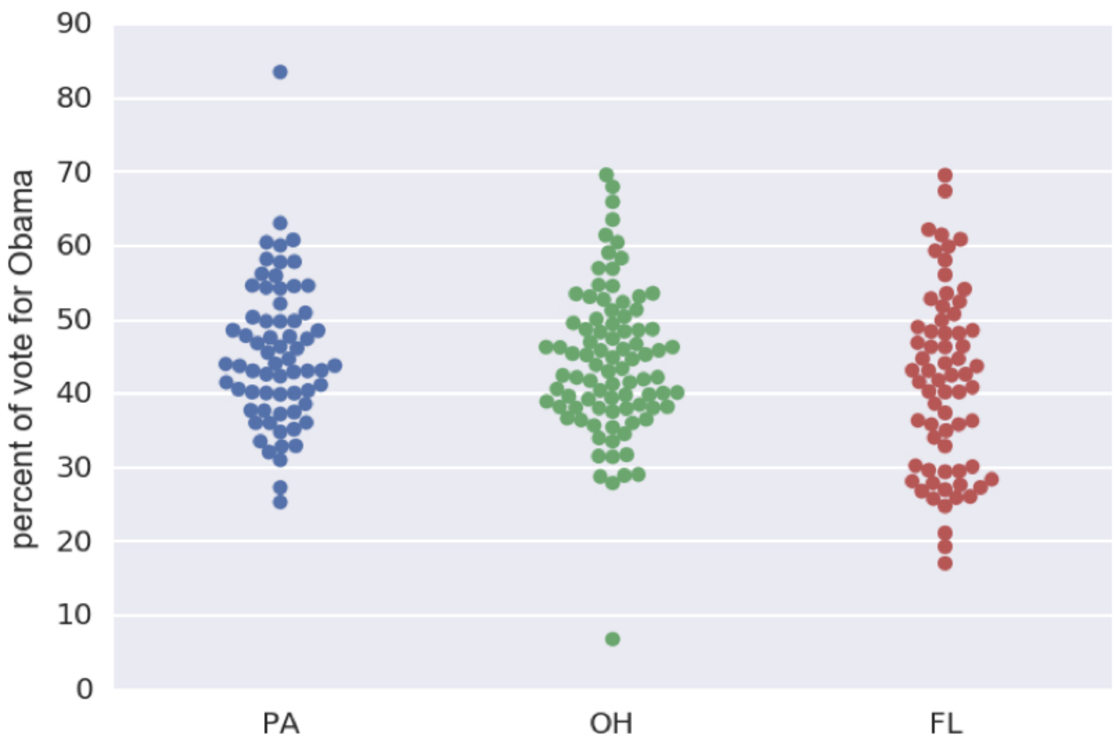
Introduction to summary statistics: The sample mean and median

STATISTICAL THINKING IN PYTHON (PART 1)

Justin Bois

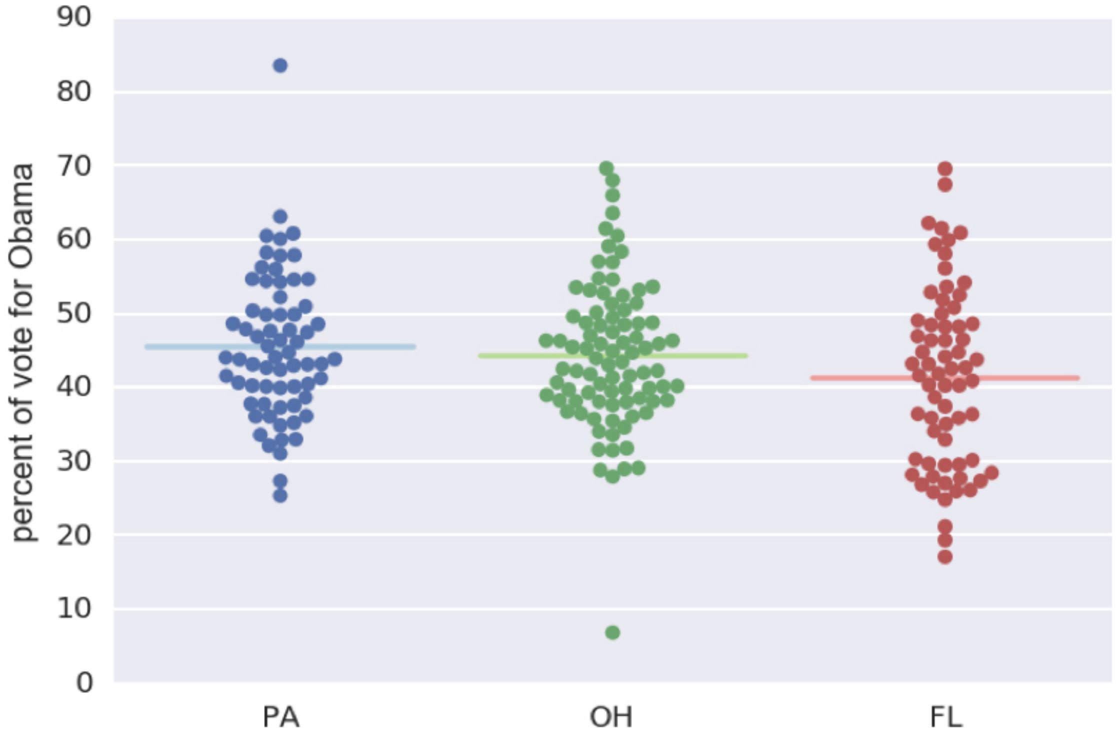
Lecturer at the California Institute of Technology

2008 US swing state election results



[1] Data retrieved from Data.gov (https://www.data.gov/)

2008 US swing state election results



[1] Data retrieved from Data.gov (https://www.data.gov/)

Mean vote percentage

```python
import numpy as np
np.mean(dem_share_PA)
```

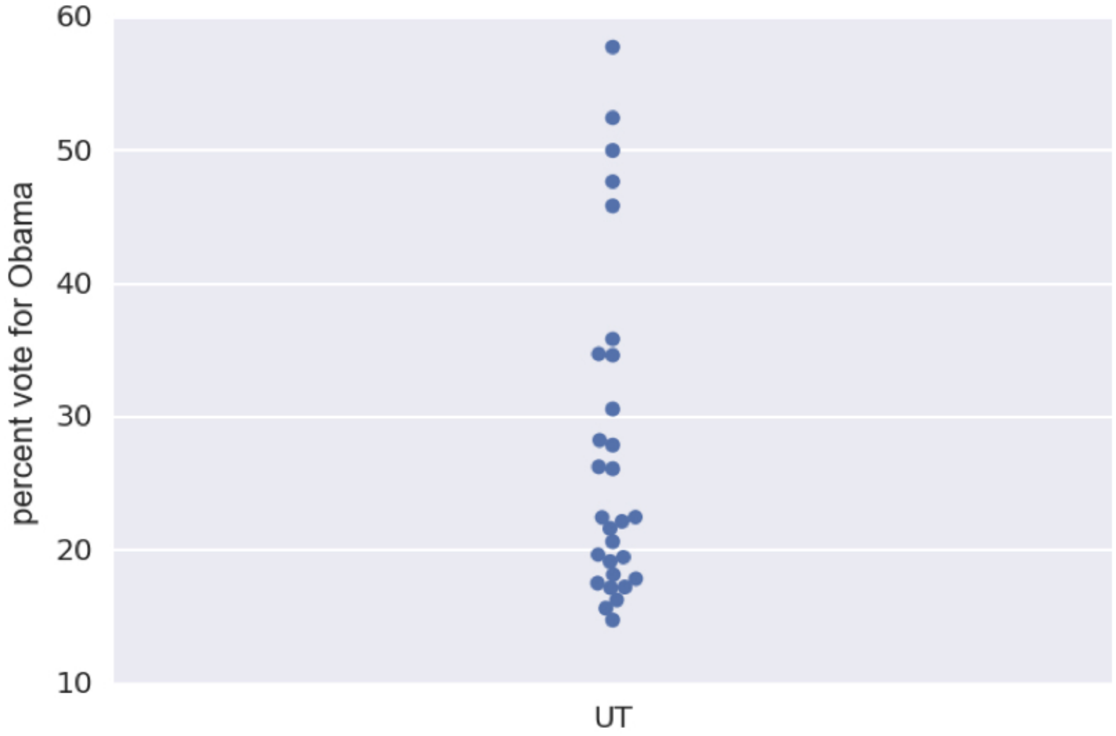
```
45.476417910447765
```

$$mean = \bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

Outliers

- Data points whose value is far greater or less than most of the rest of the data

2008 Utah election results



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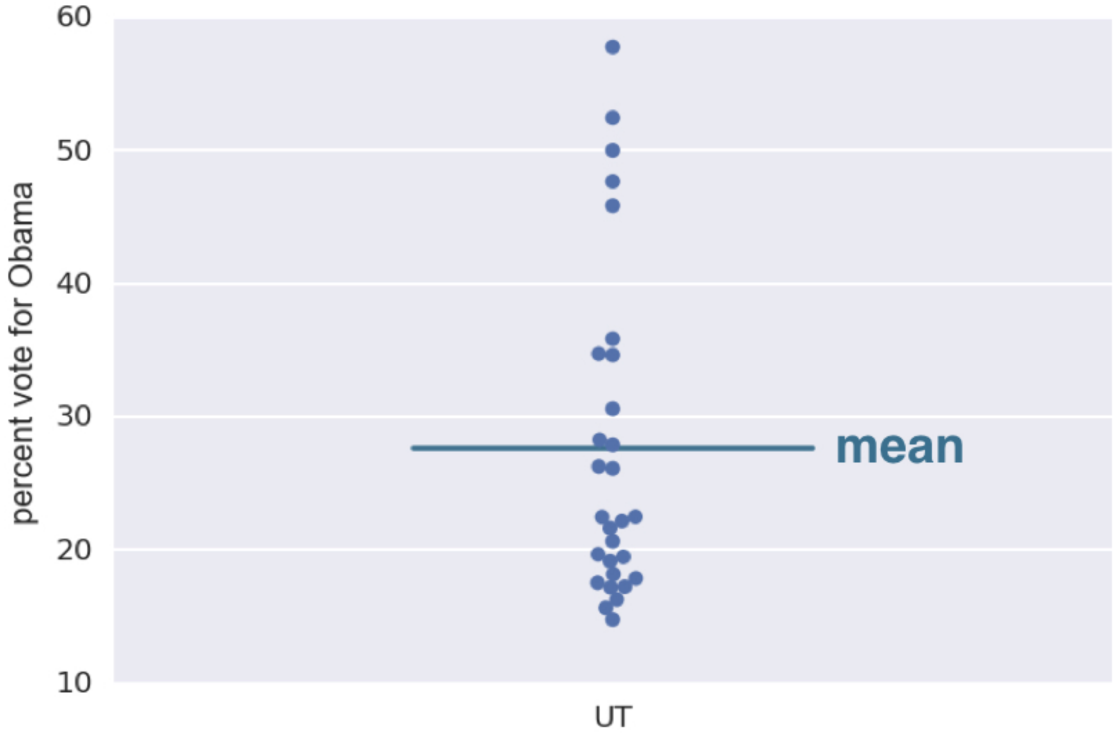
2008 Utah election results



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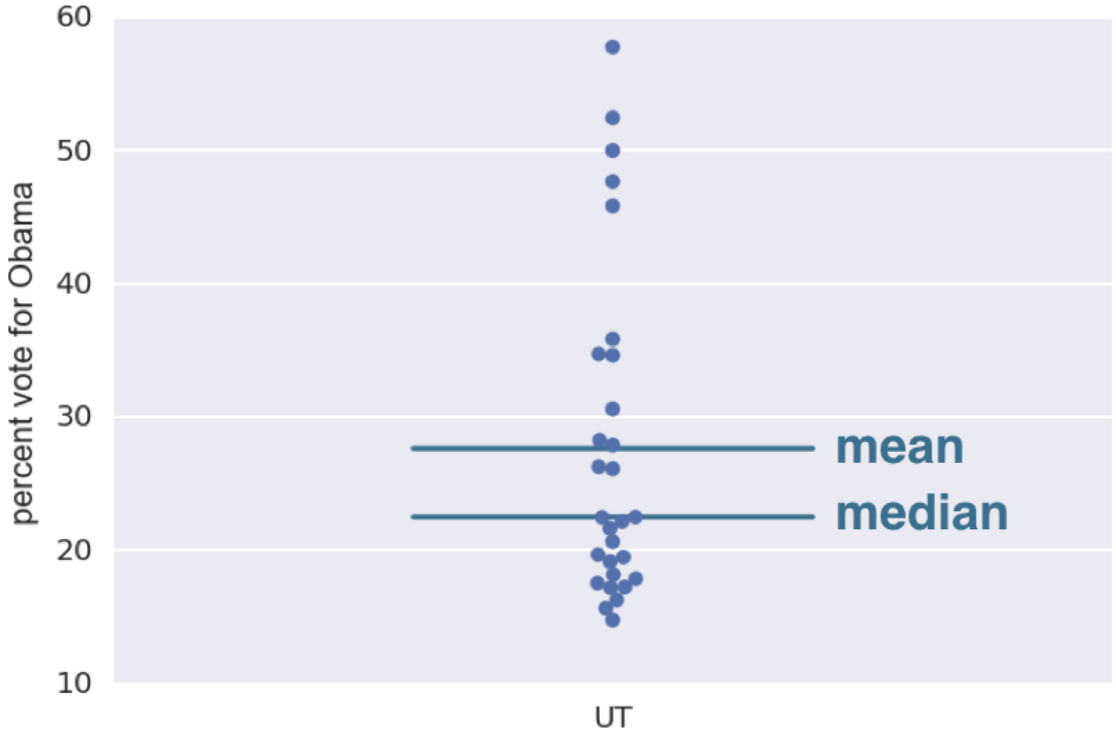
The median

- The middle value of a data set

2008 Utah election results



[1] Data retrieved from Data.gov (https://www.data.gov/)

Computing the median

```
np.median(dem_share_UT)
```

```
22.469999999999999
```

Let's practice!

STATISTICAL THINKING IN PYTHON (PART 1)

Percentiles, outliers, and box plots

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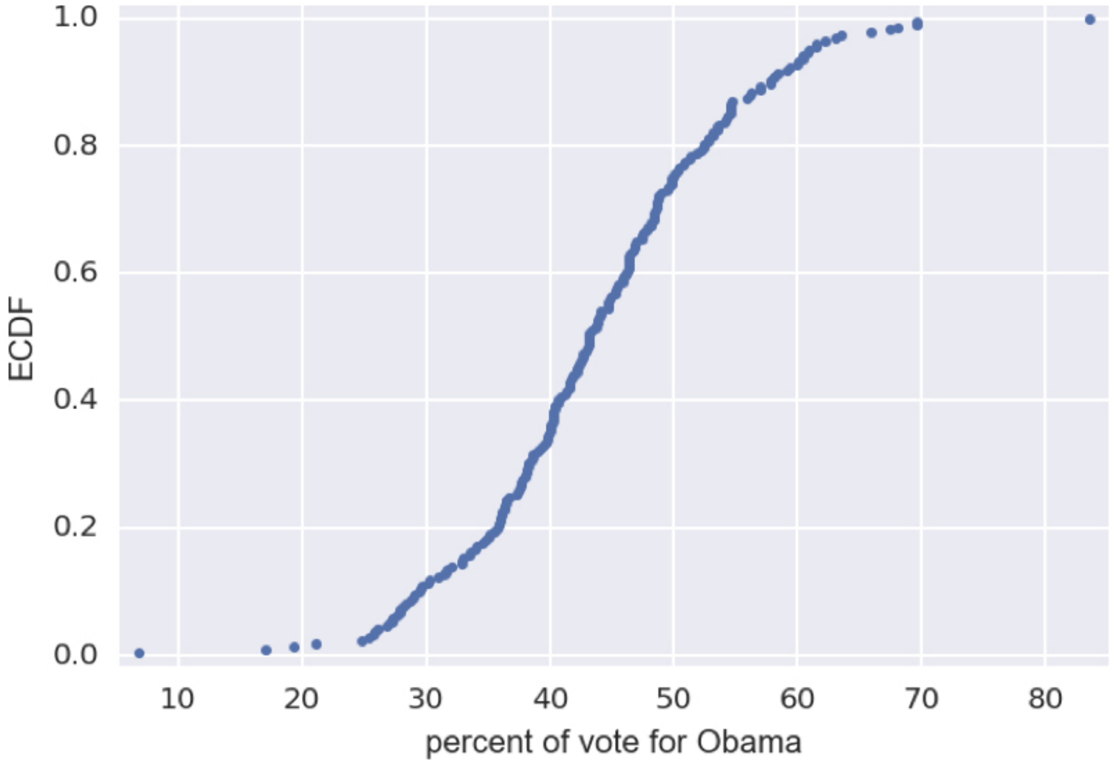
Percentiles on an ECDF



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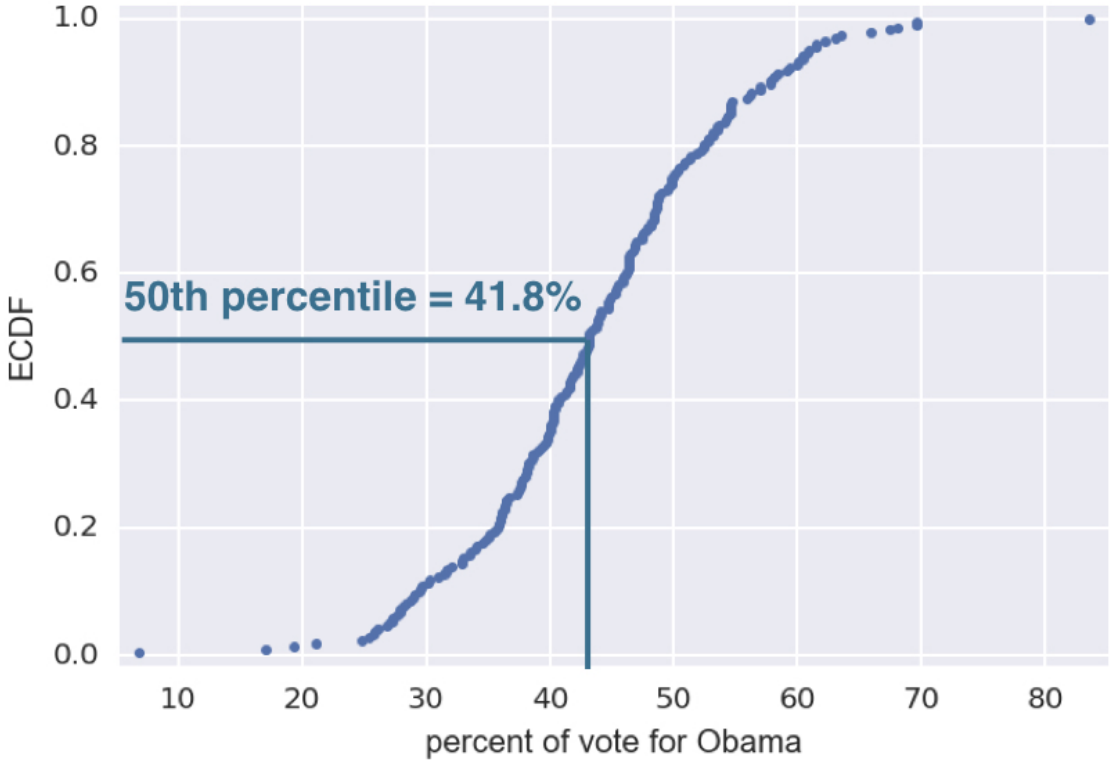
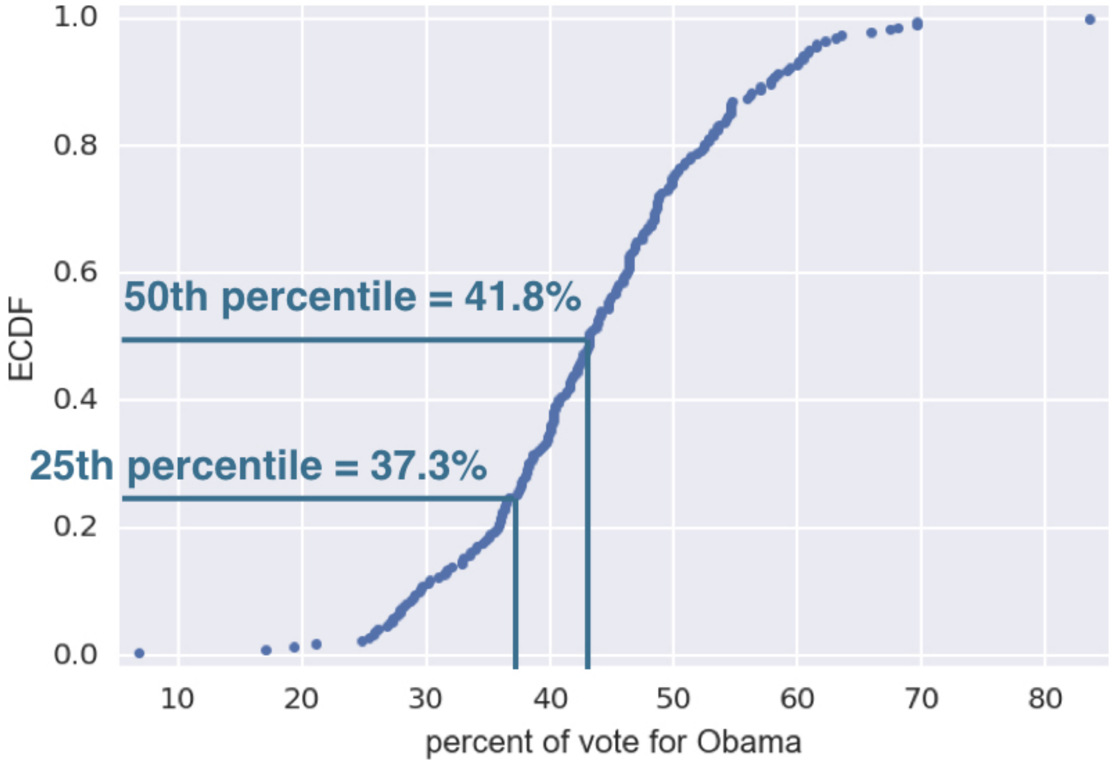
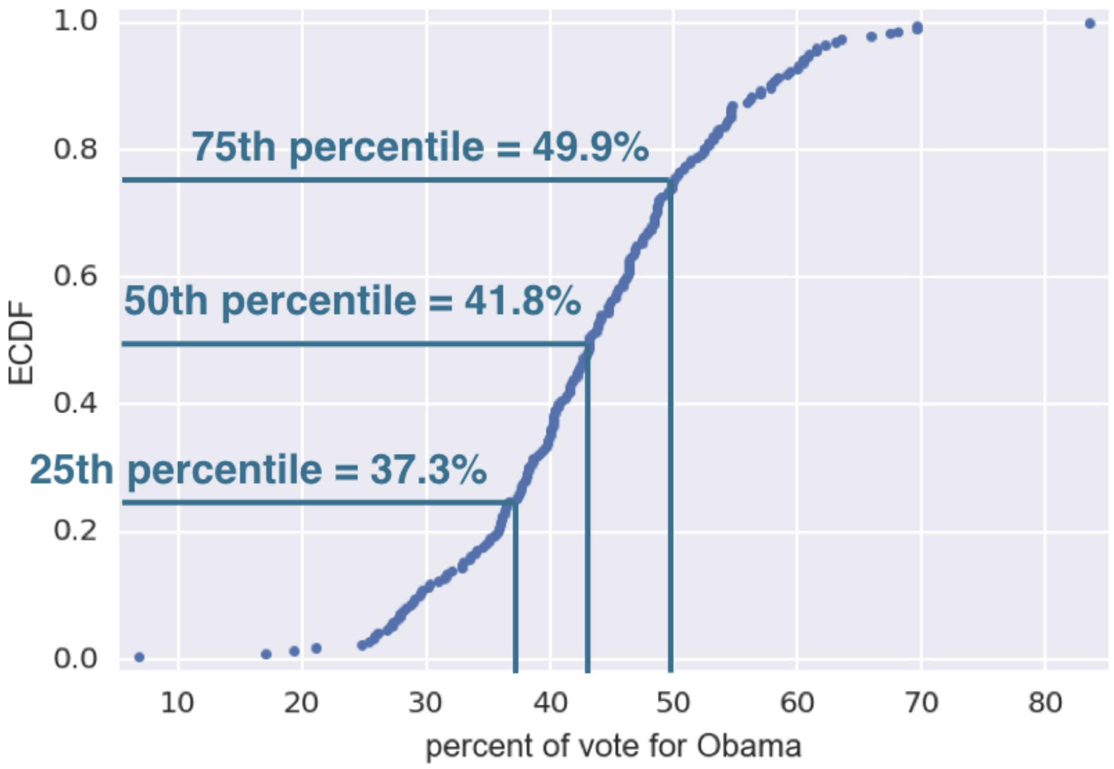
Percentiles on an ECDF



Percentiles on an ECDF



Percentiles on an ECDF

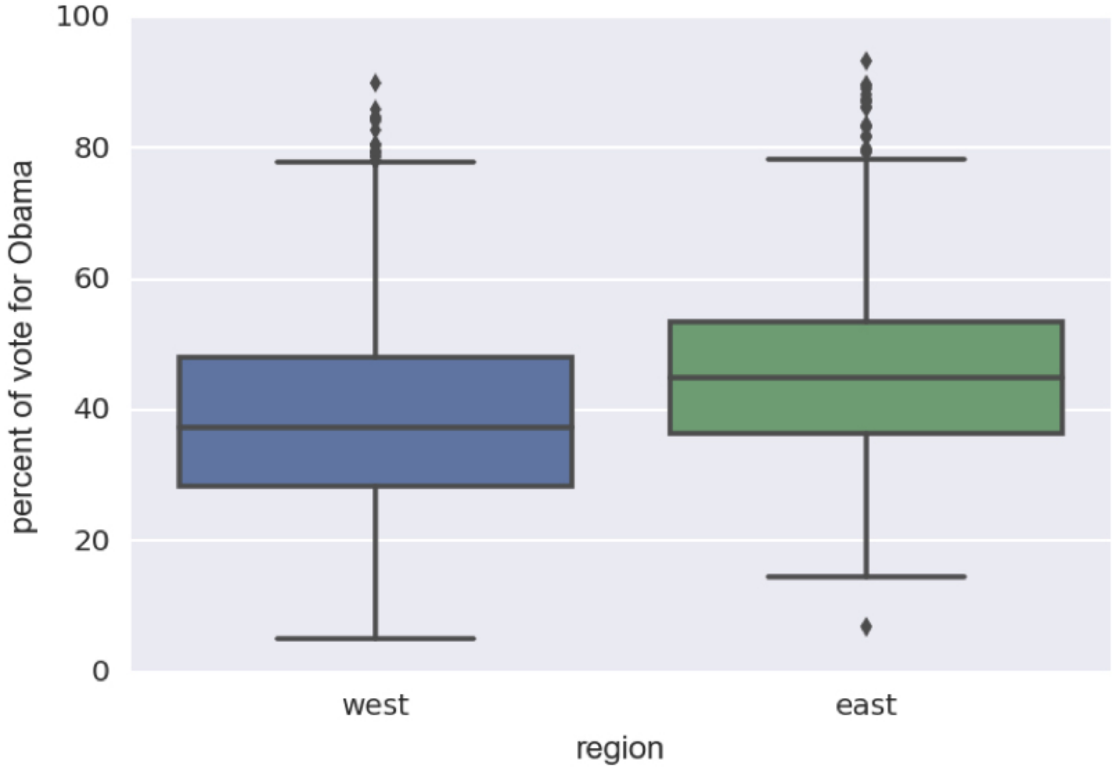


Computing percentiles

```
np.percentile(df_swing['dem_share'], [25, 50, 75])
```

```
array([ 37.3025,  43.185 ,  49.925 ])
```

2008 US election box plot



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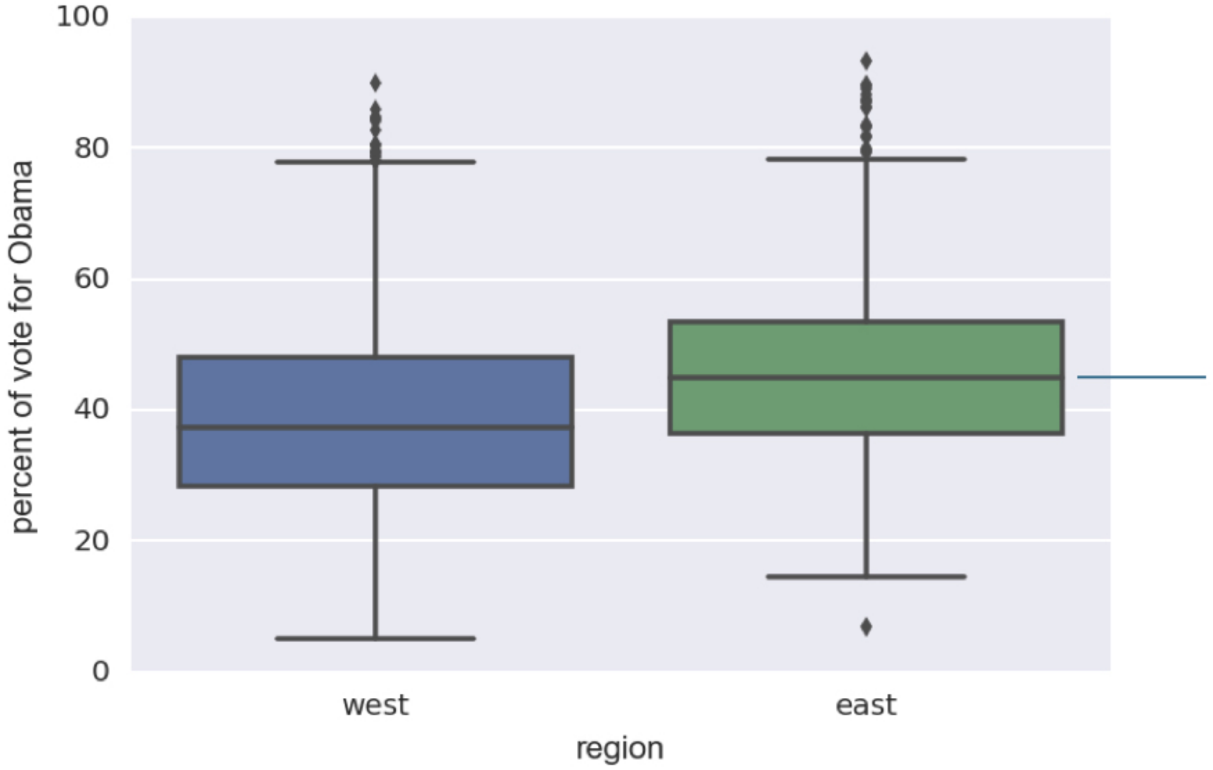
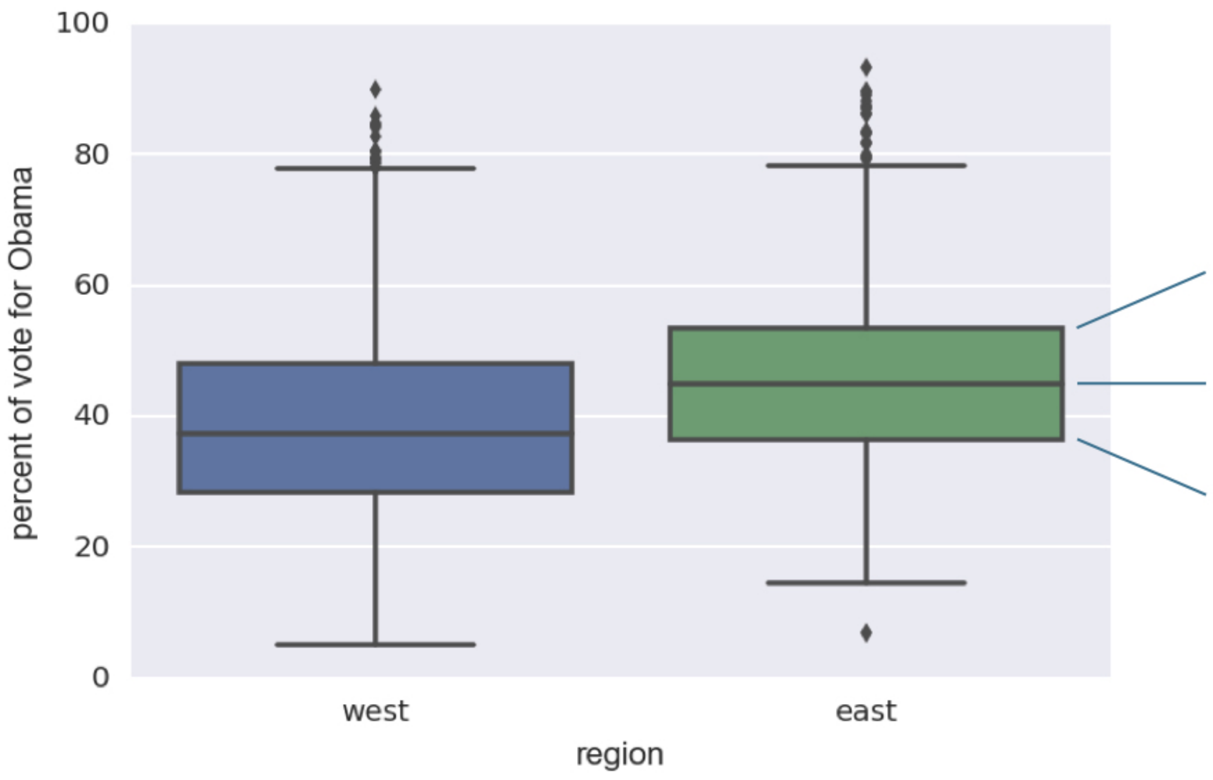
2008 US election box plot



50th percentile

2008 US election box plot

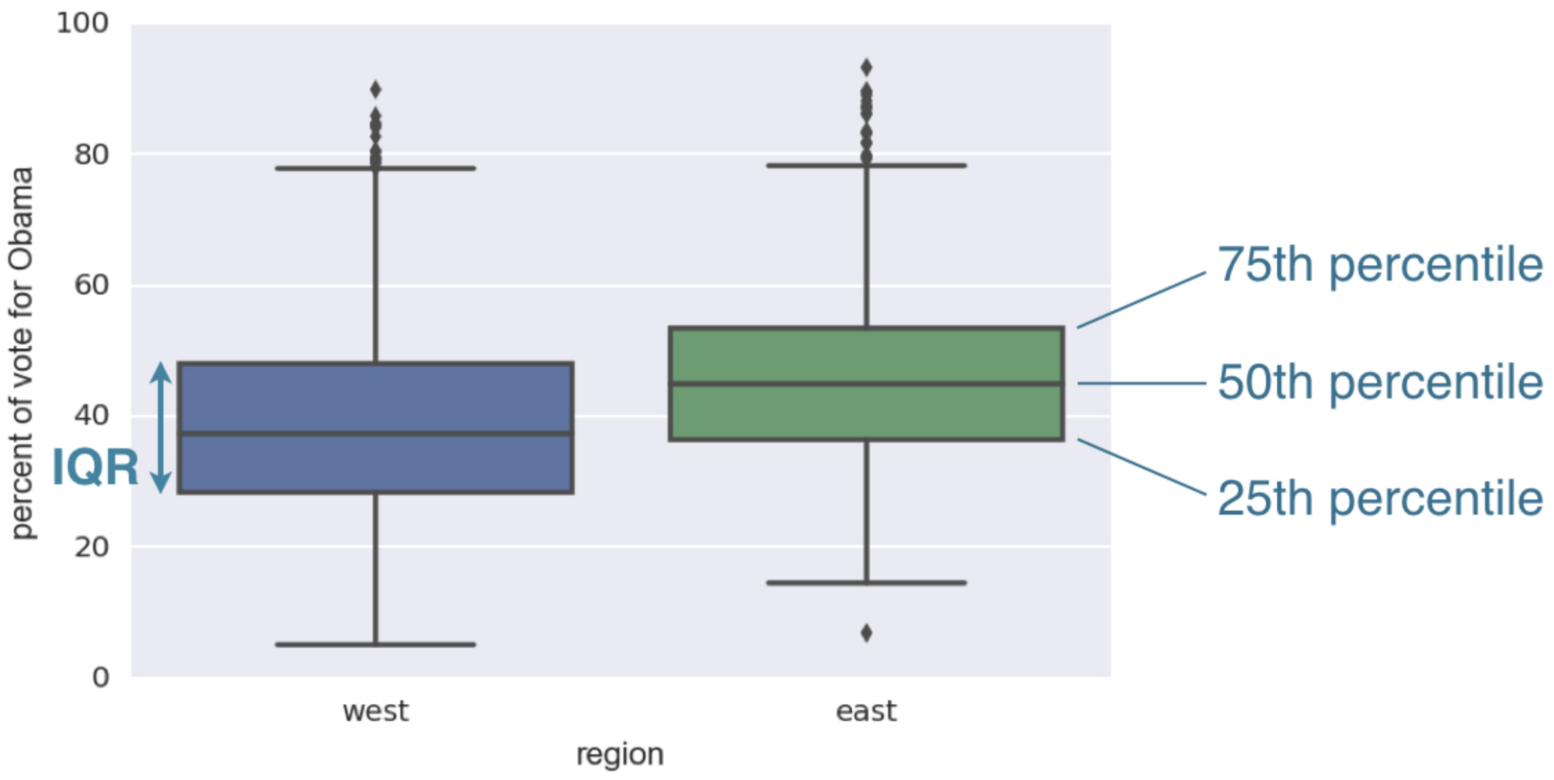


75th percentile

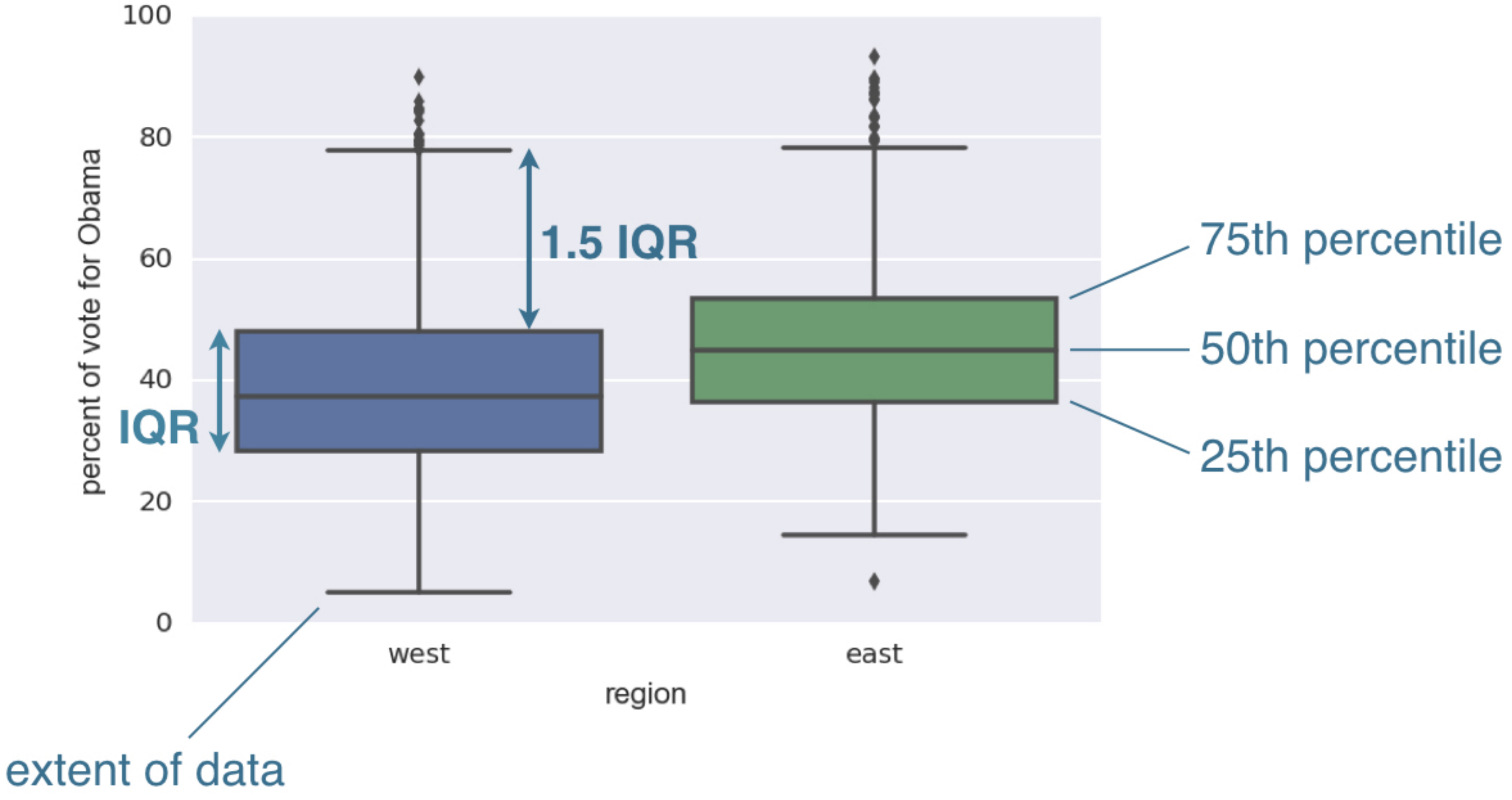
50th percentile

25th percentile

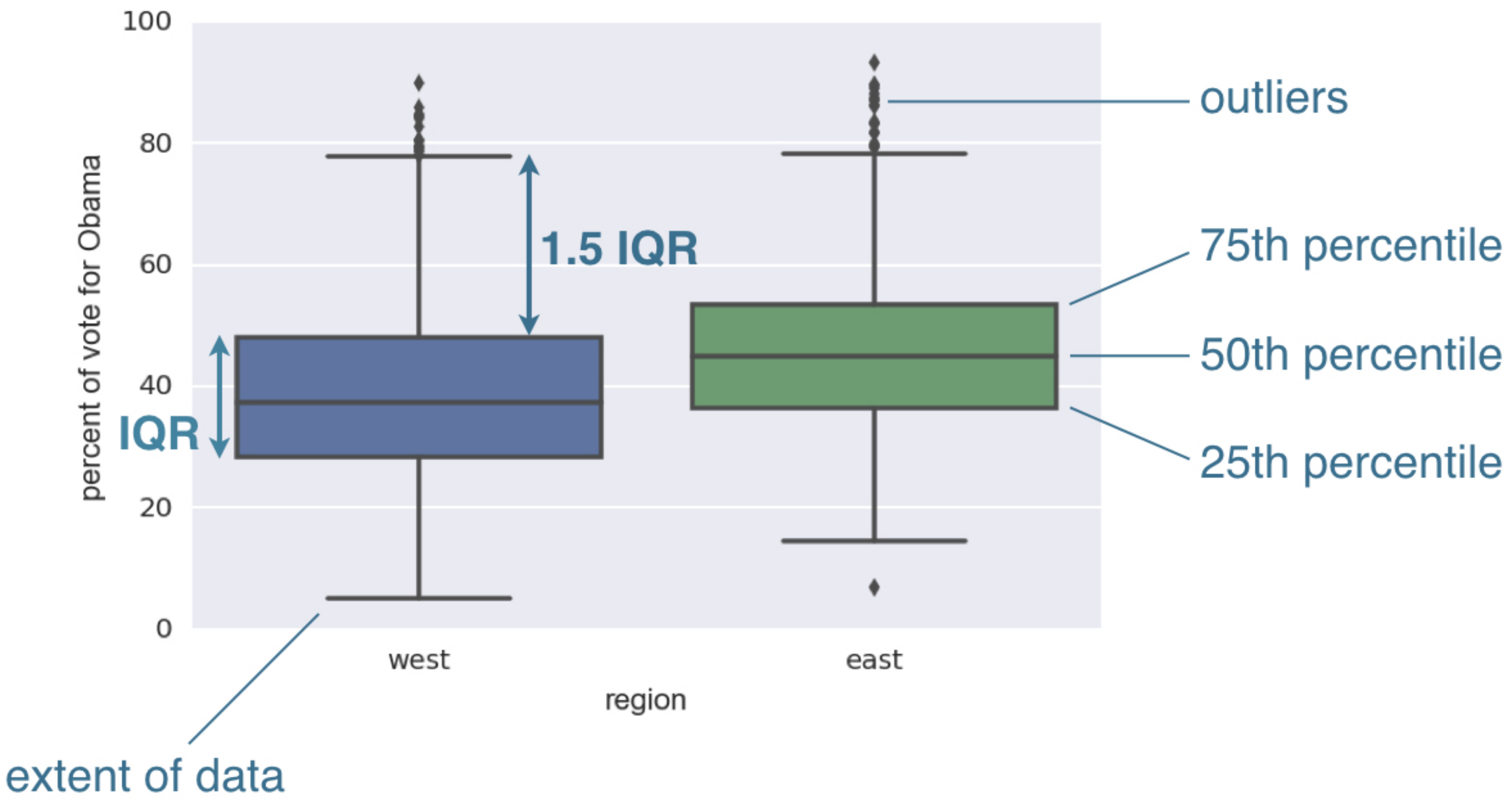
2008 US election box plot



2008 US election box plot



2008 US election box plot



Generating a box plot

```python
import matplotlib.pyplot as plt
import seaborn as sns
_ = sns.boxplot(x='east_west', y='dem_share',
                    data=df_all_states)
_ = plt.xlabel('region')
_ = plt.ylabel('percent of vote for Obama')
plt.show()
```

Let's practice!

STATISTICAL THINKING IN PYTHON (PART 1)

Variance and standard deviation

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Justin Bois

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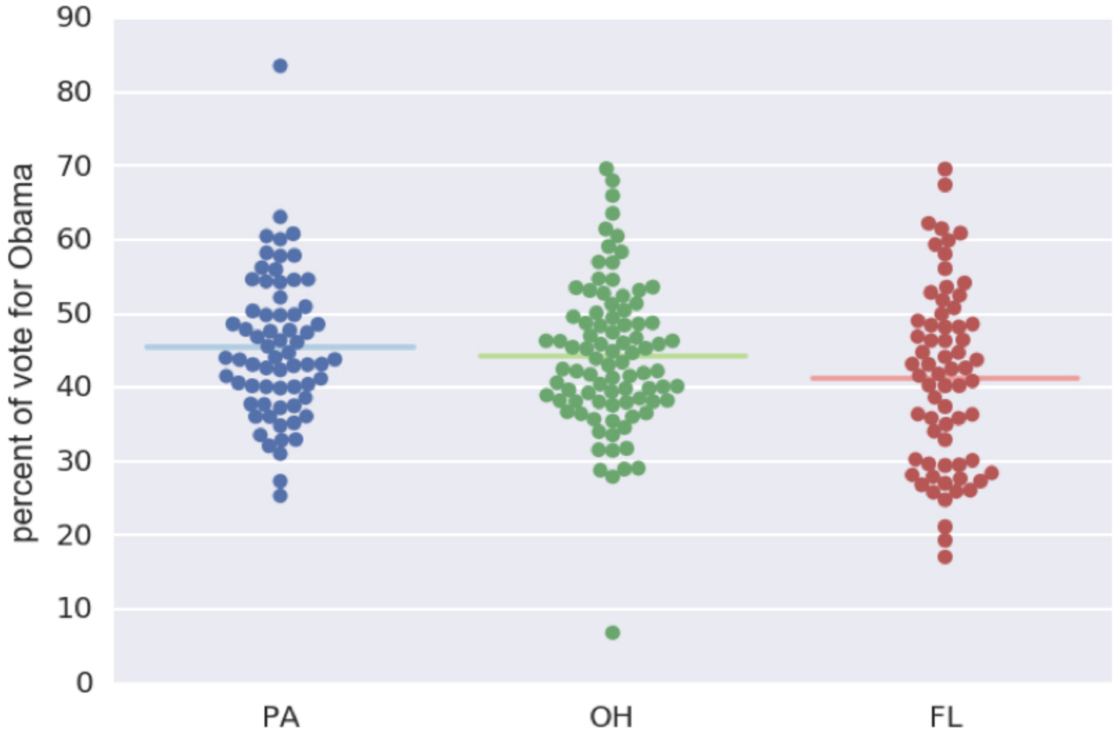

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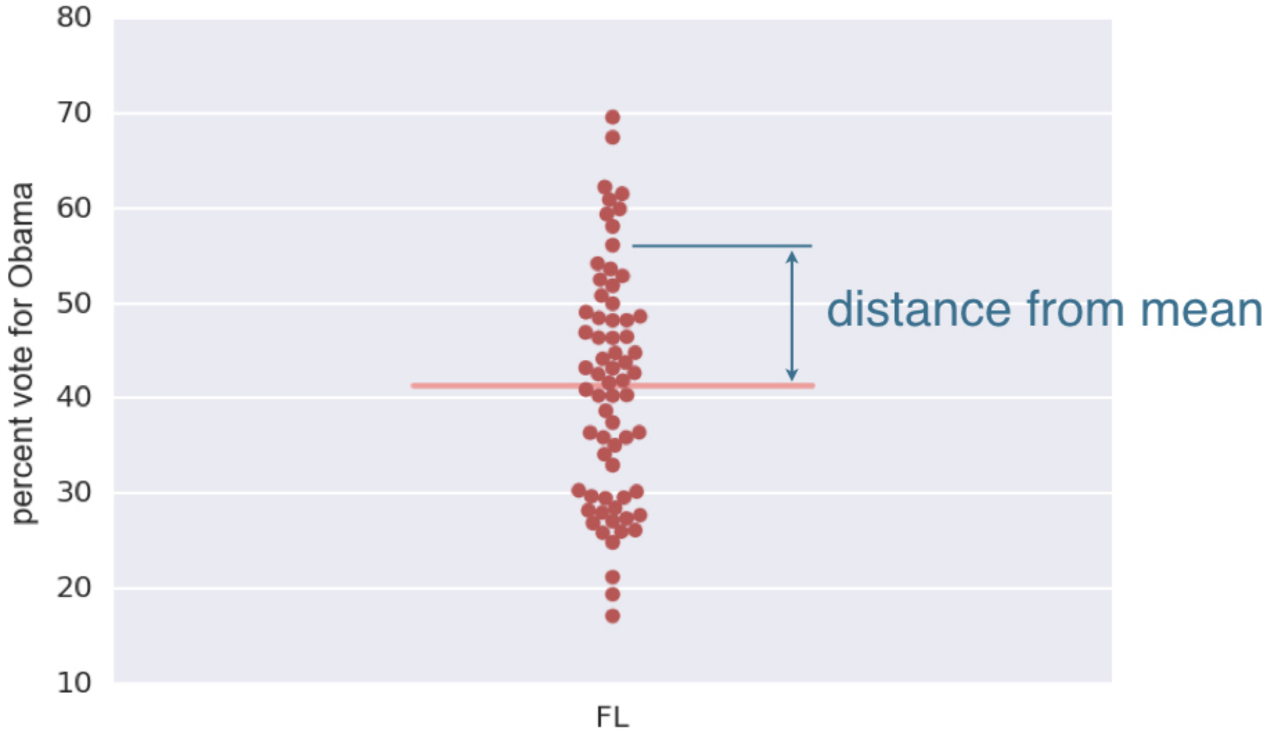
Variance

- The mean squared distance of the data from their mean
- Informally, a measure of the spread of data

2008 Florida election results



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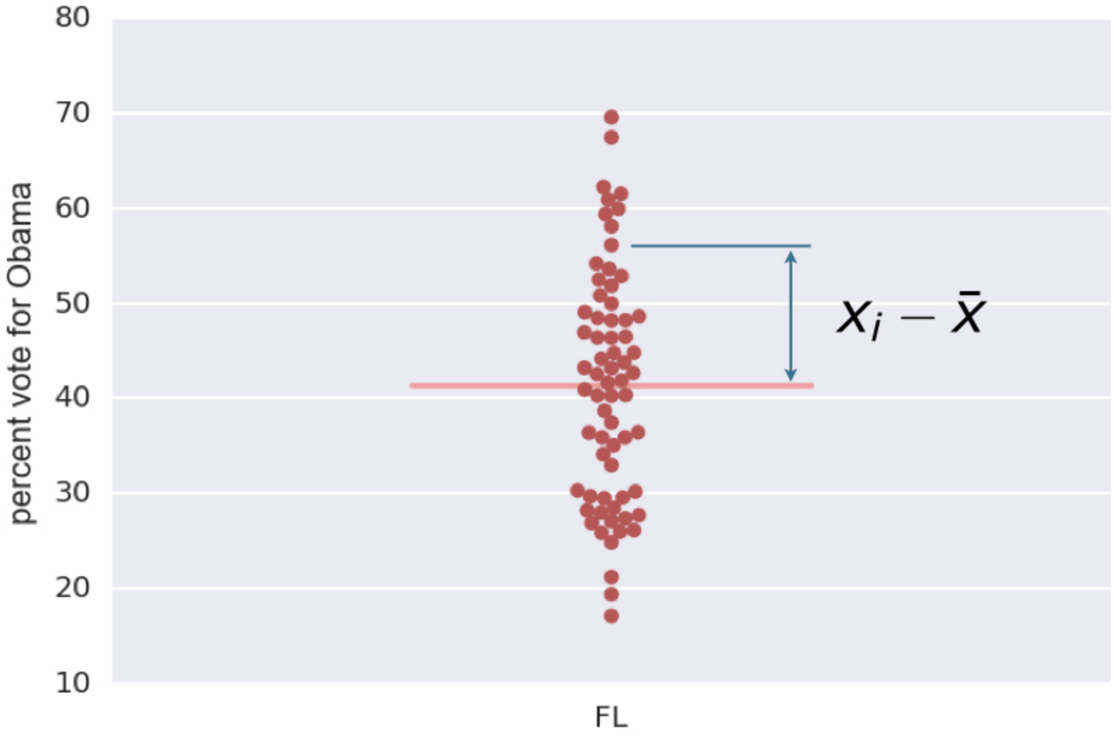
2008 Florida election results



$$variance = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

[1] Data retrieved from Data.gov (https://www.data.gov/)

Computing the variance

```
np.var(dem_share_FL)
```

```
147.44278618846064
```

Computing the standard deviation

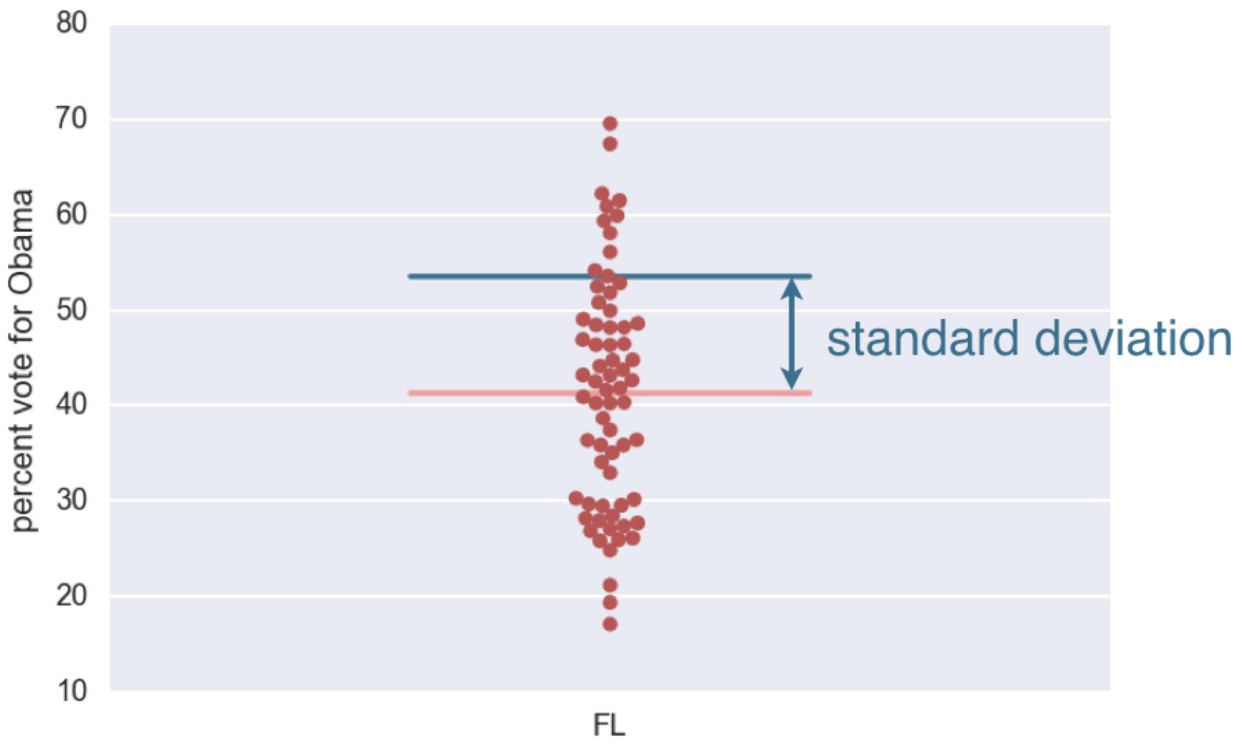
```
np.std(dem_share_FL)
```

```
12.142602117687158
```

```
np.sqrt(np.var(dem_share_FL))
```

```
12.142602117687158
```

2008 Florida election results



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Let's practice!

STATISTICAL THINKING IN PYTHON (PART 1)

Covariance and the Pearson correlation coefficient

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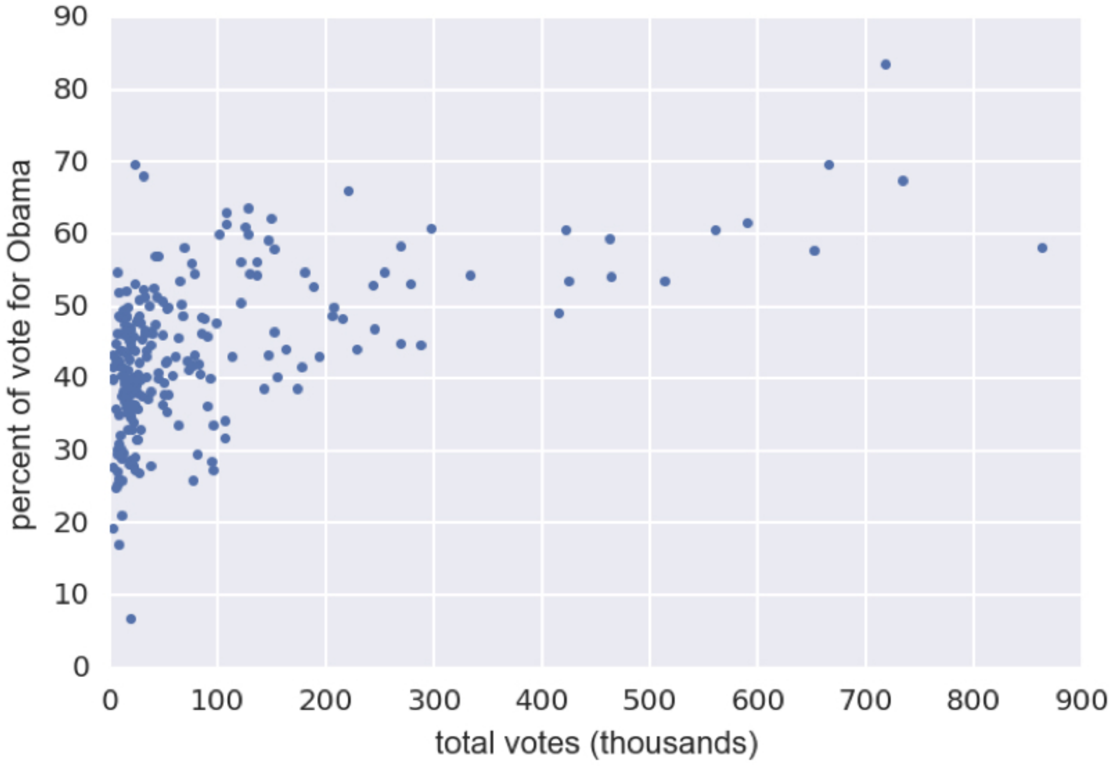
2008 US swing state election results



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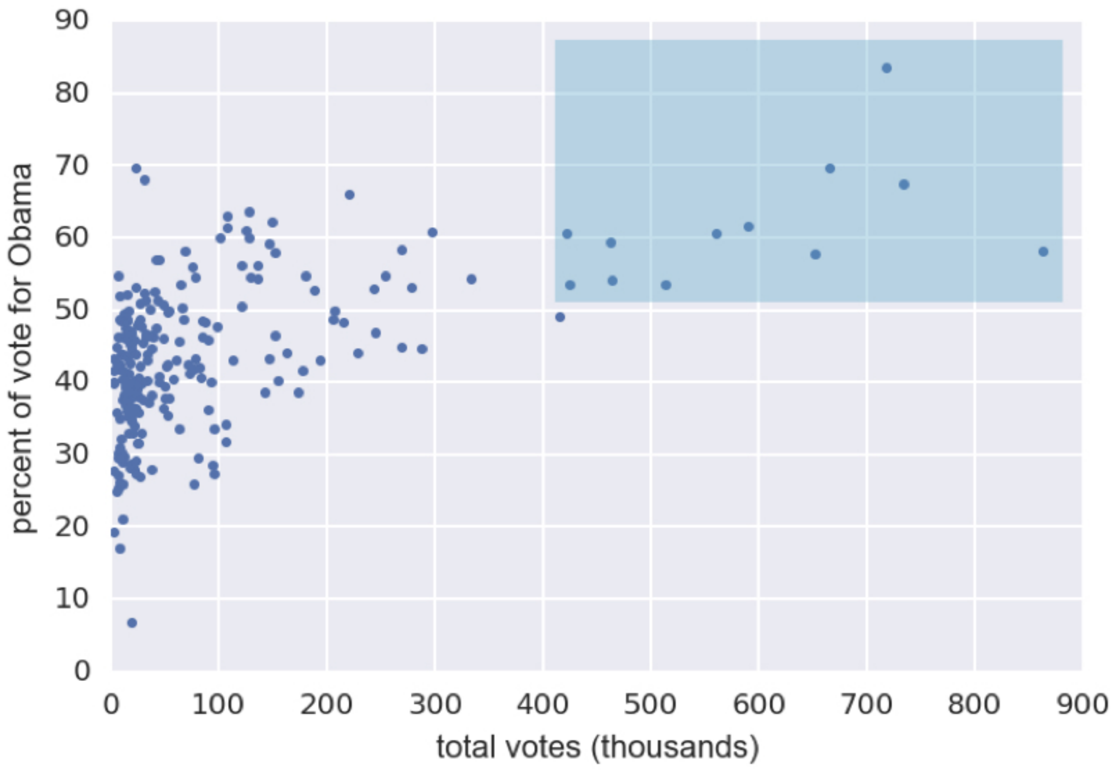
2008 US swing state election results



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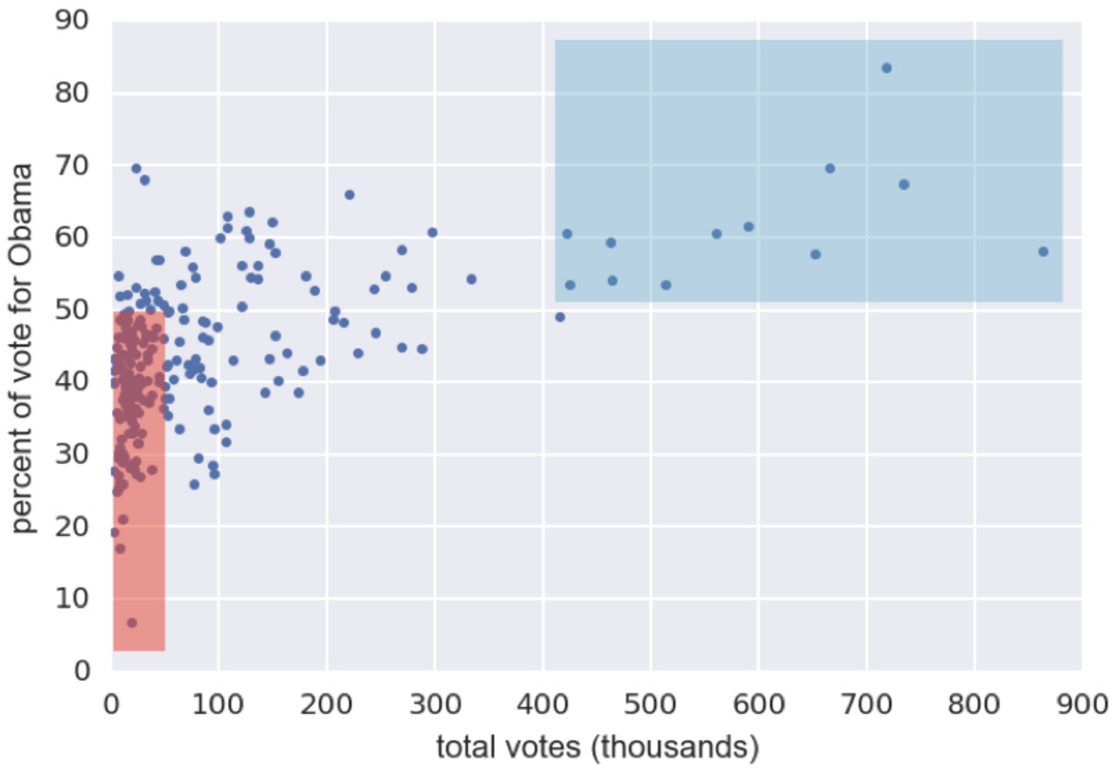


[1] Data retrieved from Data.gov (https://www.data.gov/)

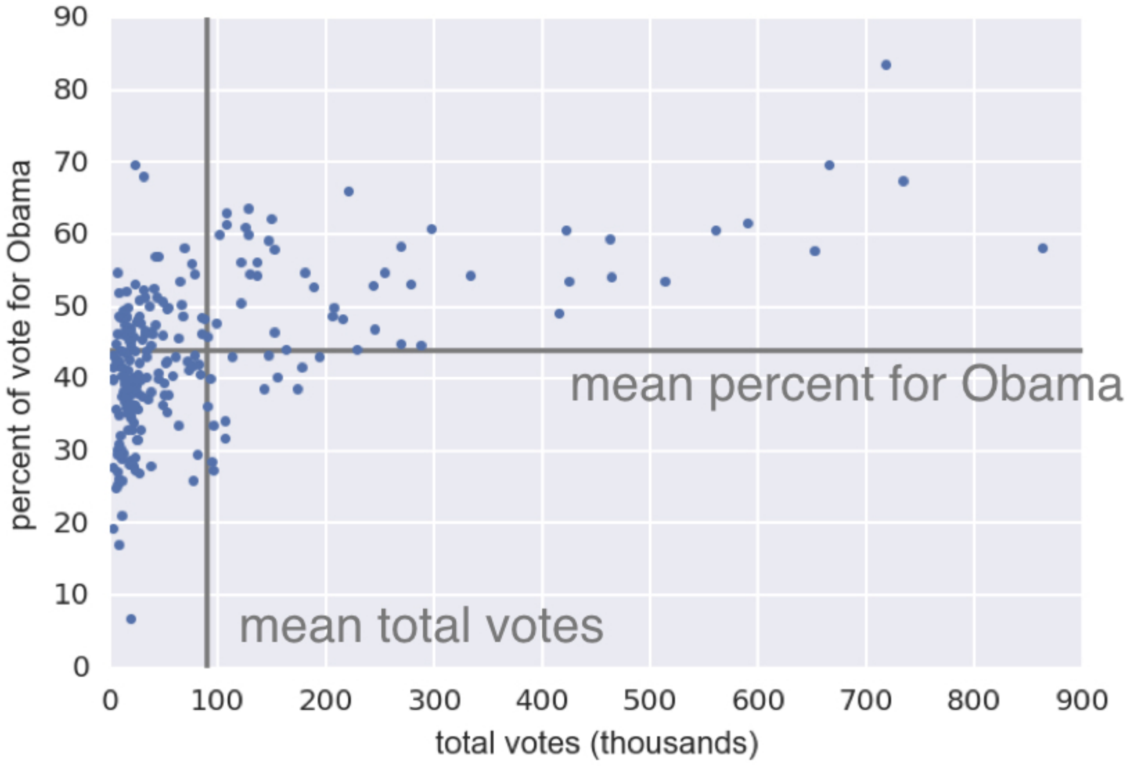
Generating a scatter plot

```python
_ = plt.plot(total_votes/1000, dem_share,
                 marker='.', linestyle='none')
_ = plt.xlabel('total votes (thousands)')
_ = plt.ylabel('percent of vote for Obama')
```

Covariance

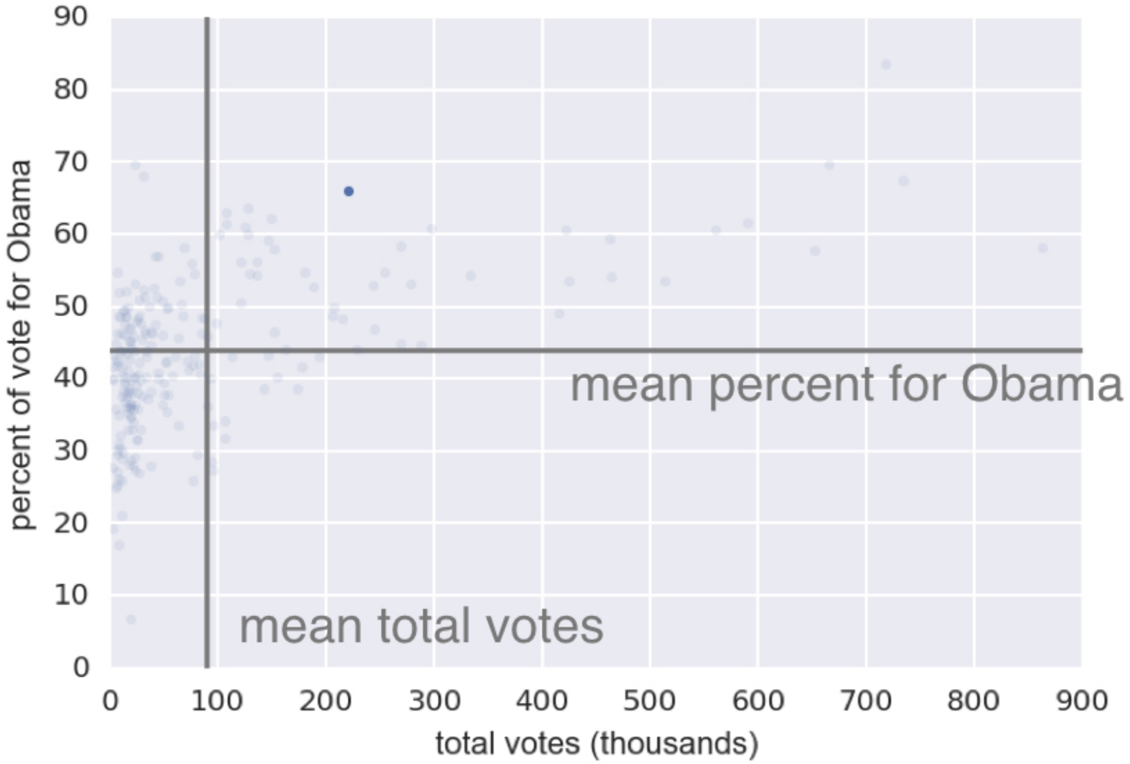
- A measure of how two quantities vary together

Calculation of the covariance



[1] Data retrieved from Data.gov (https://www.data.gov/)

Calculation of the covariance



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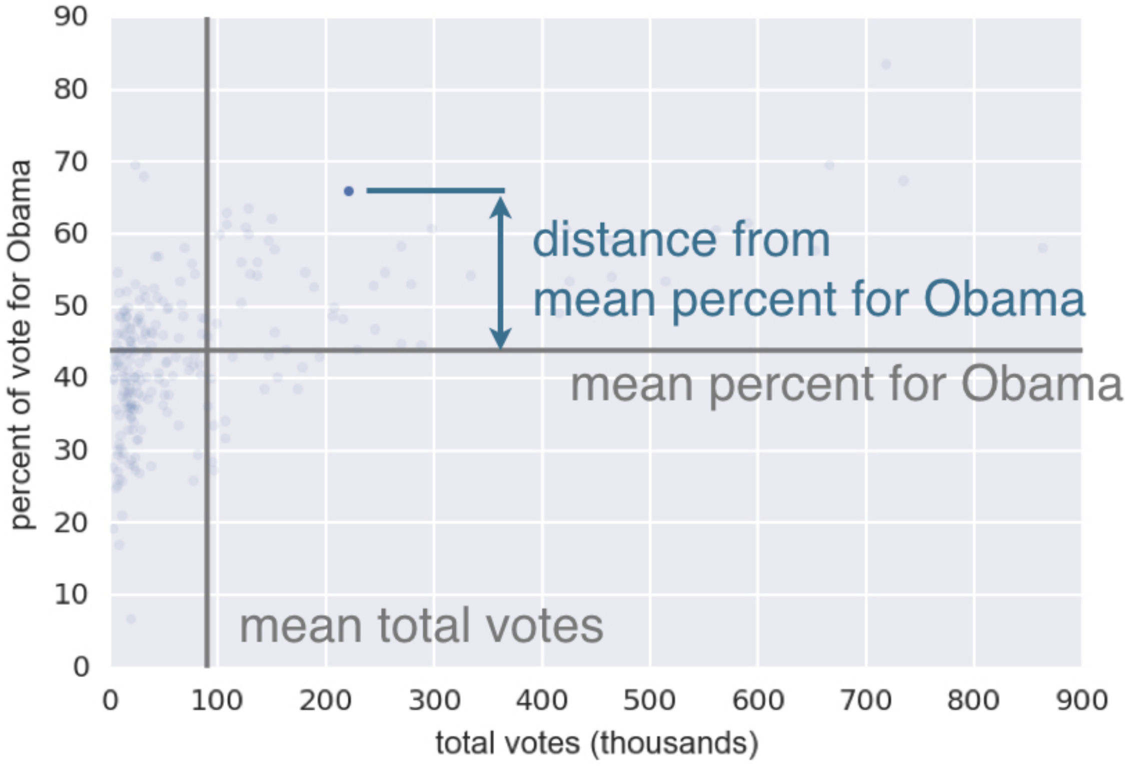
Calculation of the covariance



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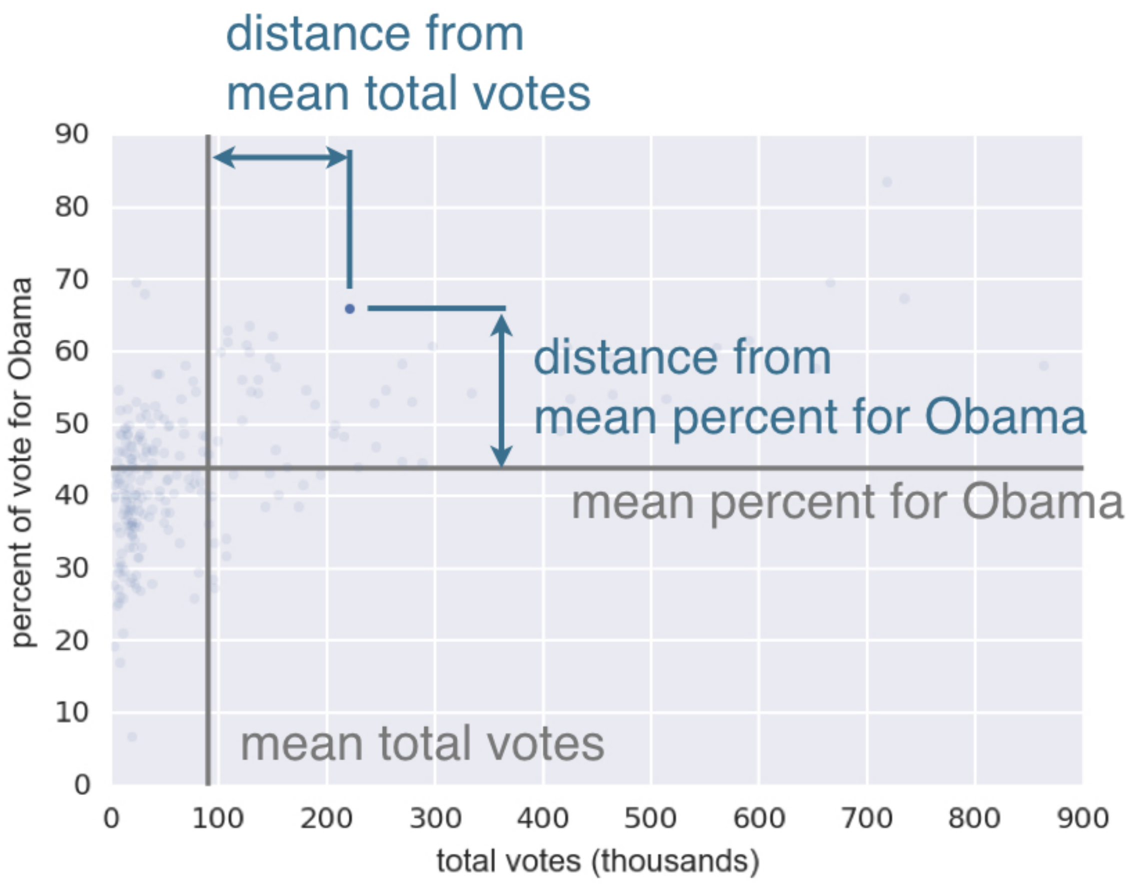
Calculation of the covariance



$$covariance = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

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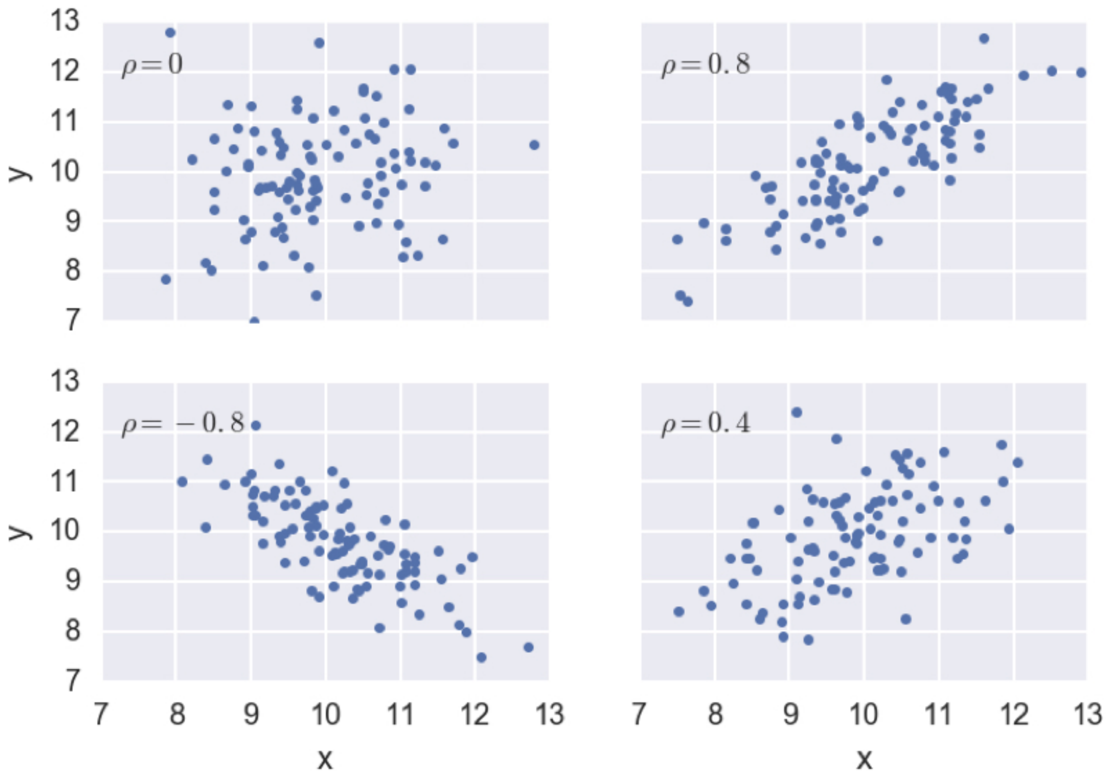
Pearson correlation coefficient

$$\rho = \text{Pearson correlation} = \frac{\text{covariance}}{(\text{std of x})(\text{std of y})}$$

$$= \frac{\text{variability due to codependence}}{\text{independant variability}}$$

Pearson correlation coefficient examples



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