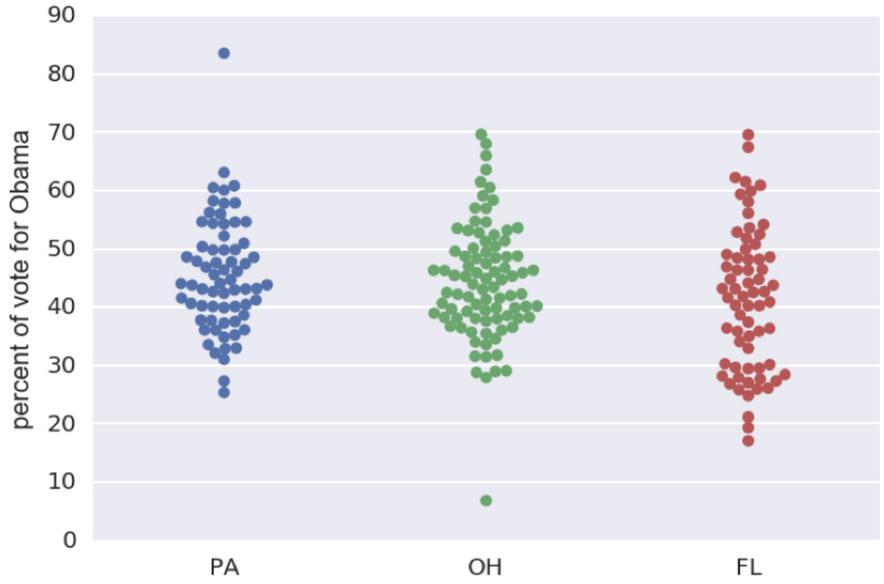
Introduction to summary statistics: The sample mean and median

STATISTICAL THINKING IN PYTHON (PART 1)

Justin Bois

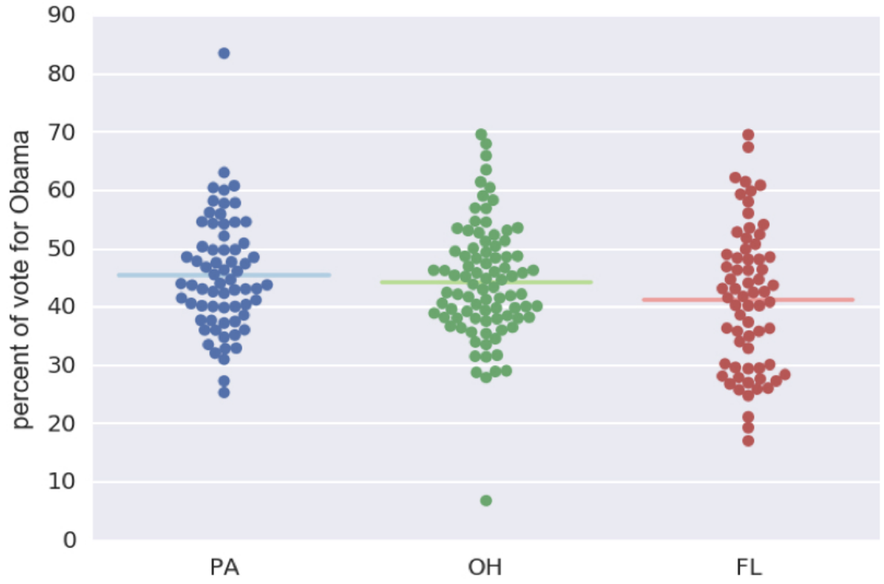
Teaching Professor at the California Institute of Technology

2008 US swing state election results



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

2008 US swing state election results



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Mean vote percentage

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

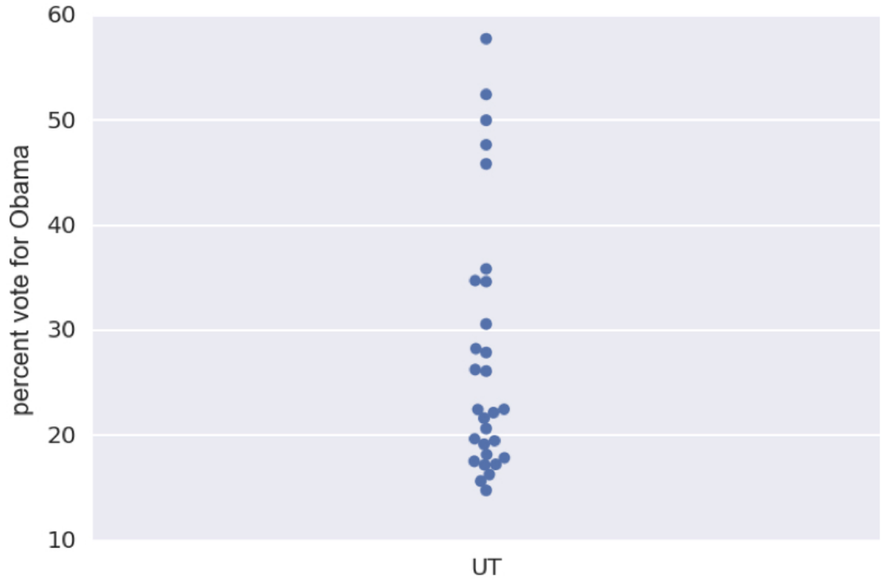
```
45.476417910447765
```

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

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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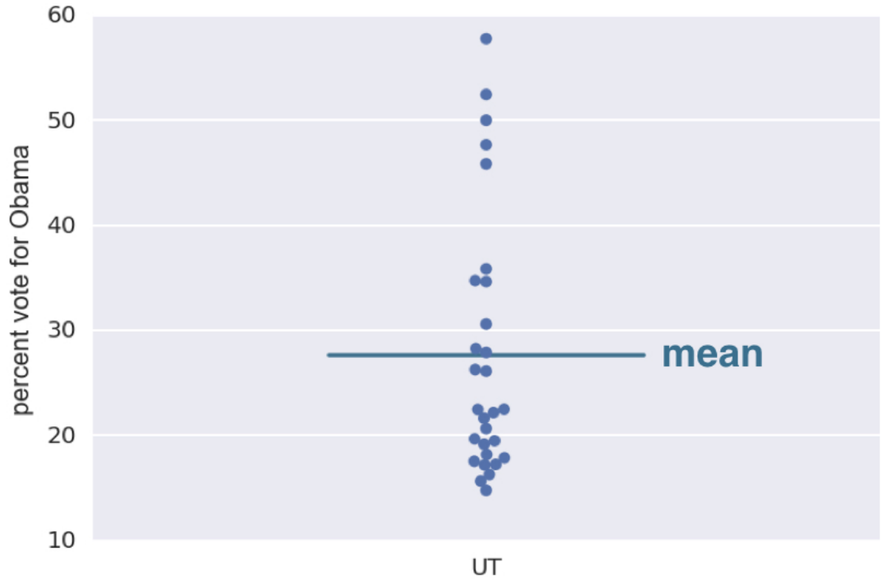
2008 Utah election results



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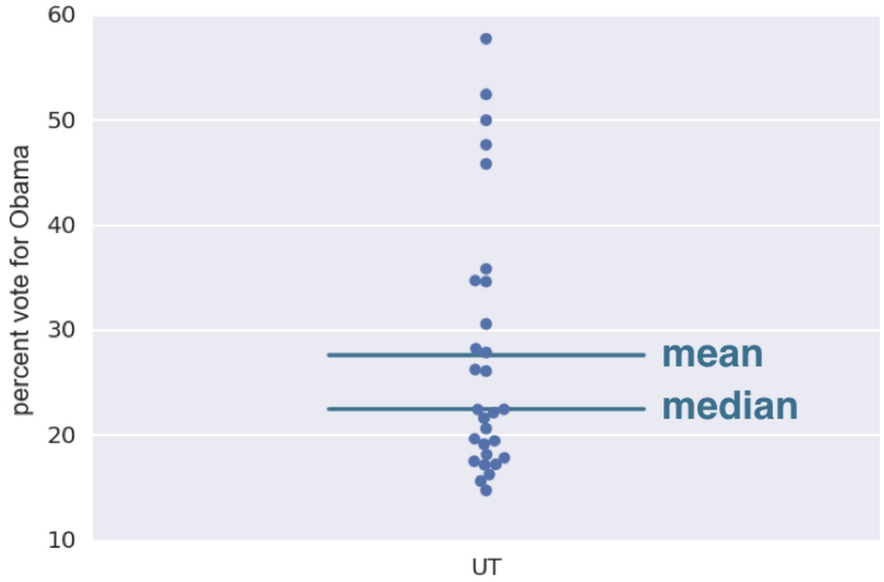
The median

- 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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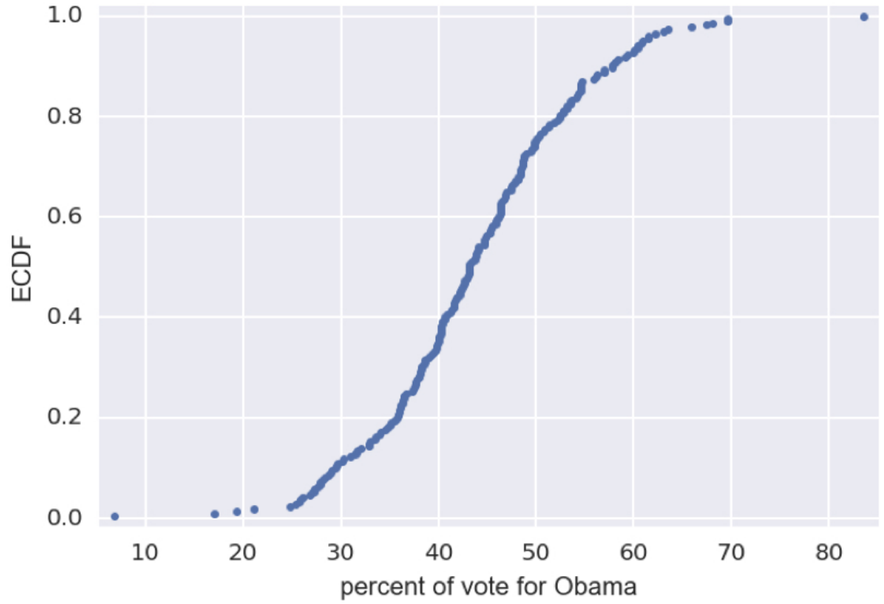
Percentiles on an ECDF



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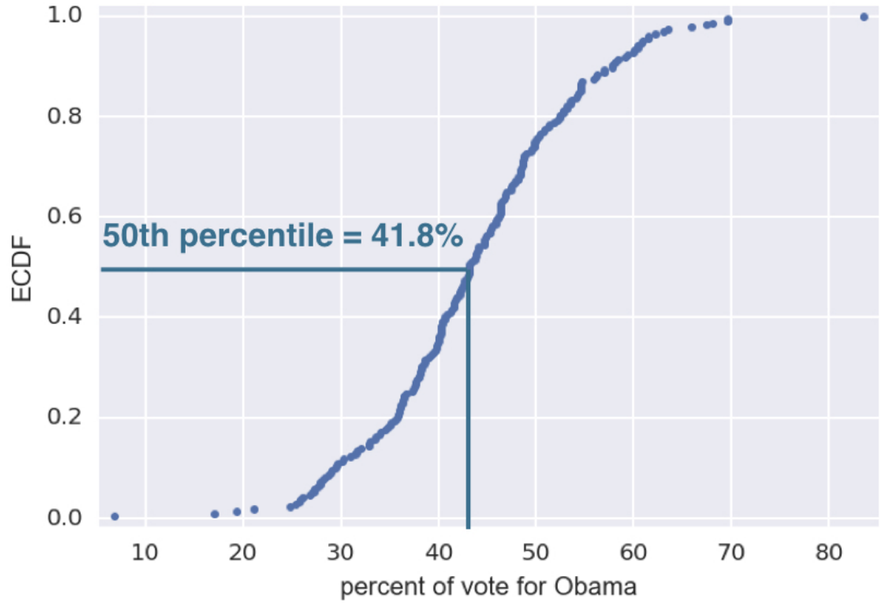
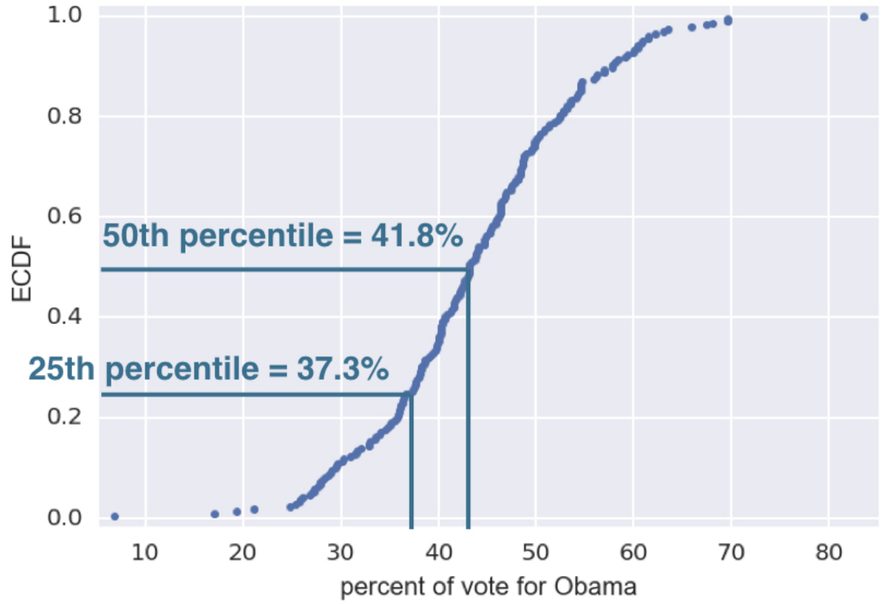
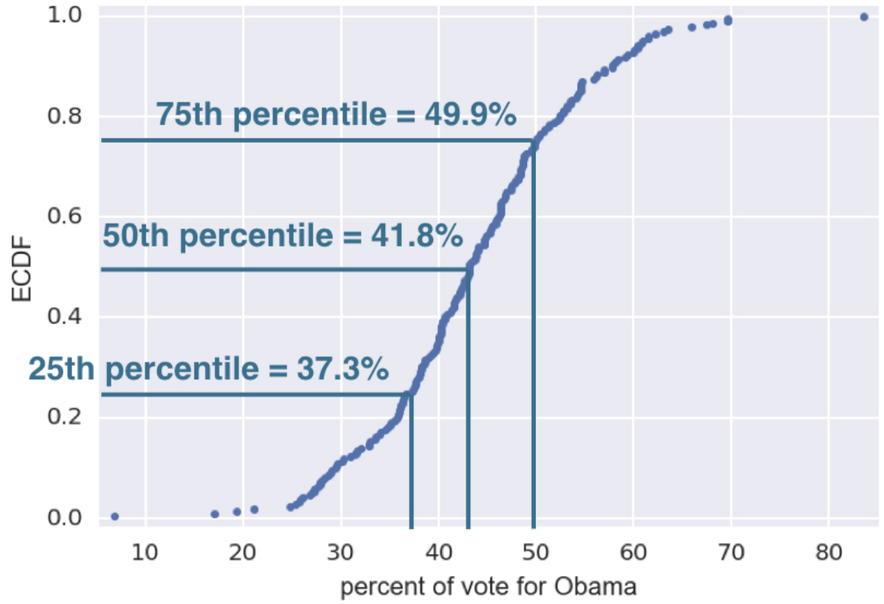
Percentiles on an ECDF



Percentiles on an ECDF



Percentiles on an ECDF

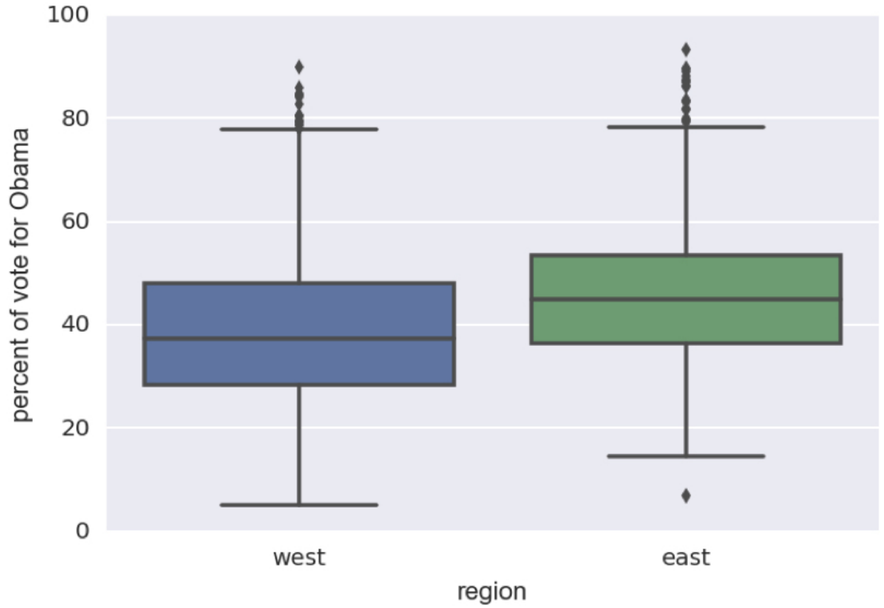


Computing percentiles

```
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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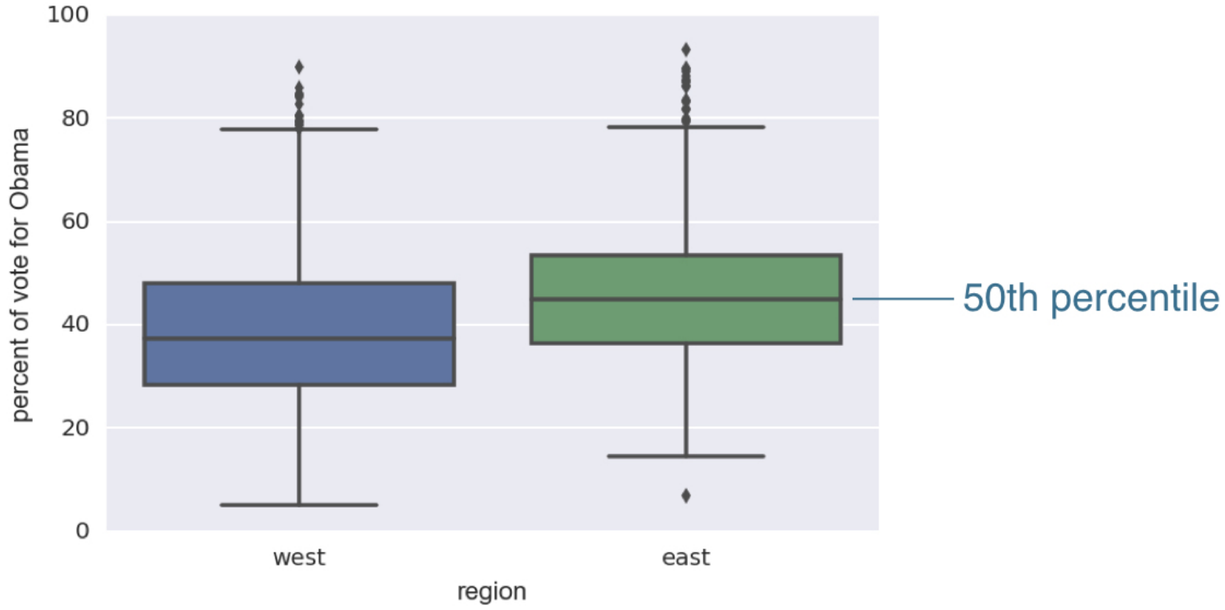
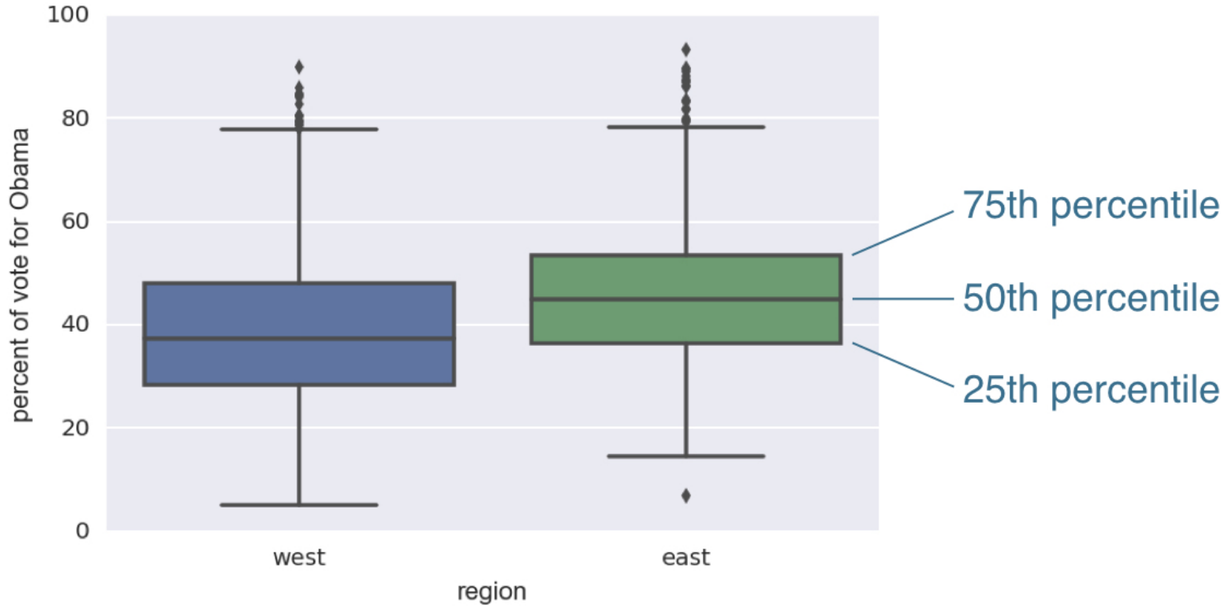
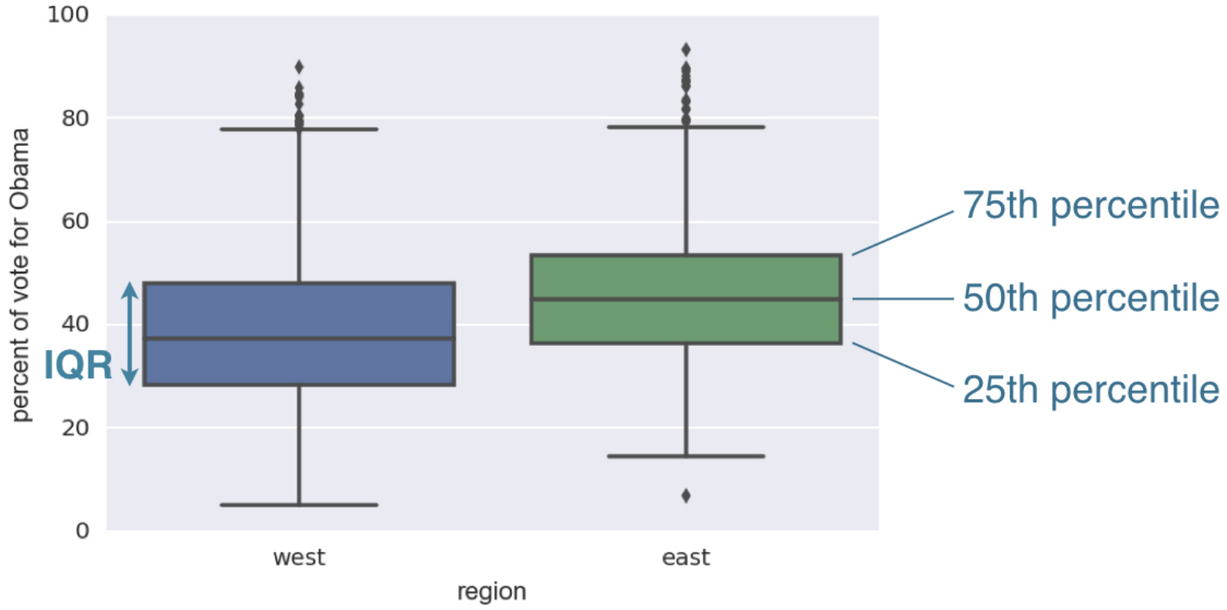
2008 US election box plot



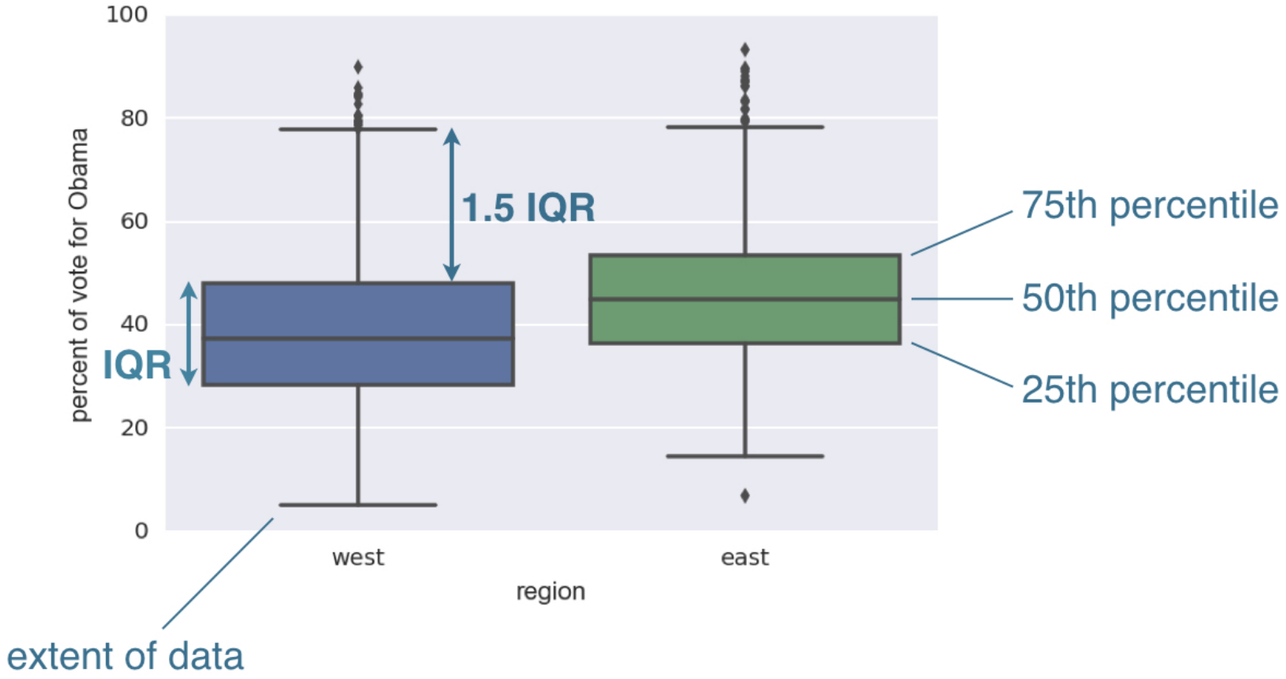
2008 US election box plot



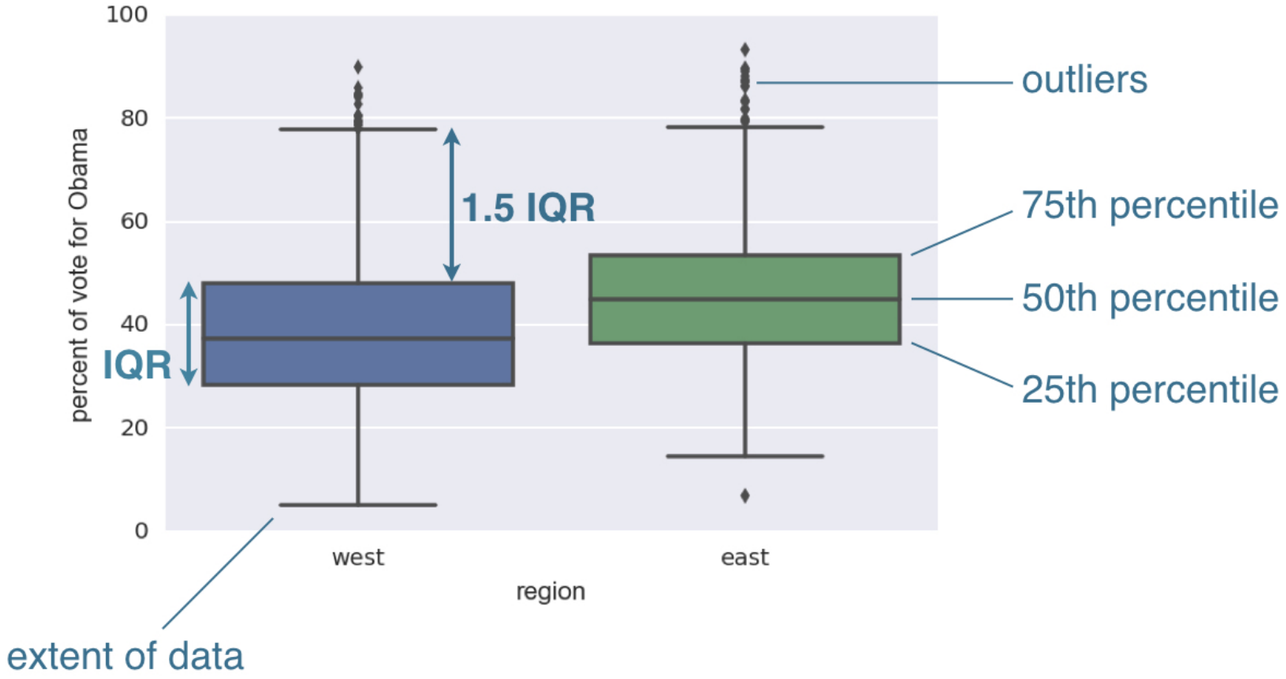
2008 US election box plot



2008 US election box plot



2008 US election box plot



Generating a box plot

```
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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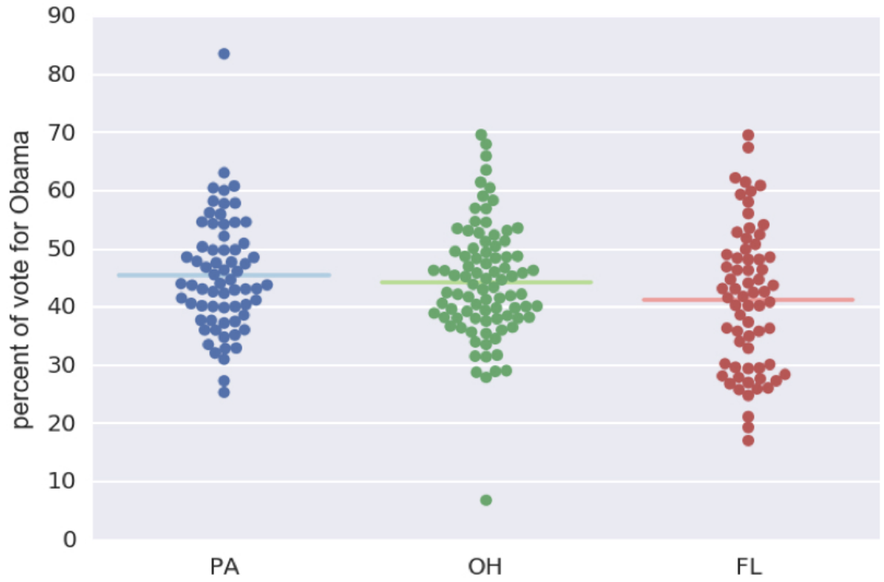
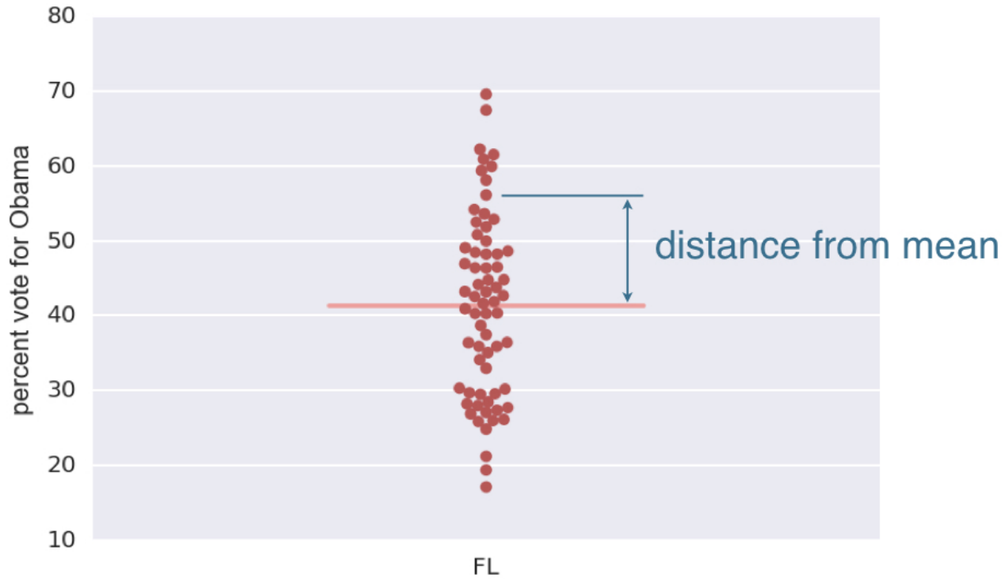


[1] Data retrieved from Data.gov (https://www.data.gov/)

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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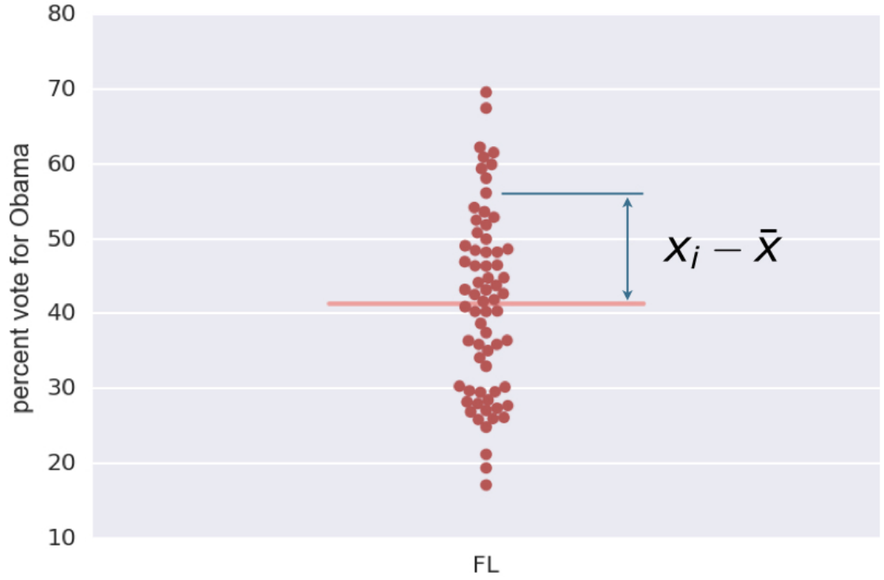
2008 Florida election results



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

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

Computing the variance

```
np.var(dem_share_FL)
147.44278618846064
```

Computing the standard deviation

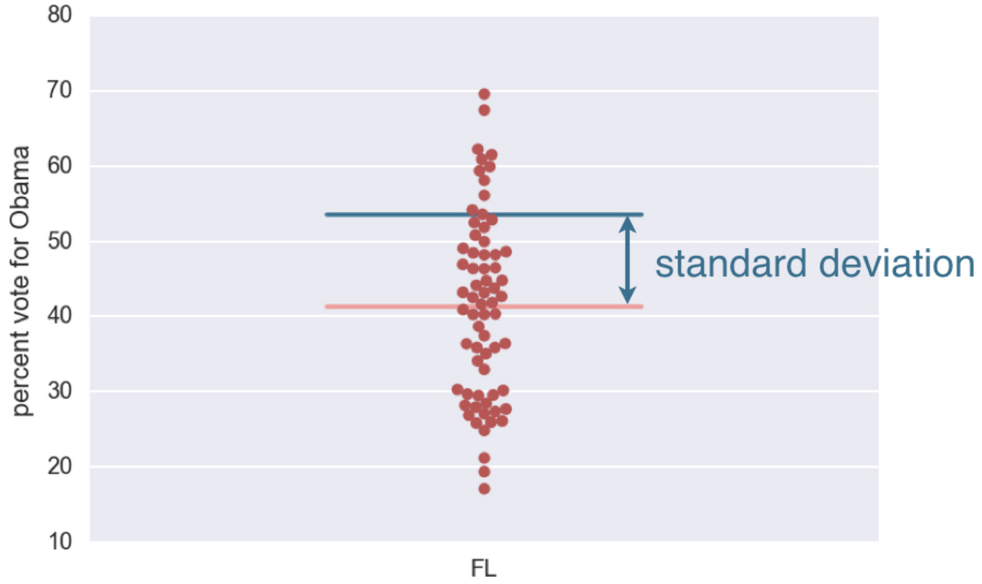
```
np.std(dem_share_FL)
```

```
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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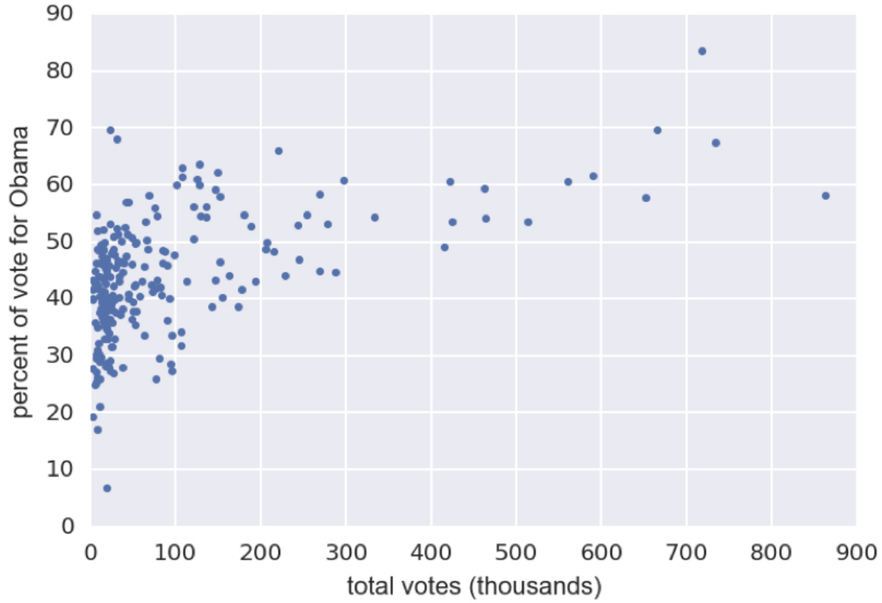
2008 US swing state election results



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2008 US swing state election results

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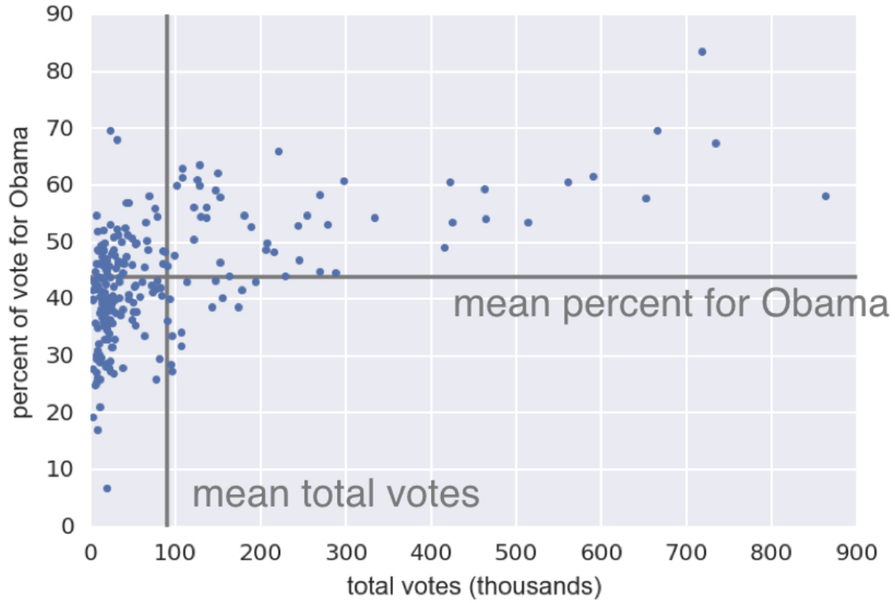
Generating a scatter plot

```
_ = 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



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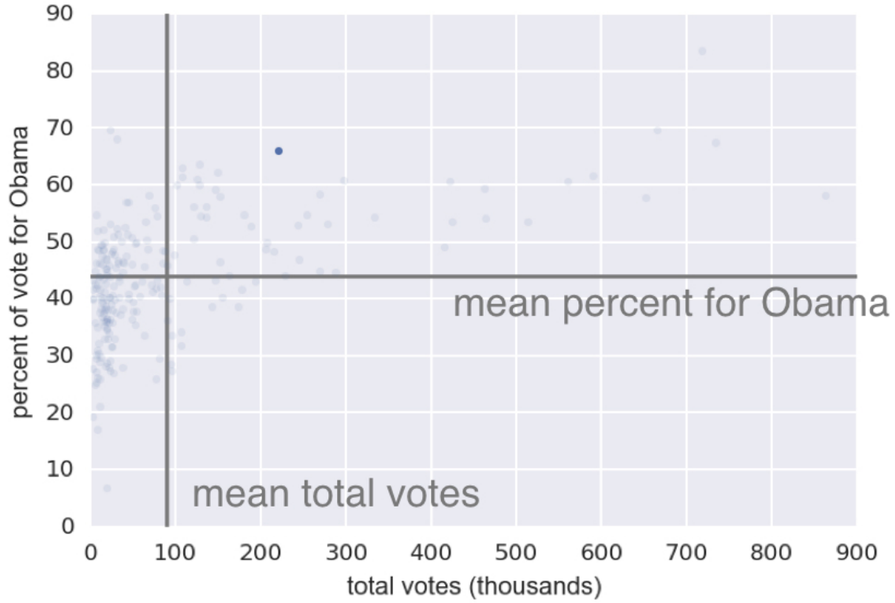
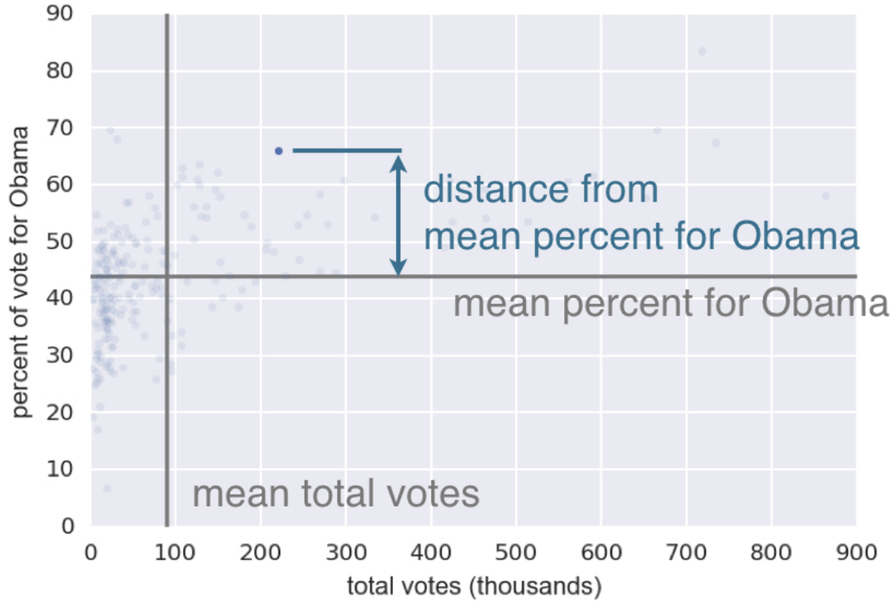
Calculation of the covariance



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

Calculation of the covariance



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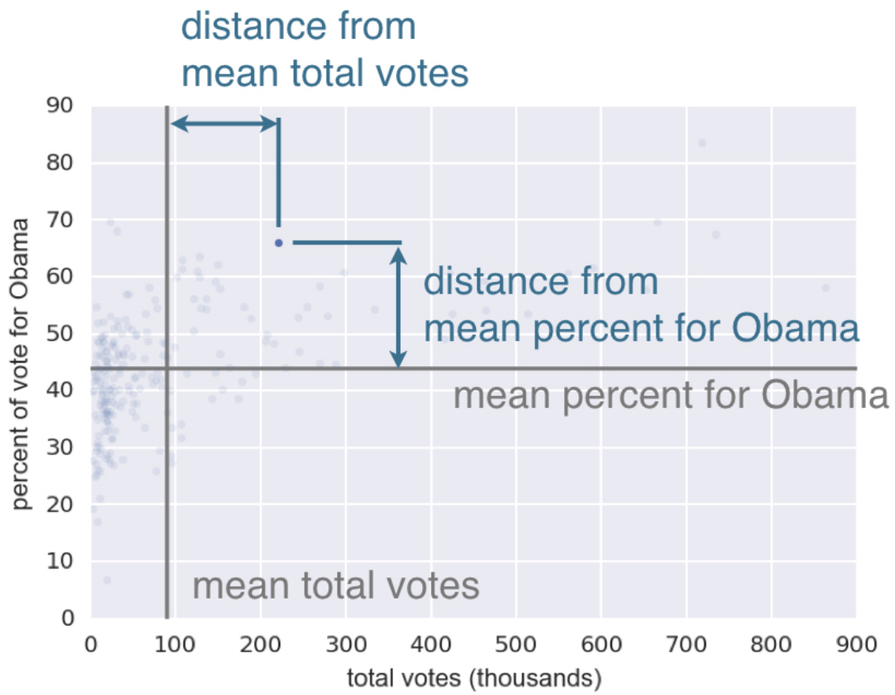
Calculation of the covariance



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

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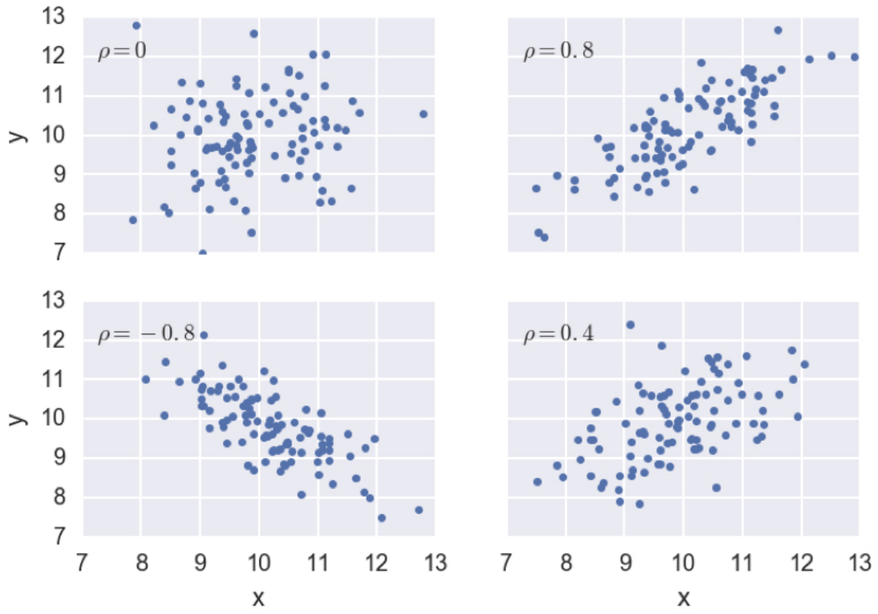
Pearson correlation coefficient

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

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

Pearson correlation coefficient examples



Let's practice!

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