

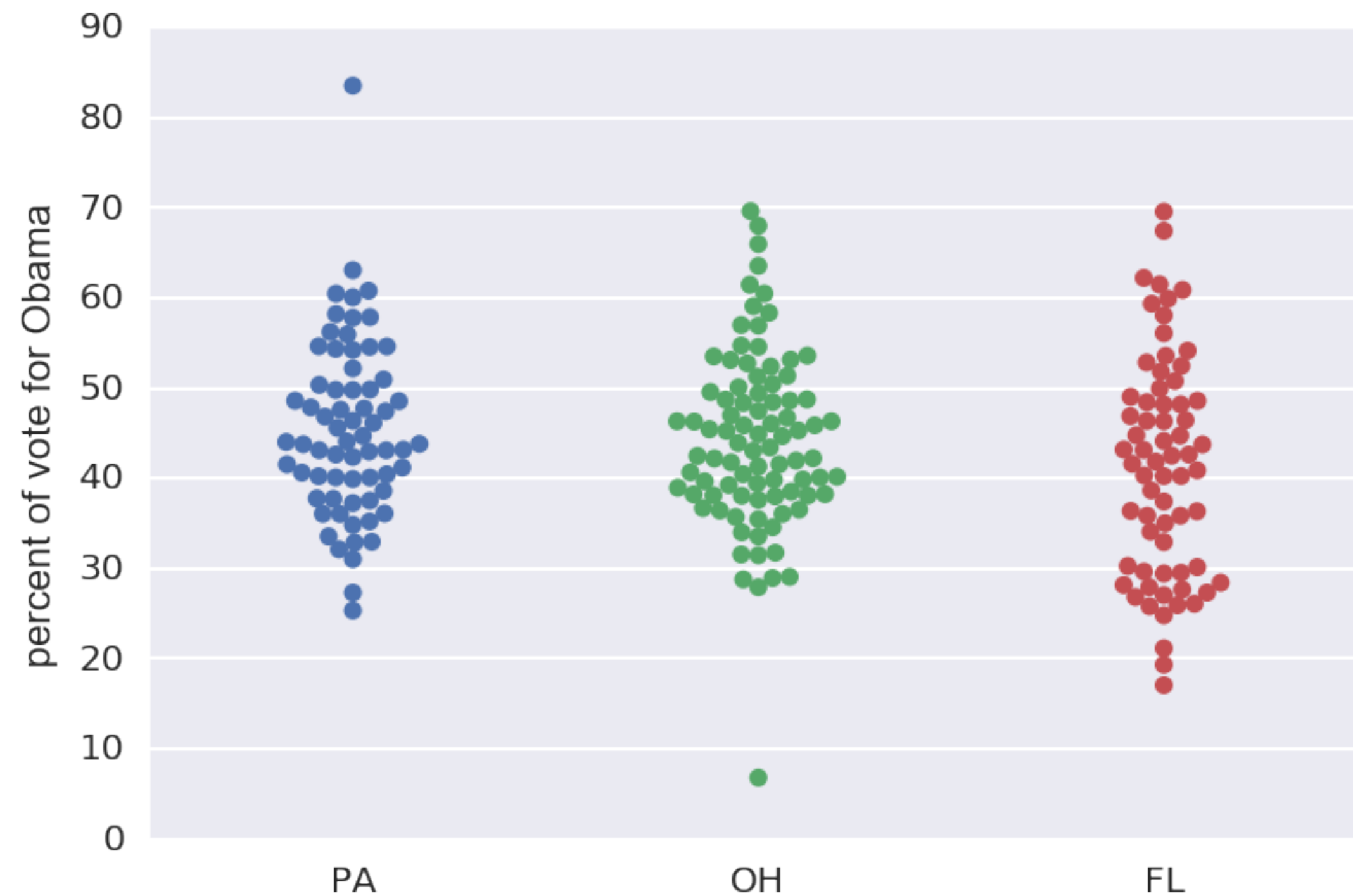


STATISTICAL THINKING IN PYTHON I

Introduction to summary statistics: The sample mean and median

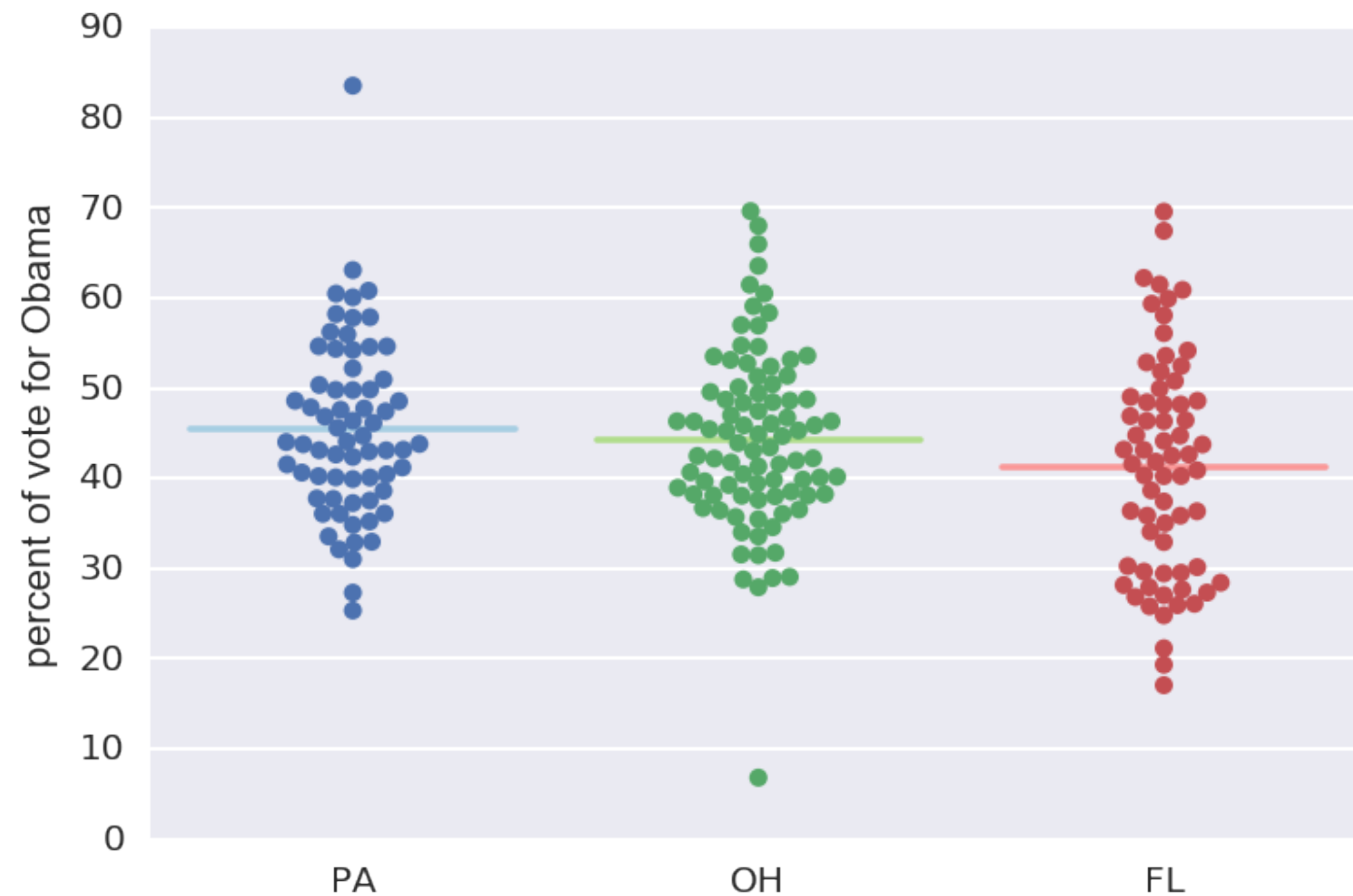


2008 US swing state election results





2008 US swing state election results





Mean vote percentage

```
In [1]: import numpy as np  
  
In [2]: np.mean(dem_share_PA)  
Out[2]: 45.476417910447765
```

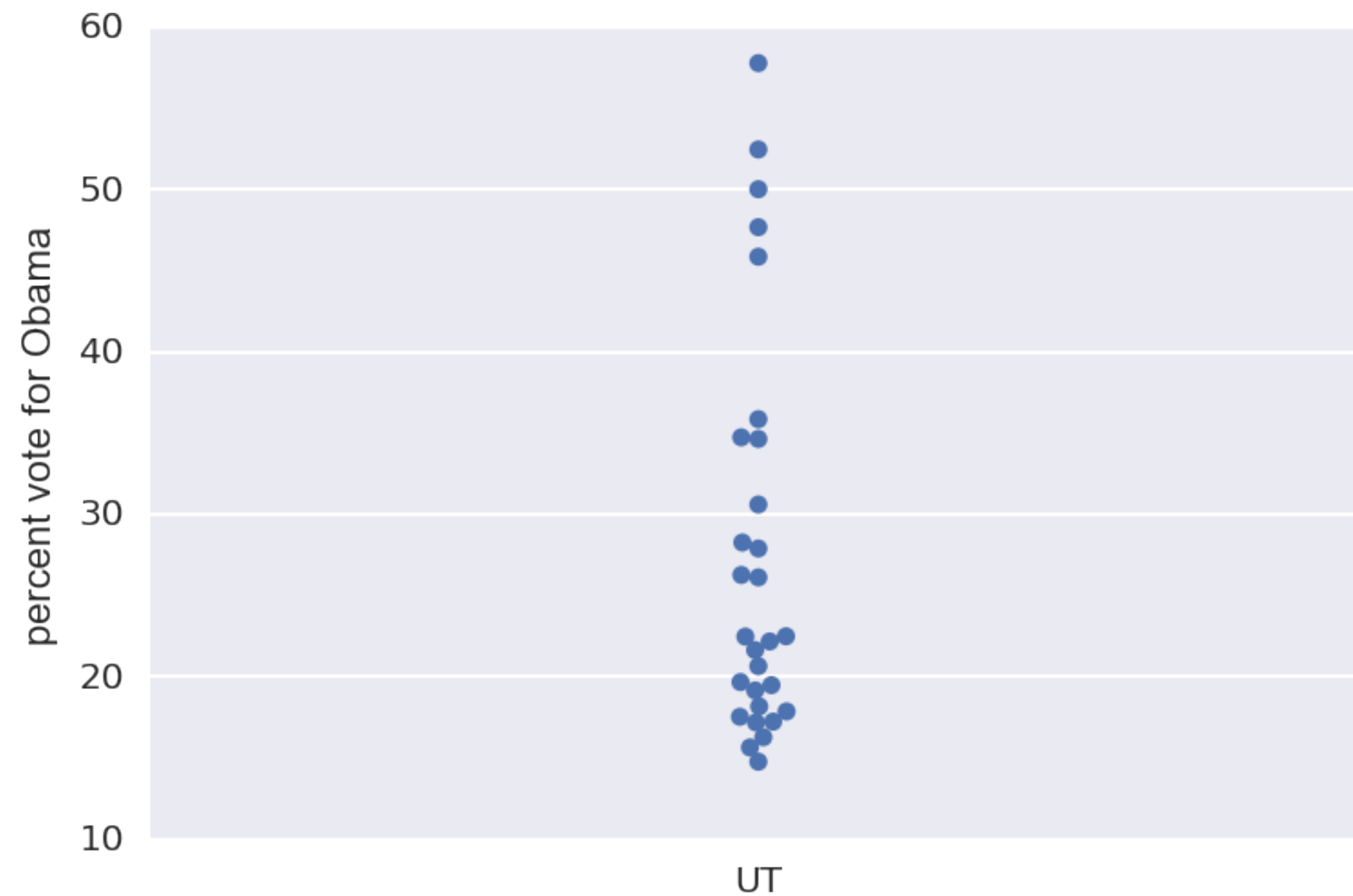
$$\text{mean} = \bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$



Outliers

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

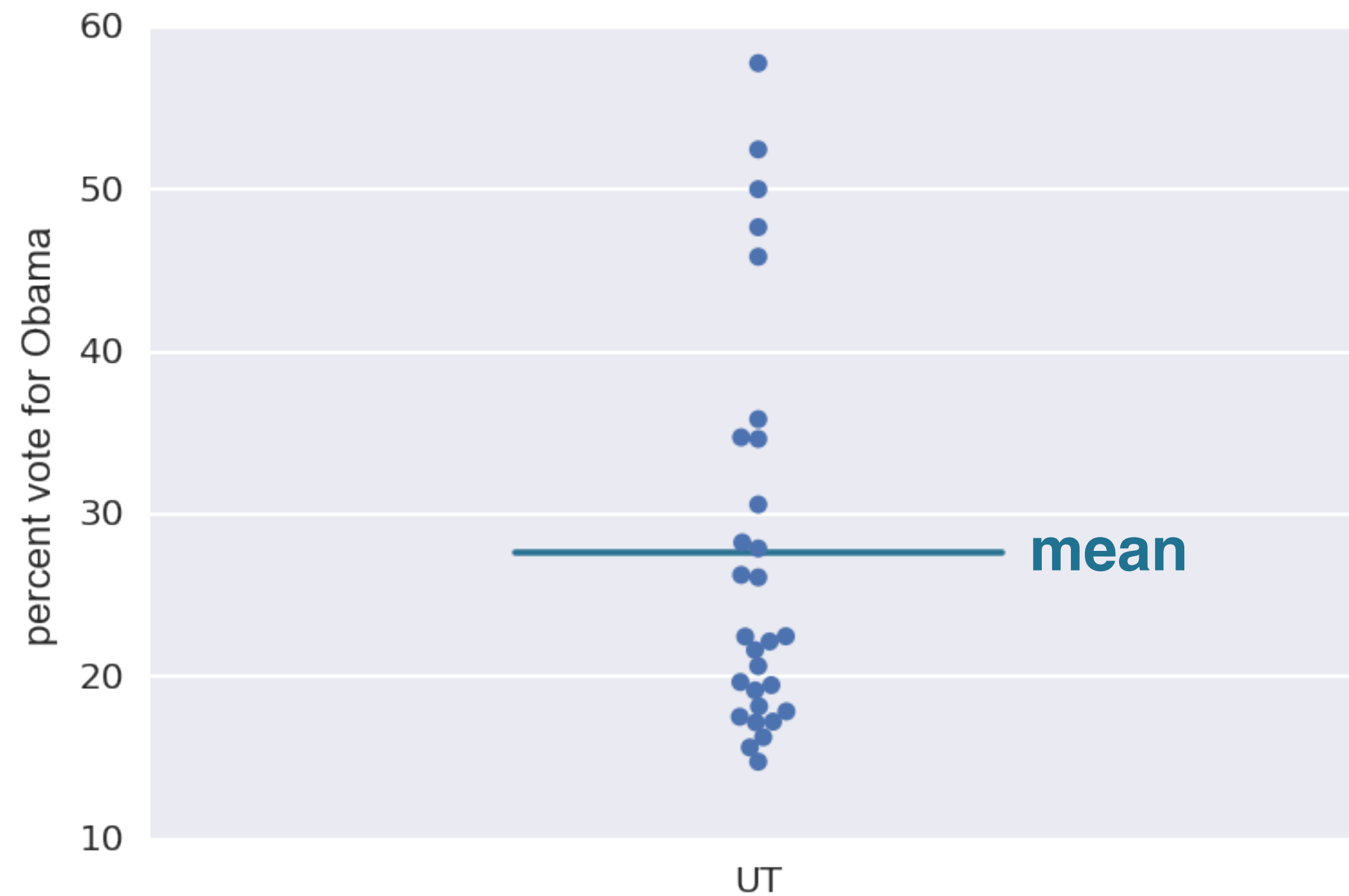
2008 Utah election results



Data retrieved from Data.gov (<https://www.data.gov/>)



2008 Utah election results



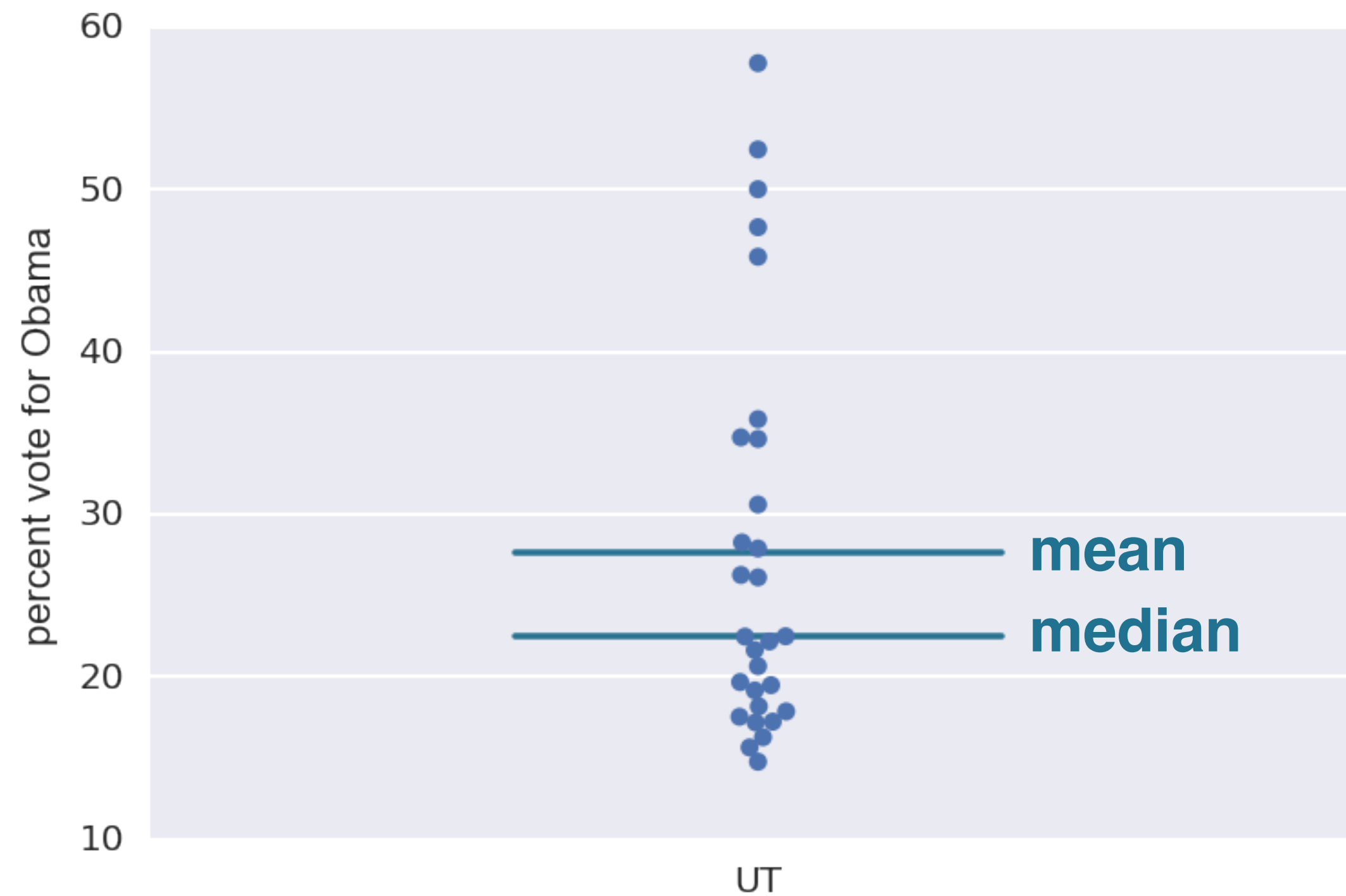


The median

- The middle value of a data set



2008 Utah election results



Computing the median

```
In [1]: np.median(dem_share_UT)
Out[1]: 22.469999999999999
```



STATISTICAL THINKING IN PYTHON I

Let's practice!

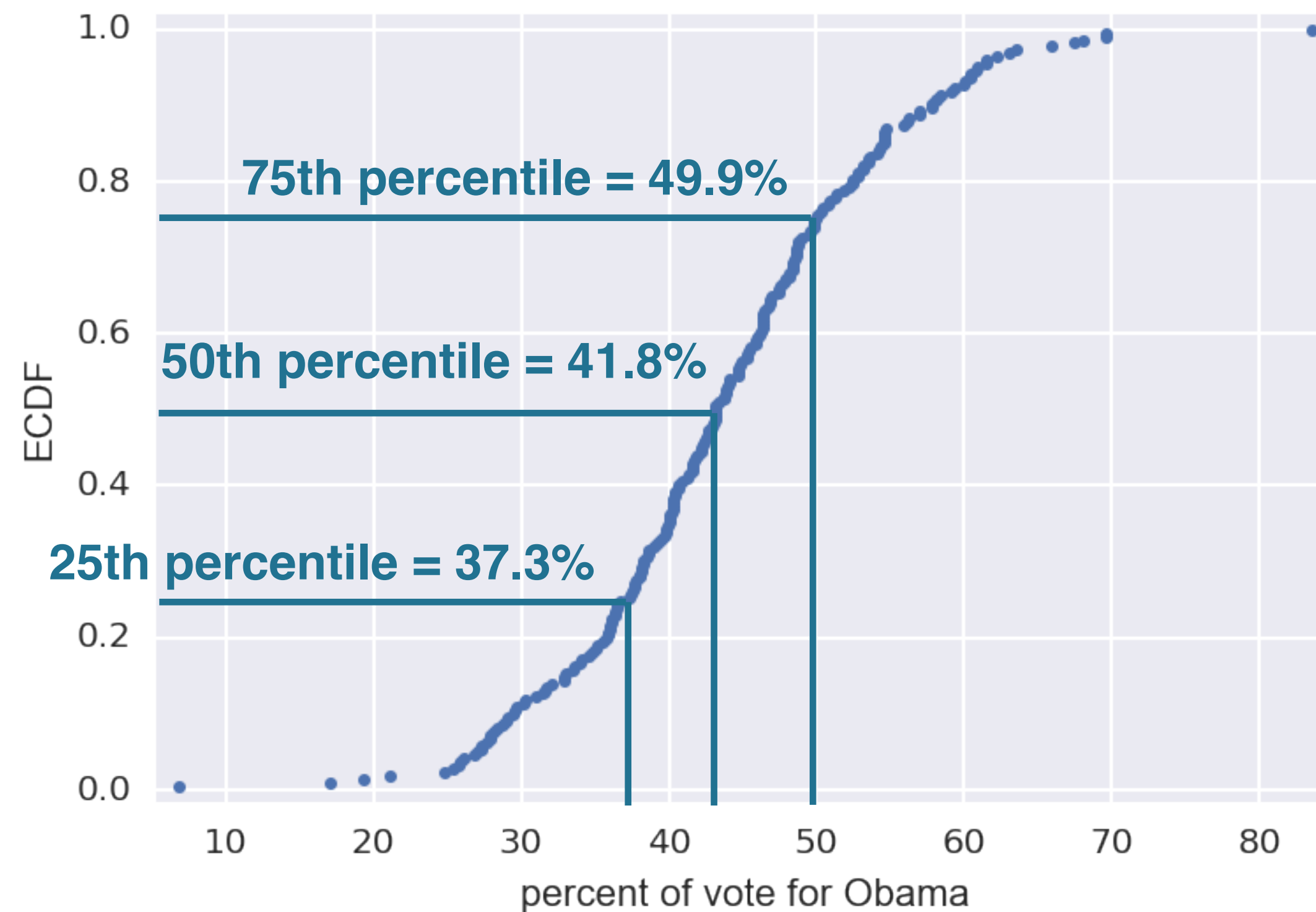


STATISTICAL THINKING IN PYTHON I

Percentiles, outliers, and box plots



Percentiles on an ECDF



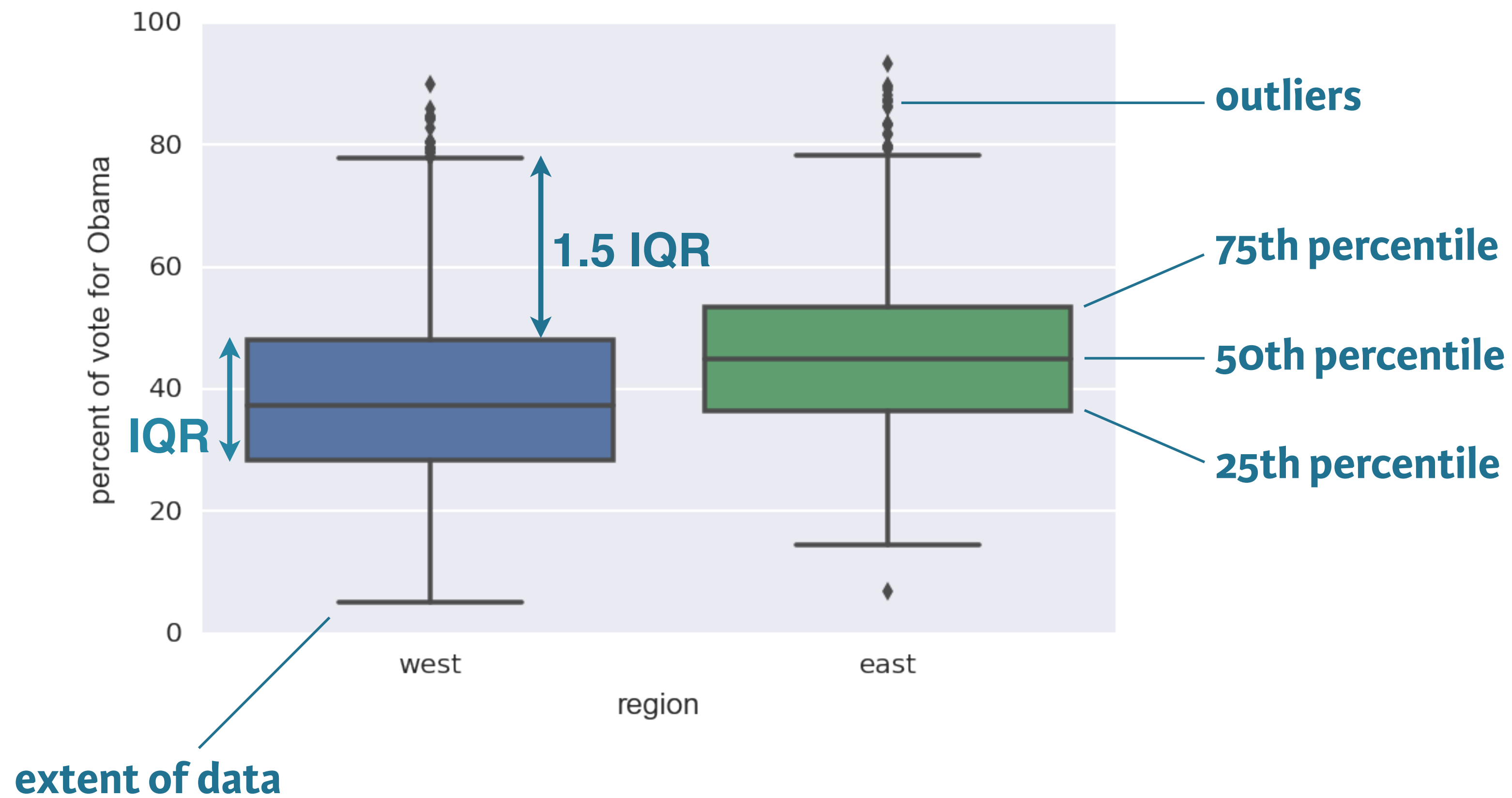


Computing percentiles

```
In [1]: np.percentile(df_swing['dem_share'], [25, 50, 75])  
Out[1]: array([ 37.3025,  43.185 ,  49.925 ])
```



2008 US election box plot





Generating a box plot

```
In [1]: import matplotlib.pyplot as plt
```

```
In [2]: import seaborn as sns
```

```
In [3]: _ = sns.boxplot(x='east_west', y='dem_share',  
....:                  data=df_all_states)
```

```
In [4]: _ = plt.xlabel('region')
```

```
In [5]: _ = plt.ylabel('percent of vote for Obama')
```

```
In [6]: plt.show()
```




STATISTICAL THINKING IN PYTHON I

Let's practice!

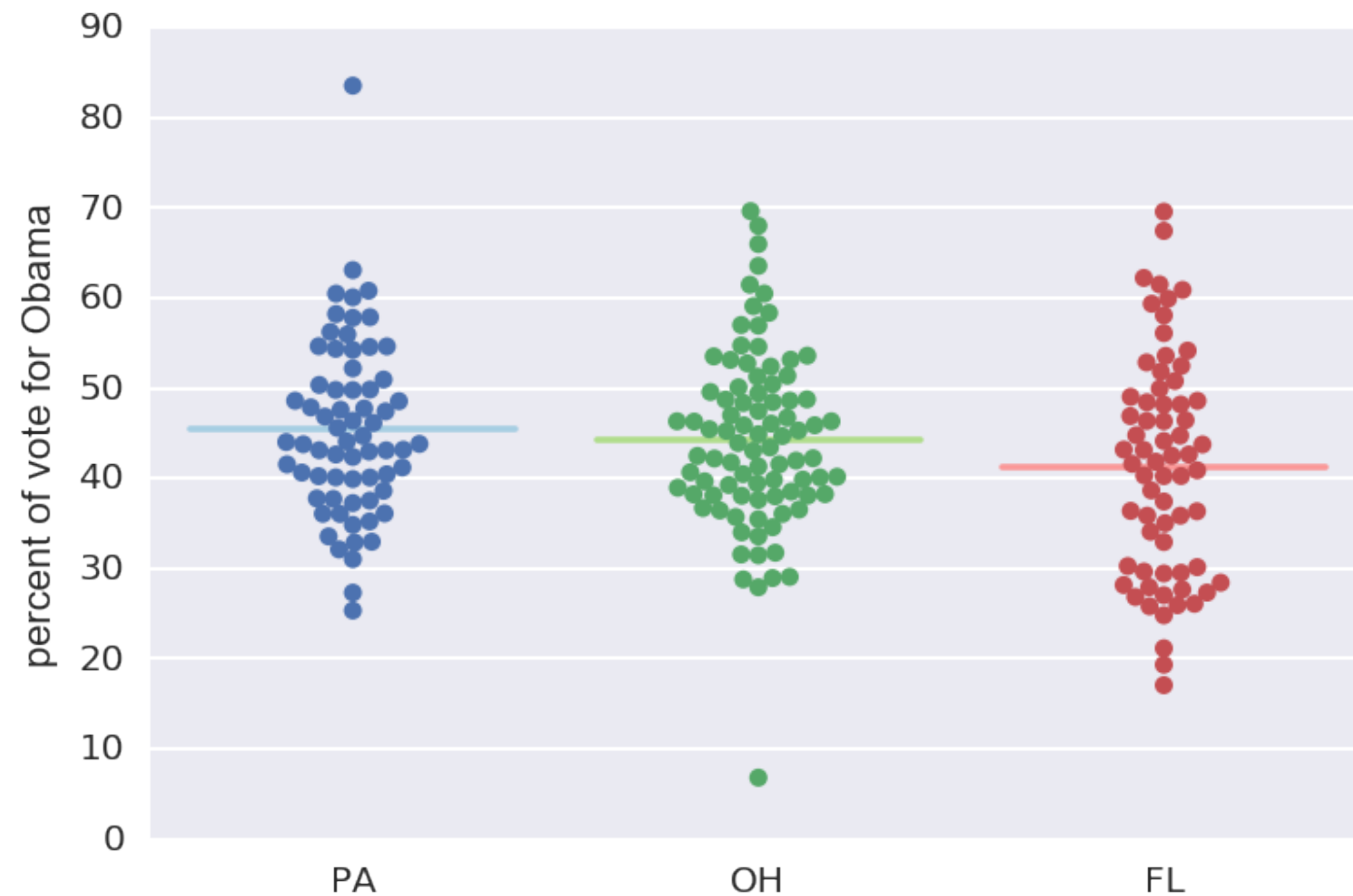


STATISTICAL THINKING IN PYTHON I

Variance and standard deviation



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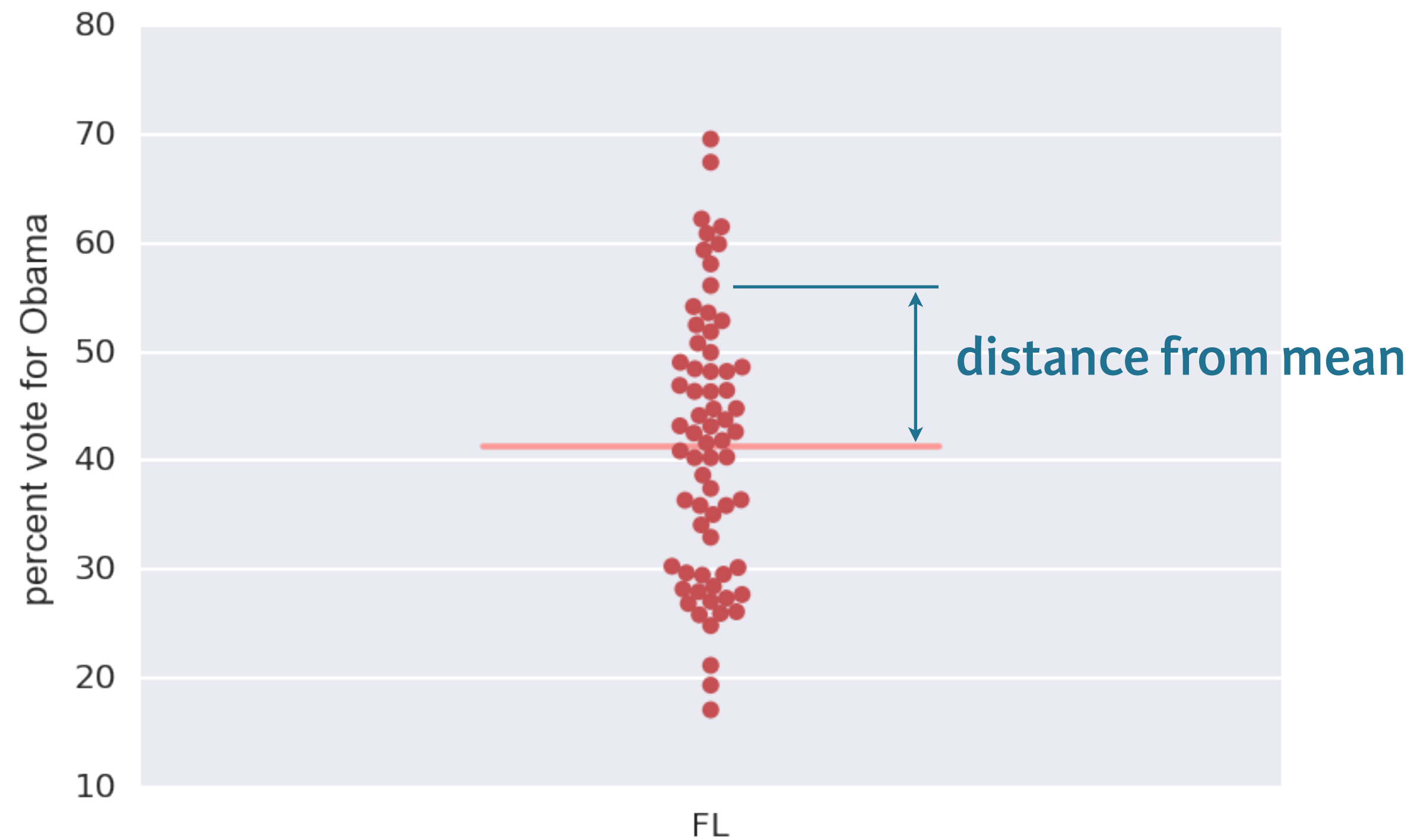


Variance

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

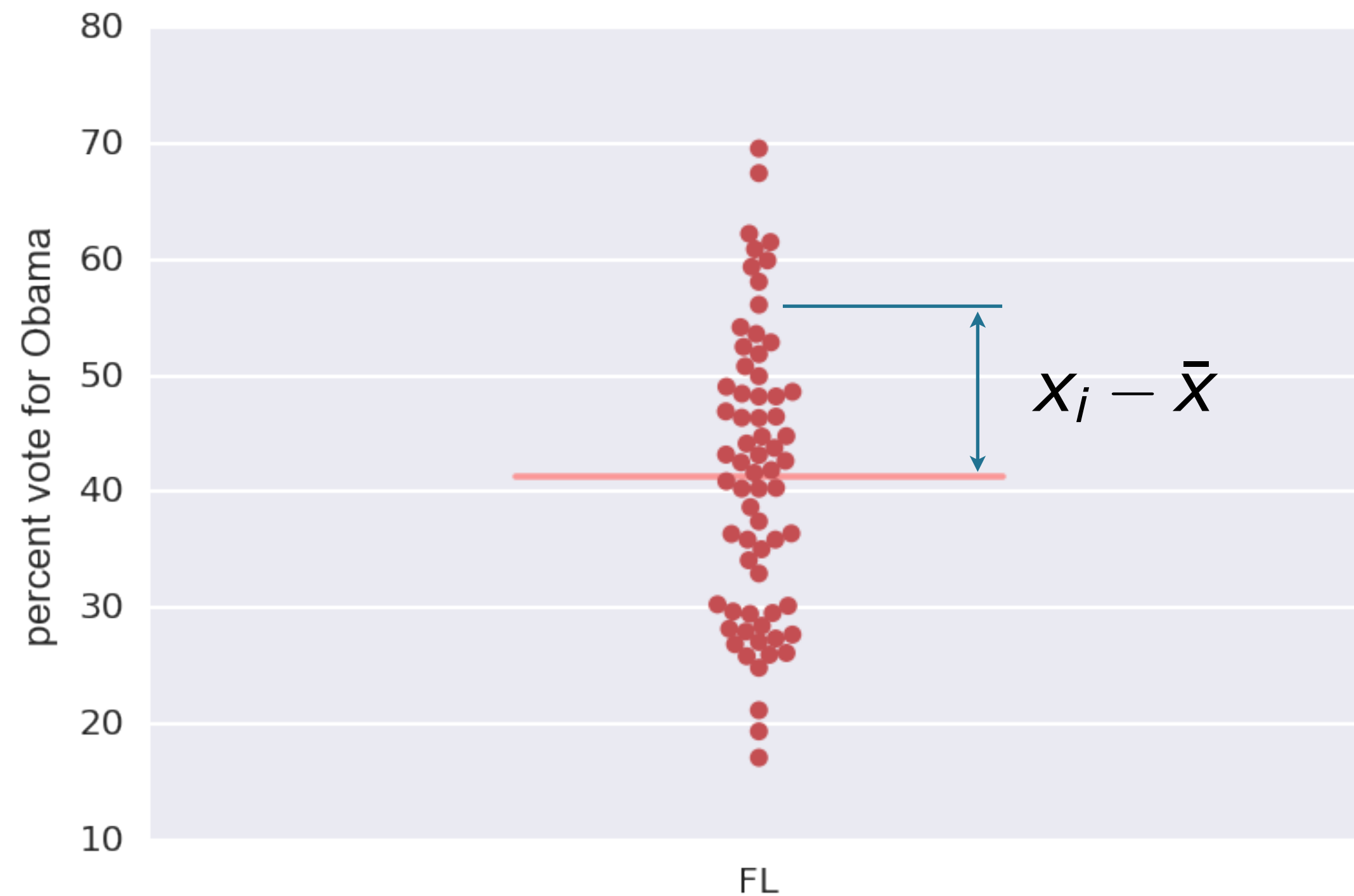


2008 Florida election results





2008 Florida election results



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

Computing the variance

```
In [1]: np.var(dem_share_FL)
Out[1]: 147.44278618846064
```

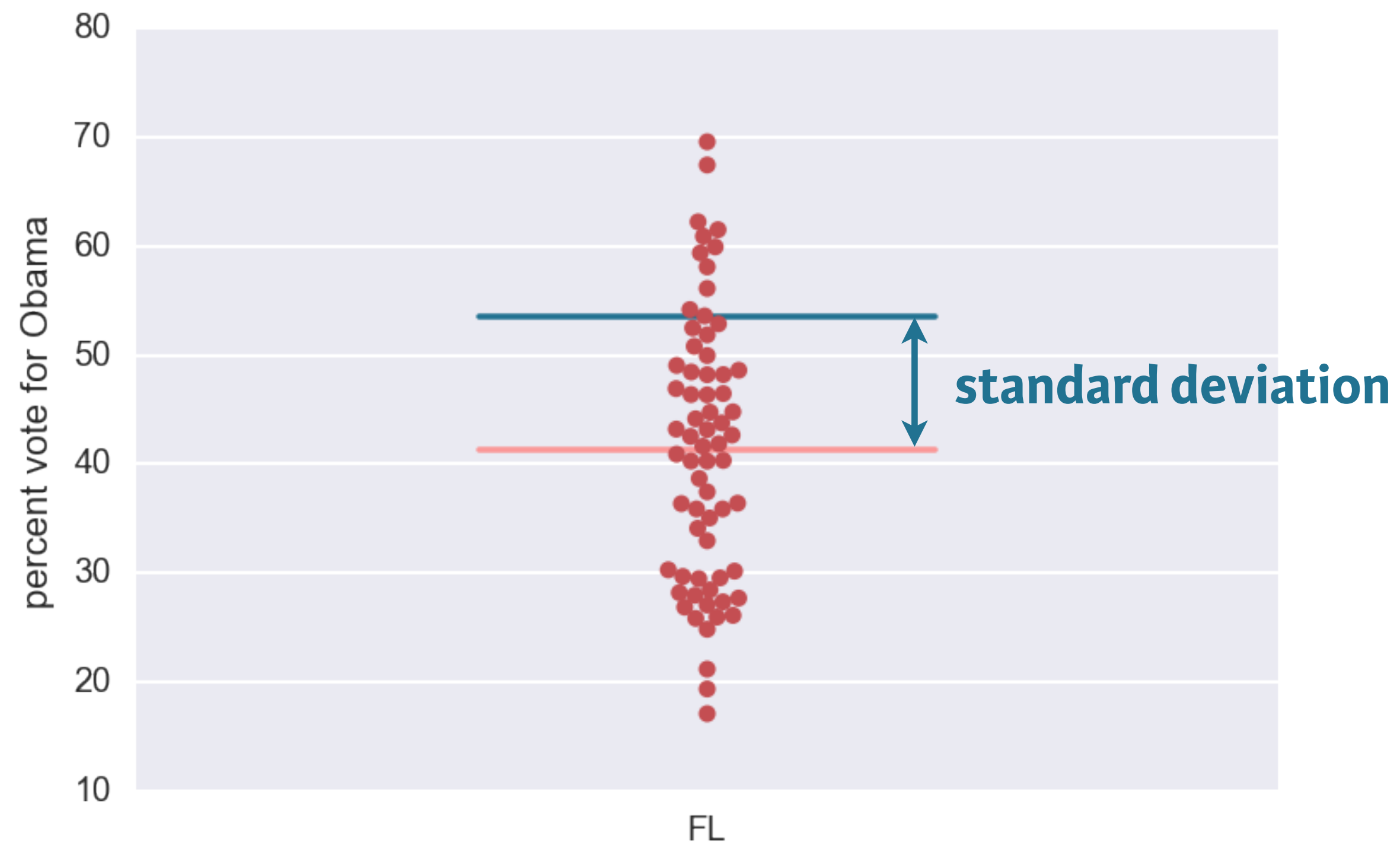
Computing the standard deviation

```
In [1]: np.std(dem_share_FL)
Out[1]: 12.142602117687158
```

```
In [2]: np.sqrt(np.var(dem_share_FL))
Out[2]: 12.142602117687158
```




2008 Florida election results





STATISTICAL THINKING IN PYTHON I

Let's practice!

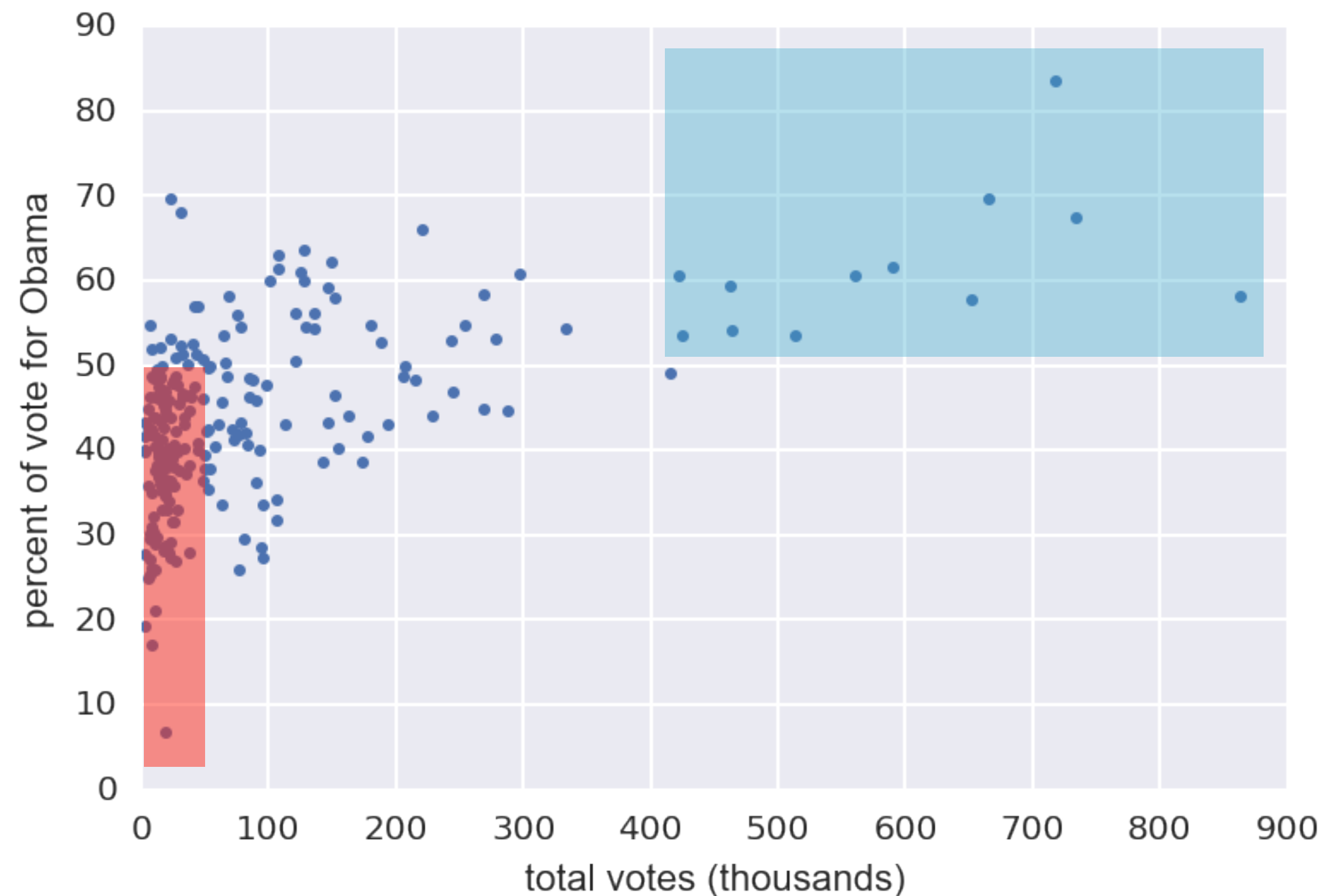


STATISTICAL THINKING IN PYTHON I

Covariance and the Pearson correlation coefficient



2008 US swing state election results





Generating a scatter plot

```
In [1]: _ = plt.plot(total_votes/1000, dem_share,  
....:                 marker='.', linestyle='none')  
  
In [2]: _ = plt.xlabel('total votes (thousands)')  
  
In [3]: _ = plt.ylabel('percent of vote for Obama')
```

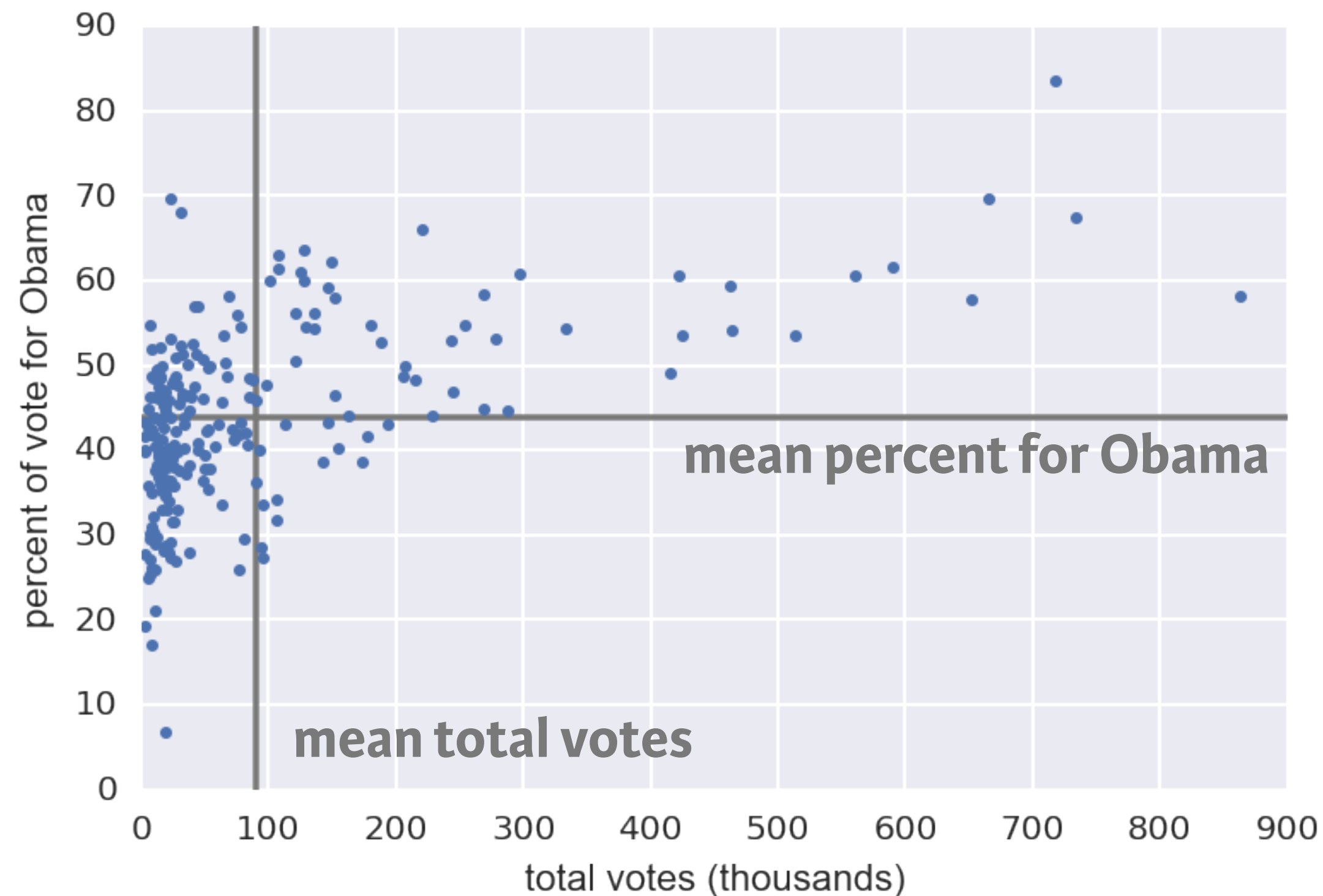


Covariance

- A measure of how two quantities vary *together*

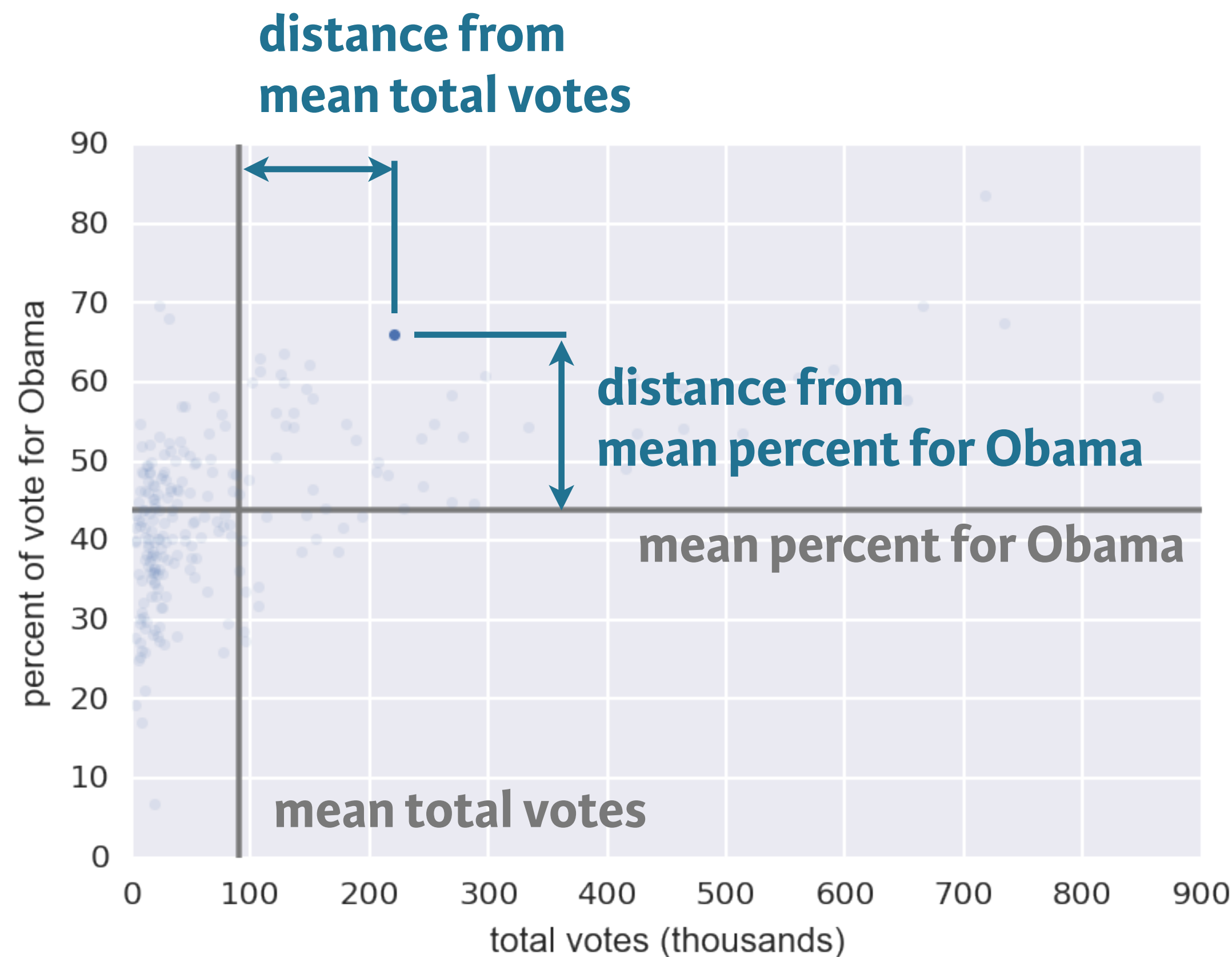


Calculation of the covariance





Calculation of the covariance



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



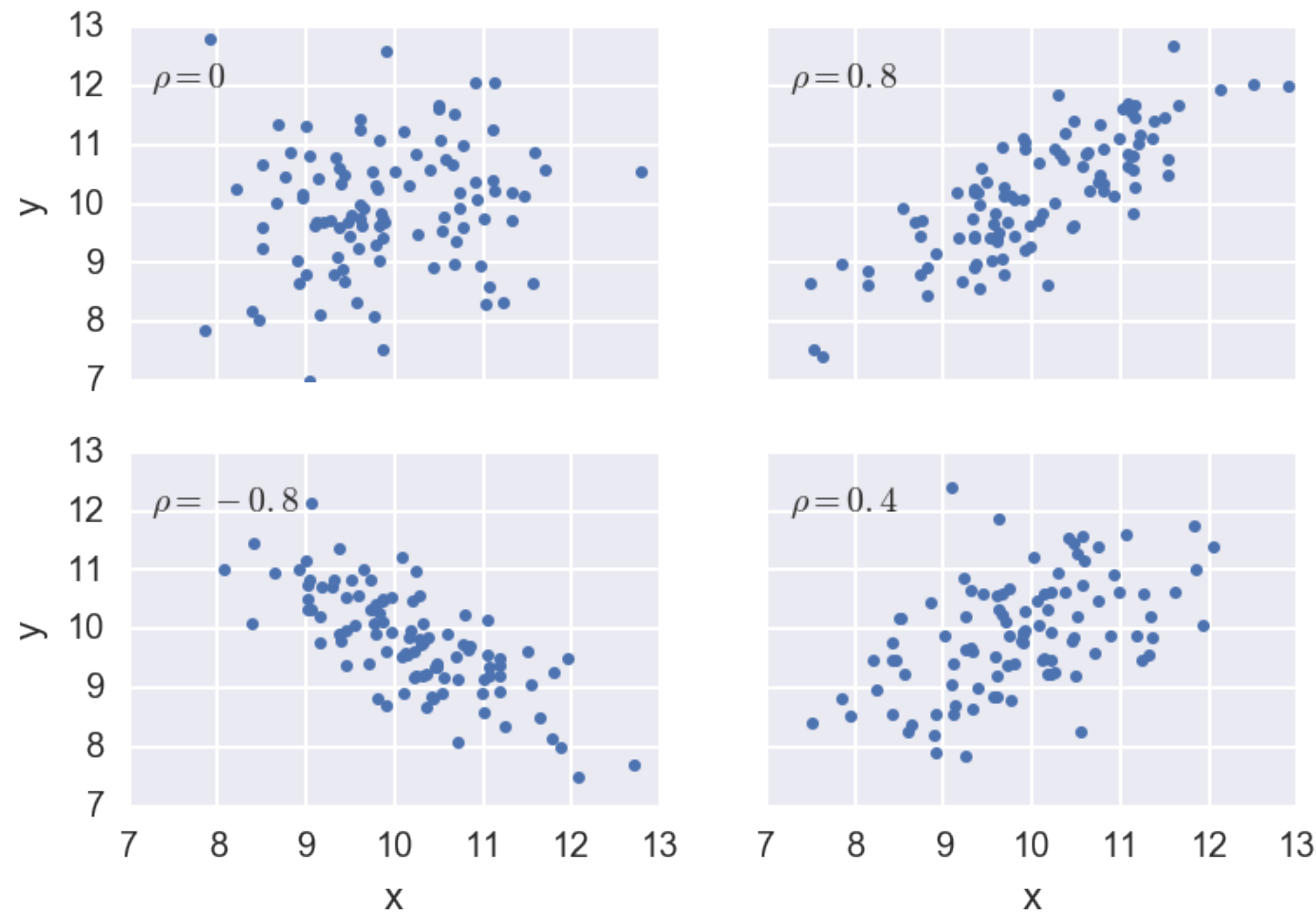
Pearson correlation coefficient

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

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



Pearson correlation coefficient examples





STATISTICAL THINKING IN PYTHON I

Let's practice!