Exploring the weather dataset

ANALYZING POLICE ACTIVITY WITH PANDAS

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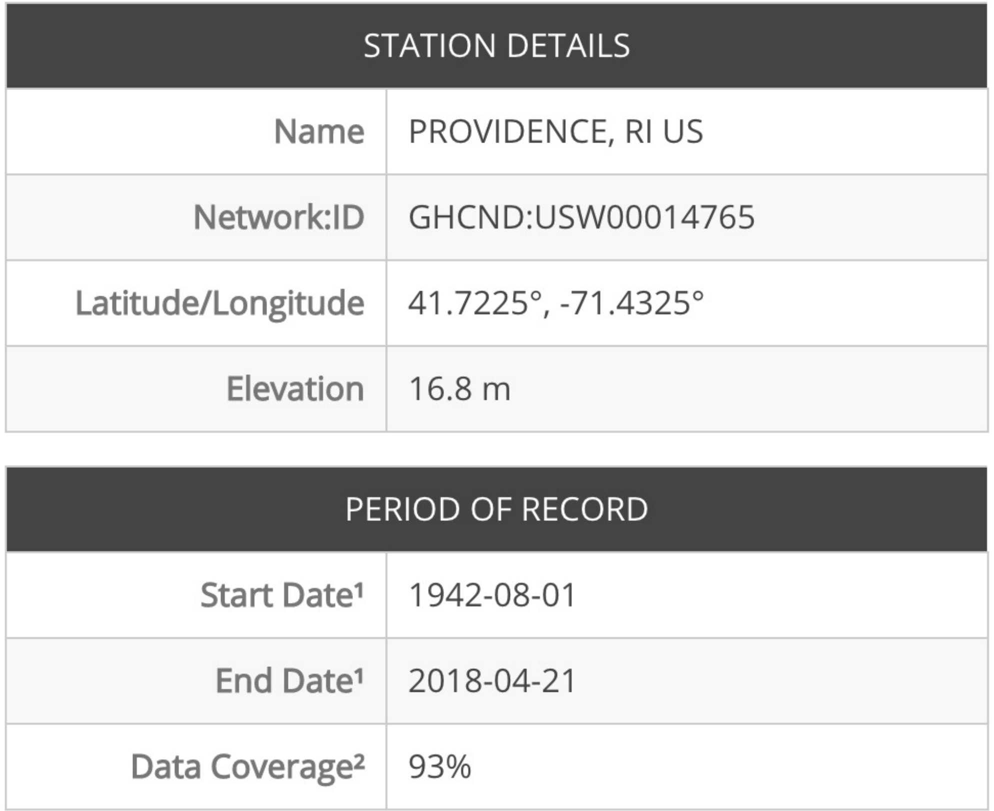
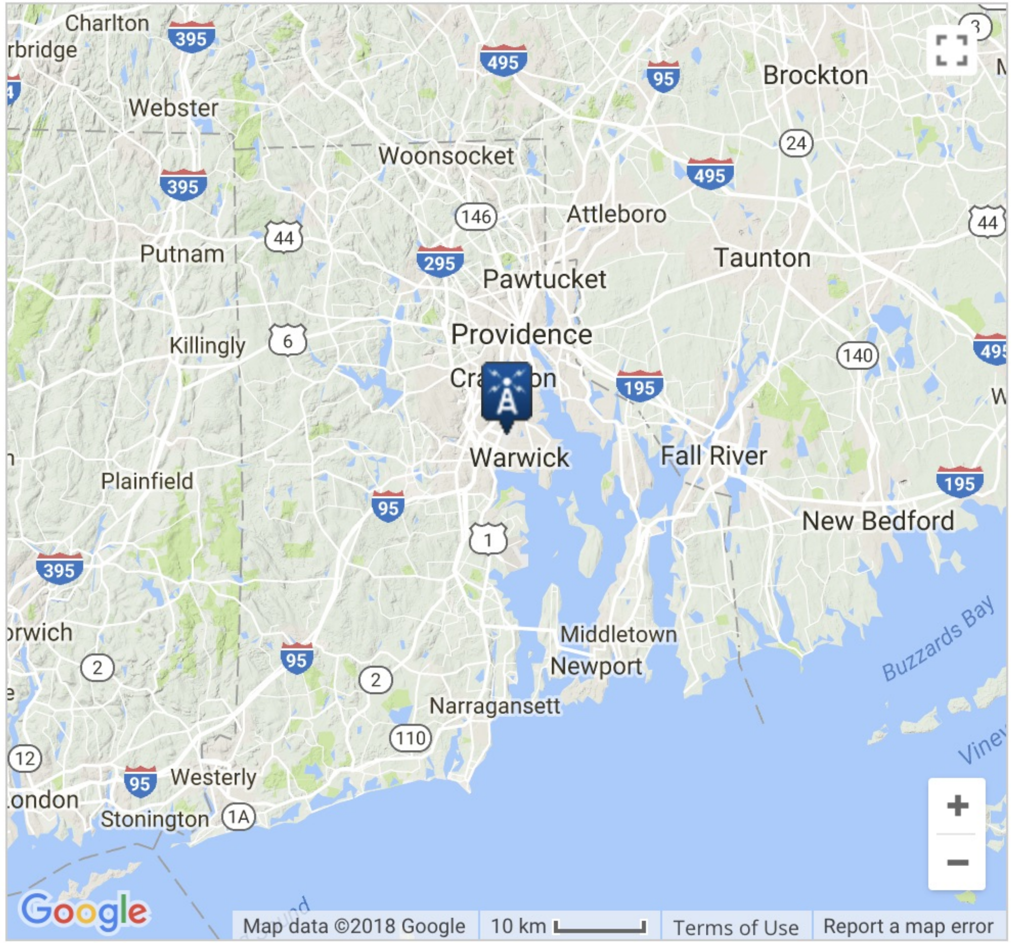
Introduction to the dataset

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



STATION DETAILS	
Name	PROVIDENCE, RI US
Network:ID	GHCND:USW00014765
Latitude/Longitude	41.7225°, -71.4325°
Elevation	16.8 m

PERIOD OF RECORD	
Start Date[1]	1942-08-01
End Date[1]	2018-04-21
Data Coverage[2]	93%



```
weather = pd.read_csv('weather.csv')
weather.head(3)
```

```
       STATION        DATE  TAVG  TMIN  TMAX  AWND  WSF2  WT01  WT02
0  USW00014765  2005-01-01  44.0    35    53  8.95  25.1   1.0   NaN
1  USW00014765  2005-01-02  36.0    28    44  9.40  14.1   NaN   NaN
2  USW00014765  2005-01-03  49.0    44    53  6.93  17.0   1.0   NaN

   ...   WT11  WT13  WT14  WT15  WT16  WT17  WT18  WT19  WT21  WT22
0  ...    NaN   1.0   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
1  ...    NaN   NaN   NaN   NaN   1.0   NaN   1.0   NaN   NaN   NaN
2  ...    NaN   1.0   NaN   NaN   1.0   NaN   NaN   NaN   NaN   NaN
```

- `TAVG` , `TMIN` , `TMAX` : Temperature
- `AWND` , `WSF2` : Wind speed
- `WT01` ... `WT22` : Bad weather conditions

Examining the wind speed

```
weather[['AWND', 'WSF2']].head()
```

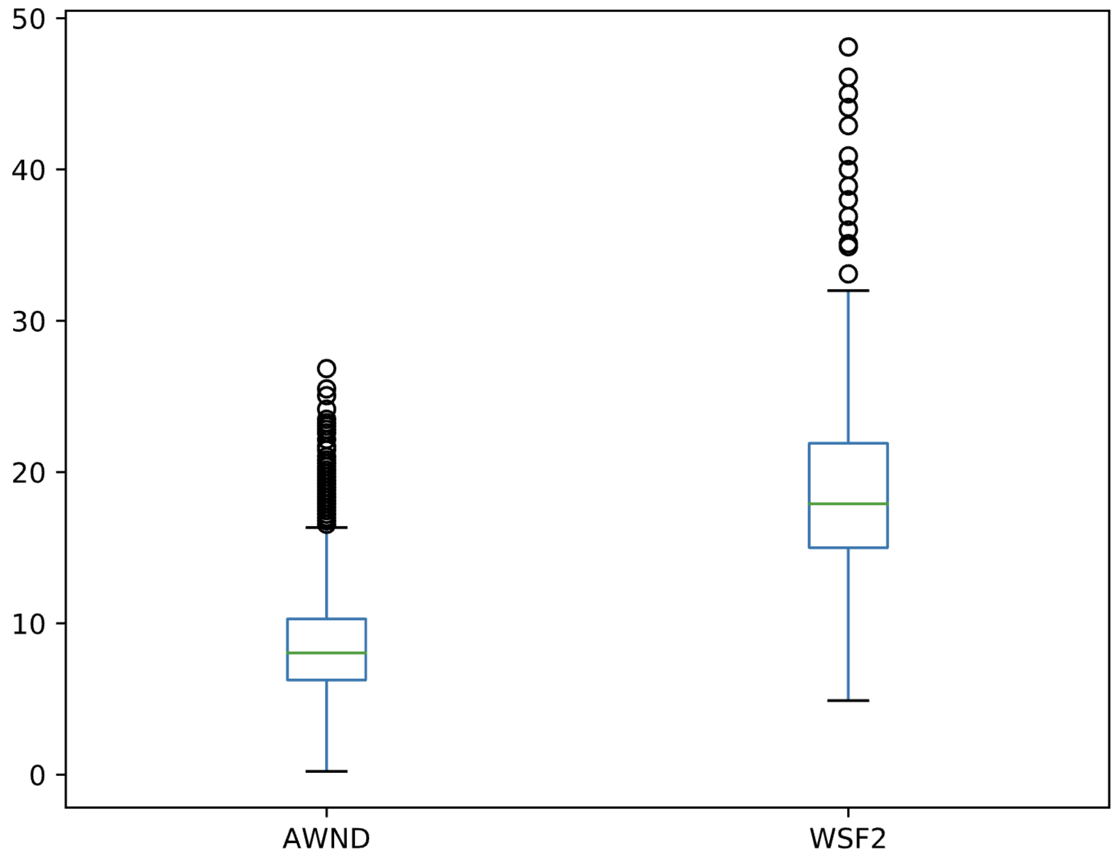
```
   AWND  WSF2
0  8.95  25.1
1  9.40  14.1
2  6.93  17.0
3  6.93  16.1
4  7.83  17.0
```

```
weather[['AWND', 'WSF2']].describe()
```

```
              AWND         WSF2
count  4017.000000  4017.000000
mean      8.593707    19.274782
std       3.364601     5.623866
min       0.220000     4.900000
25%       6.260000    15.000000
50%       8.050000    17.900000
75%      10.290000    21.900000
max      26.840000    48.100000
```

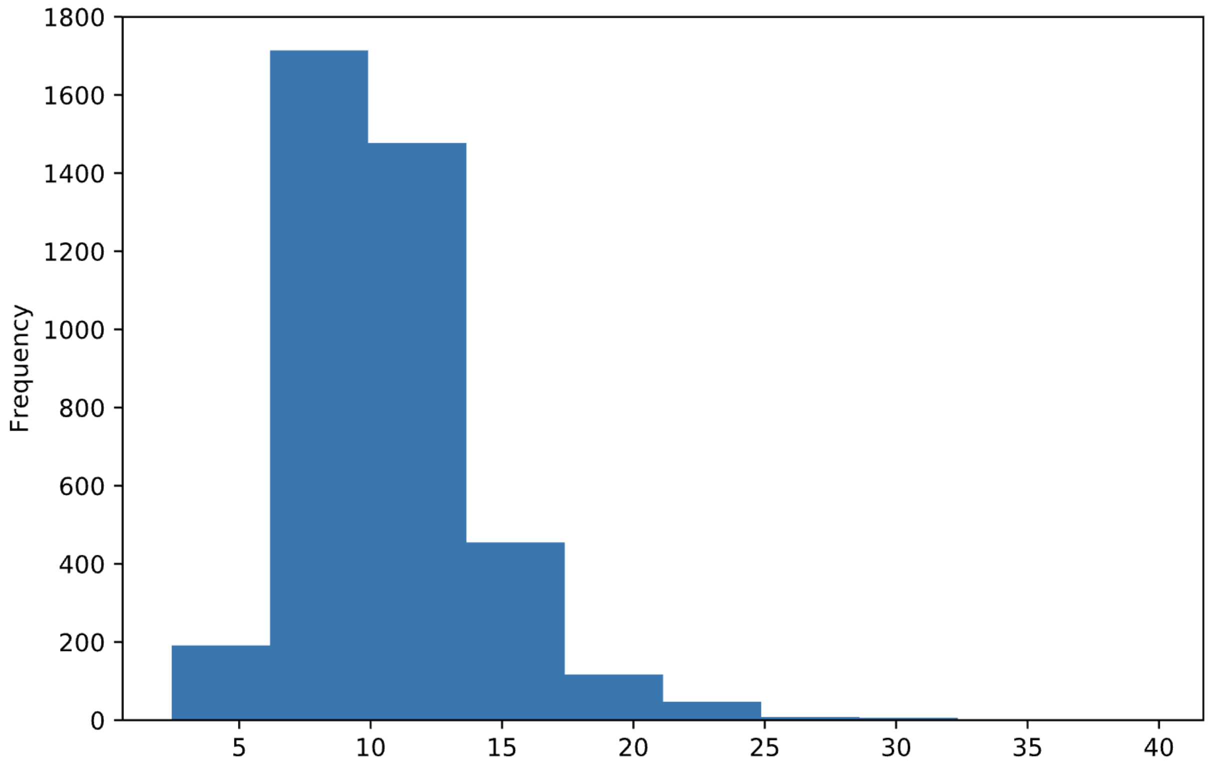
Creating a box plot

```
weather[['AWND', 'WSF2']].plot(kind='box')
plt.show()
```



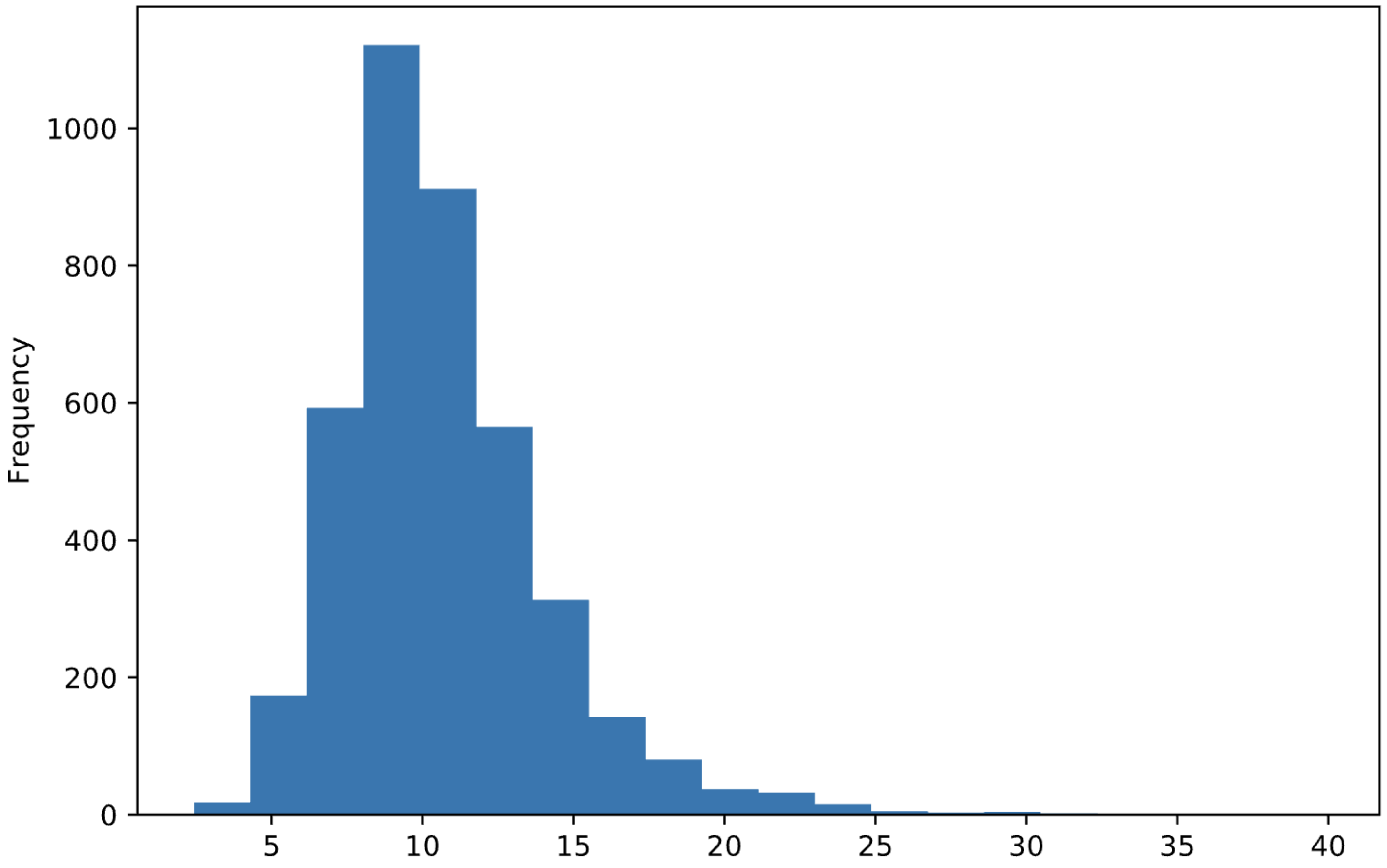
Creating a histogram (1)

```
weather['WDIFF'] = weather.WSF2 - weather.AWND
weather.WDIFF.plot(kind='hist')
plt.show()
```



Creating a histogram (2)

```
weather.WDIFF.plot(kind='hist', bins=20)
plt.show()
```



Let's practice!

ANALYZING POLICE ACTIVITY WITH PANDAS

Categorizing the weather

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Selecting a DataFrame slice (1)

```
weather.shape
```

```
(4017, 28)
```

```
weather.columns
```

```
Index(['STATION', 'DATE', 'TAVG', 'TMIN', 'TMAX', 'AWND',
       'WSF2', 'WT01', 'WT02', 'WT03', 'WT04', 'WT05',
       'WT06', 'WT07', 'WT08', 'WT09', 'WT10', 'WT11',
       'WT13', 'WT14', 'WT15', 'WT16', 'WT17', 'WT18',
       'WT19', 'WT21', 'WT22', 'TDIFF'], dtype='object')
```

Selecting a DataFrame slice (2)

```
temp = weather.loc[:, 'TAVG':'TMAX']
```

```
temp.shape
```

```
(4017, 3)
```

```
temp.columns
```

```
Index(['TAVG', 'TMIN', 'TMAX'], dtype='object')
```

DataFrame operations

```
temp.head()
```

```
   TAVG  TMIN  TMAX
0  44.0    35    53
1  36.0    28    44
2  49.0    44    53
3  42.0    39    45
4  36.0    28    43
```

```
temp.sum()
```

```
TAVG     63884.0
TMIN    174677.0
TMAX    246116.0
```

```
temp.sum(axis='columns').head()
```

```
0    132.0
1    108.0
2    146.0
3    126.0
4    107.0
```

Mapping one set of values to another

```
ri.stop_duration.unique()
```

```
array(['0-15 Min', '16-30 Min', '30+ Min'], dtype=object)
```

```
mapping = {'0-15 Min':'short',
           '16-30 Min':'medium',
           '30+ Min':'long'}
ri['stop_length'] = ri.stop_duration.map(mapping)
ri.stop_length.dtype
```

```
dtype('O')
```

Changing data type from object to category (1)

```
ri.stop_length.unique()
```

```
array(['short', 'medium', 'long'], dtype=object)
```

- Category type stores the data more efficiently
- Allows you to specify a logical order for the categories

```
ri.stop_length.memory_usage(deep=True)
```

```
8689481
```

Changing data type from object to category (2)

```
cats = ['short', 'medium', 'long']
```

```
ri['stop_length'] = ri.stop_length.astype('category',
                                          ordered=True,
                                          categories=cats)
```

```
ri.stop_length.memory_usage(deep=True)
```

```
3400602
```

Using ordered categories (1)

```
ri.stop_length.head()
```

```
stop_datetime
2005-01-04 12:55:00     short
2005-01-23 23:15:00     short
2005-02-17 04:15:00     short
2005-02-20 17:15:00    medium
2005-02-24 01:20:00     short
Name: stop_length, dtype: category
Categories (3, object): [short < medium < long]
```

Using ordered categories (2)

```
ri[ri.stop_length > 'short'].shape
```

```
(16959, 16)
```

```
ri.groupby('stop_length').is_arrested.mean()
```

```
stop_length
short     0.013654
medium    0.093595
long      0.261572
Name: is_arrested, dtype: float64
```

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Merging datasets

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```
apple
```

```
                          date   time   price
date_and_time
2018-02-14 09:30:00  2/14/18   9:30  163.04
2018-02-14 16:00:00  2/14/18  16:00  167.37
2018-02-15 09:30:00  2/15/18   9:30  169.79
2018-02-15 16:00:00  2/15/18  16:00  172.99
```

```
apple.reset_index(inplace=True)
apple
```

```
        date_and_time     date   time   price
0 2018-02-14 09:30:00  2/14/18   9:30  163.04
1 2018-02-14 16:00:00  2/14/18  16:00  167.37
2 2018-02-15 09:30:00  2/15/18   9:30  169.79
3 2018-02-15 16:00:00  2/15/18  16:00  172.99
```

Preparing the second DataFrame

```
high_low
```

```
      DATE    HIGH     LOW
0  2/14/18  167.54  162.88
1  2/15/18  173.09  169.00
2  2/16/18  174.82  171.77
```

```
high = high_low[['DATE', 'HIGH']]
high
```

```
      DATE    HIGH
0  2/14/18  167.54
1  2/15/18  173.09
2  2/16/18  174.82
```

Merging the DataFrames

```
apple_high = pd.merge(left=apple, right=high,
                      left_on='date', right_on='DATE',
                      how='left')
```

- `left=apple` : Left DataFrame
- `right=high` : Right DataFrame
- `left_on='date'` : Key column in left DataFrame
- `right_on='DATE'` : Key column in right DataFrame
- `how='left'` : Type of join

```
apple_high
```

```
         date_and_time     date   time   price     DATE    HIGH
0 2018-02-14 09:30:00  2/14/18   9:30  163.04  2/14/18  167.54
1 2018-02-14 16:00:00  2/14/18  16:00  167.37  2/14/18  167.54
2 2018-02-15 09:30:00  2/15/18   9:30  169.79  2/15/18  173.09
3 2018-02-15 16:00:00  2/15/18  16:00  172.99  2/15/18  173.09
```

```
apple
```

```
         date_and_time     date   time   price
0 2018-02-14 09:30:00  2/14/18   9:30  163.04
1 2018-02-14 16:00:00  2/14/18  16:00  167.37
2 2018-02-15 09:30:00  2/15/18   9:30  169.79
3 2018-02-15 16:00:00  2/15/18  16:00  172.99
```

```
high
```

```
      DATE    HIGH
0  2/14/18  167.54
1  2/15/18  173.09
2  2/16/18  174.82
```

Setting the index

```
apple_high.set_index('date_and_time', inplace=True)
apple_high
```

```
                         date   time   price     DATE    HIGH
date_and_time
2018-02-14 09:30:00  2/14/18   9:30  163.04  2/14/18  167.54
2018-02-14 16:00:00  2/14/18  16:00  167.37  2/14/18  167.54
2018-02-15 09:30:00  2/15/18   9:30  169.79  2/15/18  173.09
2018-02-15 16:00:00  2/15/18  16:00  172.99  2/15/18  173.09
```

Let's practice!

ANALYZING POLICE ACTIVITY WITH PANDAS

Does weather affect the arrest rate?

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Driver gender and vehicle searches

```
ri.search_conducted.mean()
```

```
0.0382153092354627
```

```
ri.groupby('driver_gender').search_conducted.mean()
```

```
driver_gender
F    0.019181
M    0.045426
```

```
ri.groupby(['violation', 'driver_gender']).search_conducted.mean()
```

```
violation           driver_gender
Equipment           F                0.039984
                    M                0.071496
Moving violation    F                0.039257
                    M                0.061524
Other               F                0.041018
                    M                0.046191
Registration/plates F                0.054924
                    M                0.108802
Seat belt           F                0.017301
                    M                0.035119
Speeding            F                0.008309
                    M                0.027885
```

```
search_rate = ri.groupby(['violation',
                          'driver_gender']).search_conducted.mean()
search_rate
```

```
violation          driver_gender
Equipment          F                0.039984
                   M                0.071496
Moving violation   F                0.039257
                   M                0.061524
...                ...                   ...
```

```
type(search_rate)
type(search_rate.index)
```

```
pandas.core.series.Series
pandas.core.indexes.multi.MultiIndex
```

```
violation          driver_gender
Equipment          F                 0.039984
                   M                 0.071496
Moving violation   F                 0.039257
                   M                 0.061524
...                ...                    ...
```

```
search_rate.loc['Equipment']
```

```
driver_gender
F    0.039984
M    0.071496
```

```
search_rate.loc['Equipment', 'M']
```

```
0.07149643705463182
```

Converting a multi-indexed Series to a DataFrame

```
search_rate.unstack()
```

```
driver_gender               F         M
violation
Equipment            0.039984  0.071496
Moving violation     0.039257  0.061524
Other                0.041018  0.046191
...                       ...       ...
```

```
type(search_rate.unstack())
```

```
pandas.core.frame.DataFrame
```

Converting a multi-indexed Series to a DataFrame

```
ri.pivot_table(index='violation',
               columns='driver_gender',
               values='search_conducted')
```

```
driver_gender               F         M
violation
Equipment            0.039984  0.071496
Moving violation     0.039257  0.061524
Other                0.041018  0.046191
...                       ...       ...
```

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Conclusion

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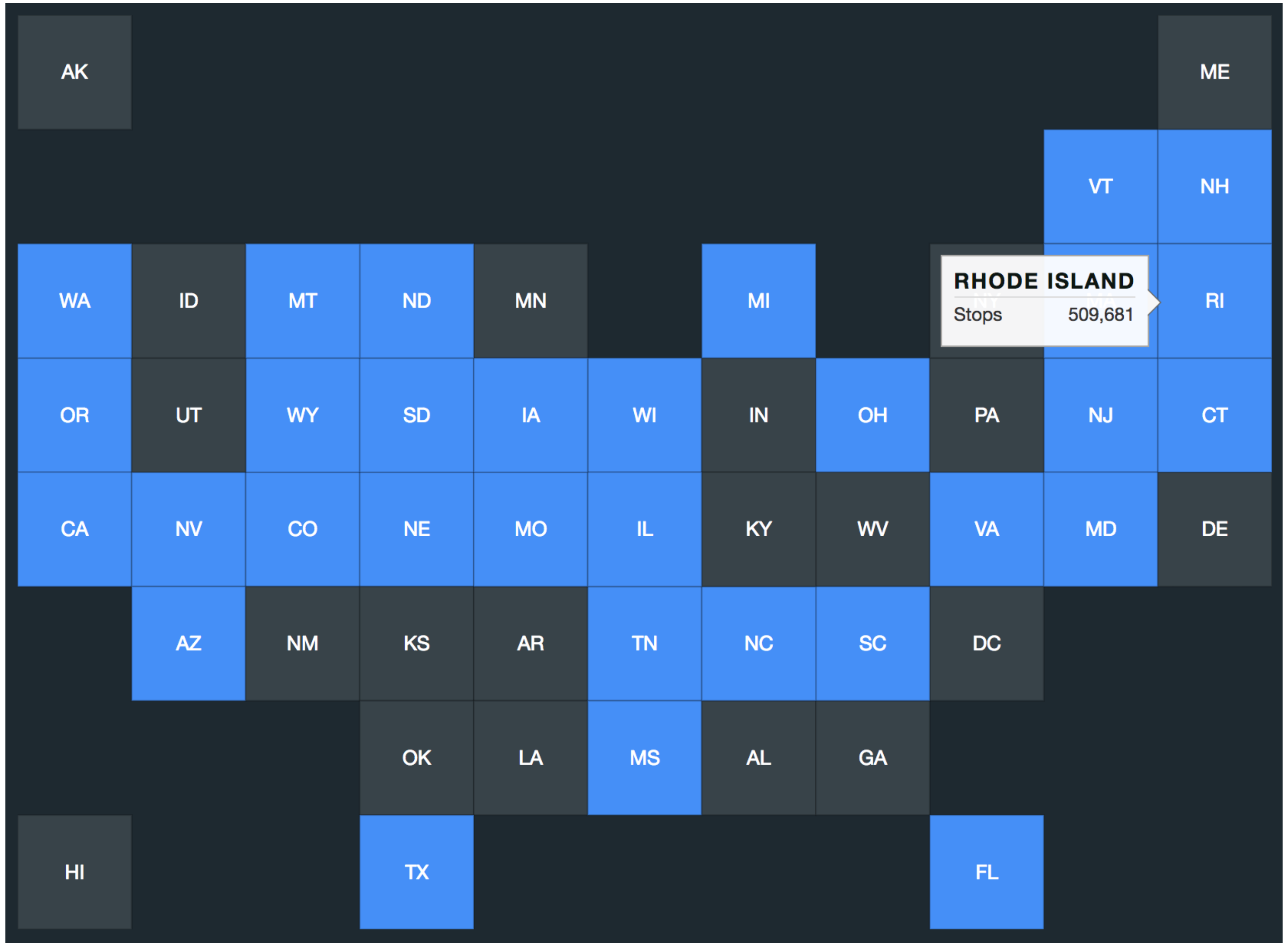
Stanford Open Policing Project



- Download data: **https://openpolicing.stanford.edu/**

Thank you!

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