0003844961283427928  
3-4 Upper bound pair6: 9.222257338908198  
3-4 Lower bound pair6: 1.467097499801484
```

- We have enough evidence to show that the mean number of takedowns had been decreased while entering new period (new laws are applied) due to the CI.

# Result

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- H2: The amendment of laws are effective in reducing imprisonment

```
sent to prison anova
F: 153.5555070632156
F critical: 2.6478014150542575
p-value: 1.1102230246251565e-16
```

```
sent to prison t-test
1-2 p-value: 1.9999999999999505
1-2 Upper bound pair1: -2.4426739436823937
1-2 Lower bound pair1: -4.751316098991865
1-3 p-value: 5.252745416406412e-07
1-3 Upper bound pair2: 4.496084687437333
1-3 Lower bound pair2: 1.4879186909410496
1-4 p-value: 0.0
1-4 Upper bound pair3: 8.660562365879777
1-4 Lower bound pair3: 5.618138593143769
2-3 p-value: 0.0
2-3 Upper bound pair4: 8.086543482206398
2-3 Lower bound pair4: 5.091449938846242
2-4 p-value: 0.0
2-4 Upper bound pair5: 12.251069446591071
2-4 Lower bound pair5: 9.221621555106733
3-4 p-value: 4.848944579194381e-08
3-4 Upper bound pair6: 5.963767354805243
3-4 Lower bound pair6: 2.3309302258399205
```

- Excluded the period 1-2 pair, we have enough evidence to show that the mean sent-to-prison had been decreased while entering new period (new laws are applied) due to the CI.

## Result

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- We infer that the reason why the number of sent-to-prison had increased from period 1 to period 2 is that people can no longer covert imprisonment into fine or detention due to the new law, so there existed a short burst in that period.

# Result

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- H3: The amendment of laws are effective in reducing accidents

```
accident anova
```

```
F: 83.50770471757689
```

```
F critical: 3.0627003994564683
```

```
p-value: 1.1102230246251565e-16
```

```
accident t-test
```

```
2-3 p-value: 1.254552017826427e-13
```

```
2-3 Upper bound pair1: 1.1356021756862766
```

```
2-3 Lower bound pair1: 0.6305910061319029
```

```
2-4 p-value: 0.0
```

```
2-4 Upper bound pair2: 1.4893682335211011
```

```
2-4 Lower bound pair2: 0.9785789805551415
```

```
3-4 p-value: 0.006352823526291074
```

```
3-4 Upper bound pair3: 0.656469064627567
```

```
3-4 Lower bound pair3: 0.045284967630496
```

```
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```

- We have enough evidence to show that the mean number of accident had been decreased while entering new period (new laws are applied) due to the CI.

# Result

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- H4: The amendment of laws are effective in reducing injury

```
injury anova
```

```
F: 88.05586119625725
```

```
F critical: 3.0627003994564683
```

```
p-value: 1.1102230246251565e-16
```

```
injury t-test
```

```
2-3 p-value: 2.0650148258027912e-14
```

```
2-3 Upper bound pair1: 1.4875564505287147
```

```
2-3 Lower bound pair1: 0.8466291555318939
```

```
2-4 p-value: 0.0
```

```
2-4 Upper bound pair2: 1.9231282760909734
```

```
2-4 Lower bound pair2: 1.2748678138406015
```

```
3-4 p-value: 0.008013730576046596
```

```
3-4 Upper bound pair3: 0.8197427727163056
```

```
3-4 Lower bound pair3: 0.04406771115466074
```

- We have enough evidence to show that the mean number of injury had been decreased while entering new period (new laws are applied) due to the CI.

# Result

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- H5: The amendment of laws are effective in reducing death

```
death anova
F: 41.28827263165483
F critical: 3.0627003994564683
p-value: 9.769962616701378e-15
death t-test
2-3 p-value: 7.387416200987929e-07
2-3 Upper bound pair1: 0.053150720498090456
2-3 Lower bound pair1: 0.01955761283524292
2-4 p-value: 8.282263763703668e-14
2-4 Upper bound pair2: 0.0770424949802559
2-4 Lower bound pair2: 0.0430650319014646
3-4 p-value: 0.005631776956772194
3-4 Upper bound pair3: 0.044027437433995294
3-4 Lower bound pair3: 0.003371756114391826
```

- We have enough evidence to show that the mean number of death had been decreased while entering new period (new laws are applied) due to the CI.

# Result

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- H6: There is a negative relationship between number of takedowns and the sum of injuries and death.

```
r: 0.7522143004359515  
p-value: 9.16061709817468e-25
```

- The result shows that there exists a positive correlation between takedowns and injury/death with correlation coefficient = 0.75, thus H6 is completely rejected.

## Potential bias

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- The awareness of severity of drunk driving due to incident on the news.
- The awareness of severity of drunk driving due to education.
- The popularity of chauffeur service and public transportation.

# Conclusion

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- The analyses show that the number of takedowns, accidents, injury and death did reduce as relative laws amended, noticing that other factors like awareness of drunk driving may also affect the result, too.
- For imprisonment, there exist a slight bounce when entering period 2, but in long term, the number did reduce in period 3 and 4. This may show that people need time to raise the awareness that drunk driving is a behavior that should be completely prevented.
- When the number of takedowns increases, it doesn't mean that the injury/death are reduced, it simply means that the occurrence of drunk driving increases.

# Creativity

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