



STATISTICAL THINKING IN PYTHON II

**Welcome
to the course!**

You will be able to...

- Estimate parameters
- Compute confidence intervals
- Perform linear regressions
- Test hypotheses

with real data!

Caltech

We use hacker statistics

- Literally simulate probability
- Broadly applicable with a few principles

Statistical analysis of the beak of the finch



Geospiza fortis



Geospiza scandens



STATISTICAL THINKING IN PYTHON II

**Let's start
thinking statistically!**

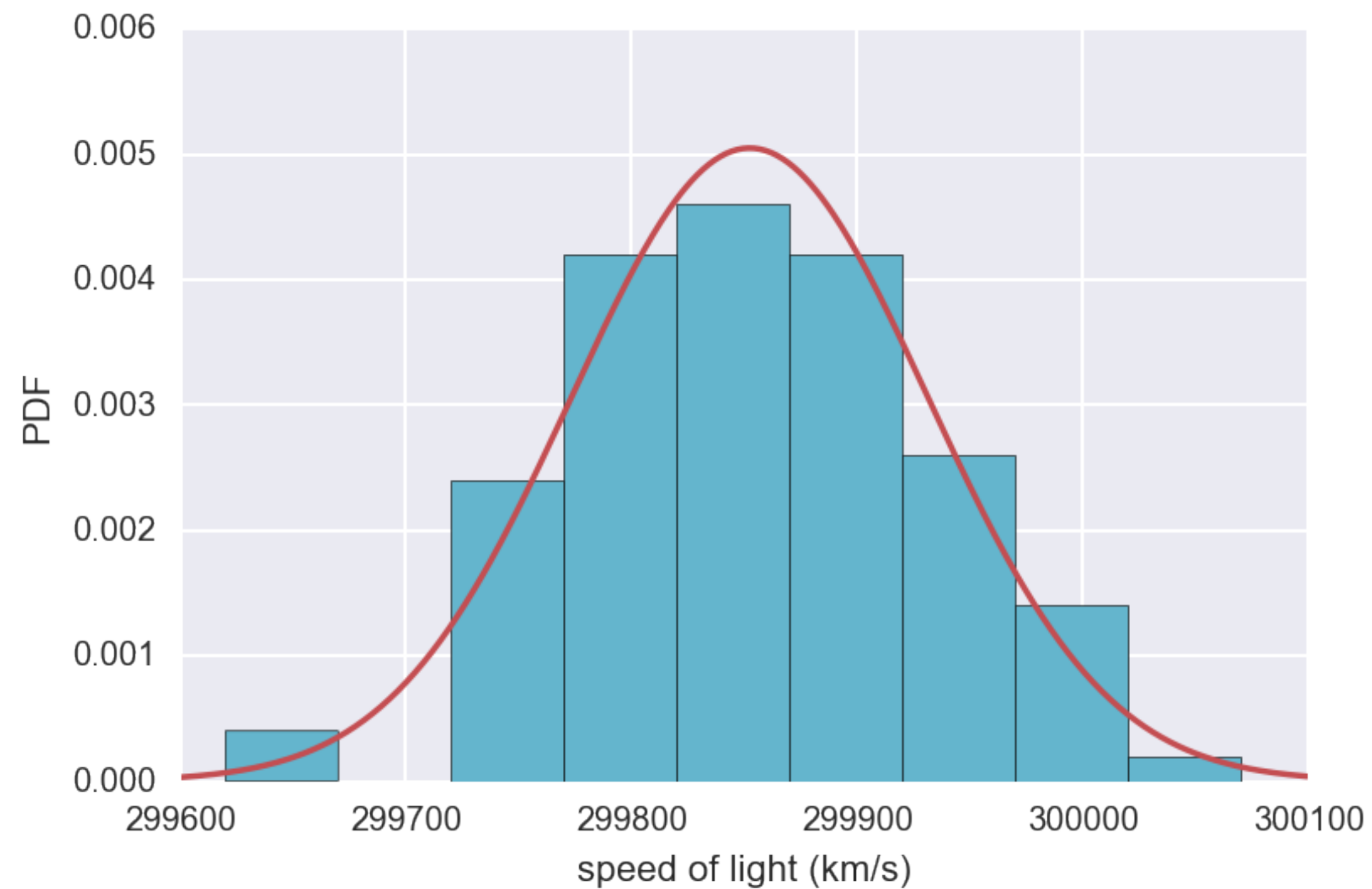


STATISTICAL THINKING IN PYTHON II

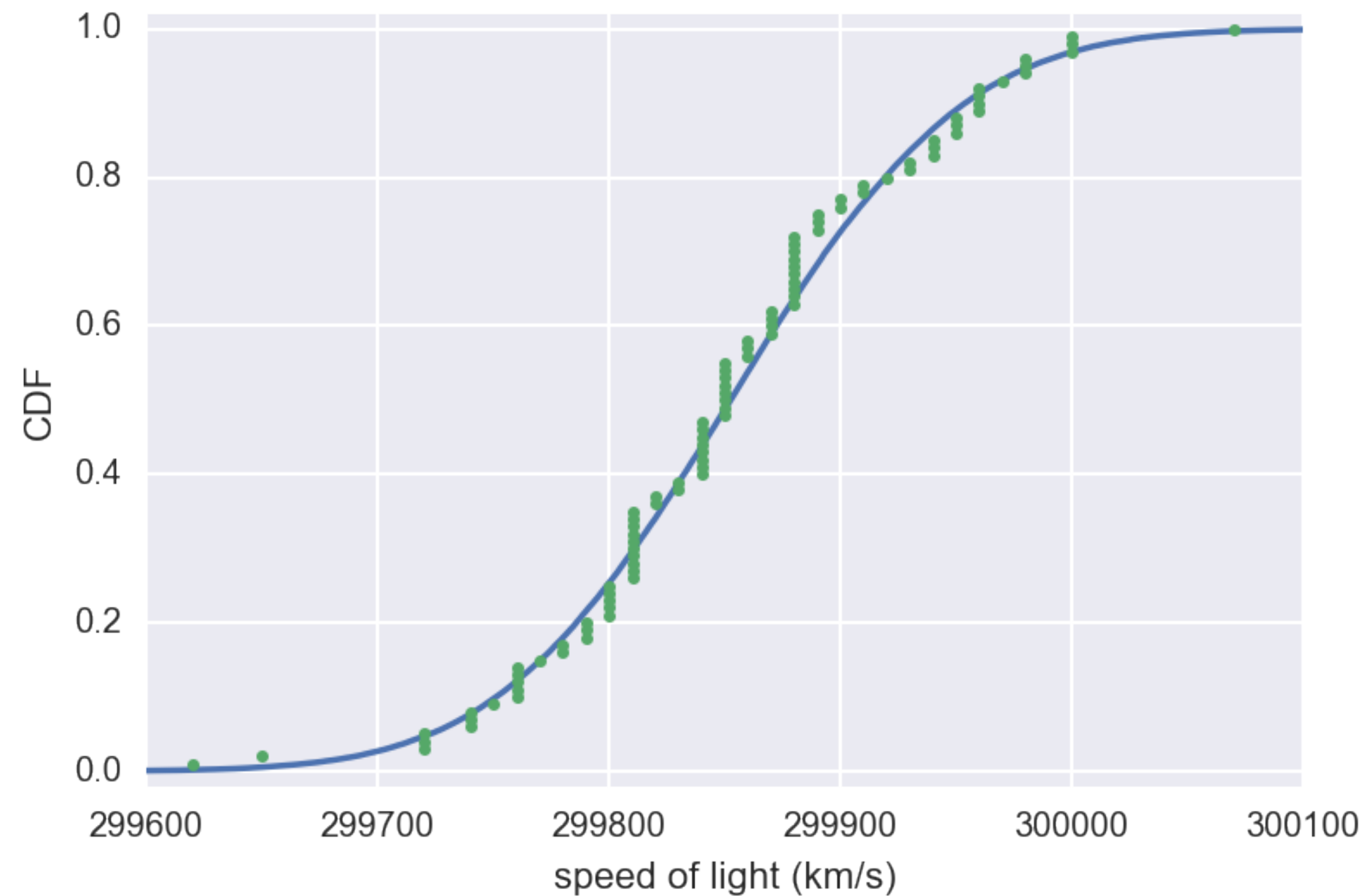
Optimal parameters



Histogram of Michelson's measurements



CDF of Michelson's measurements





Checking Normality of Michelson data

```
In [1]: import numpy as np

In [2]: import matplotlib.pyplot as plt

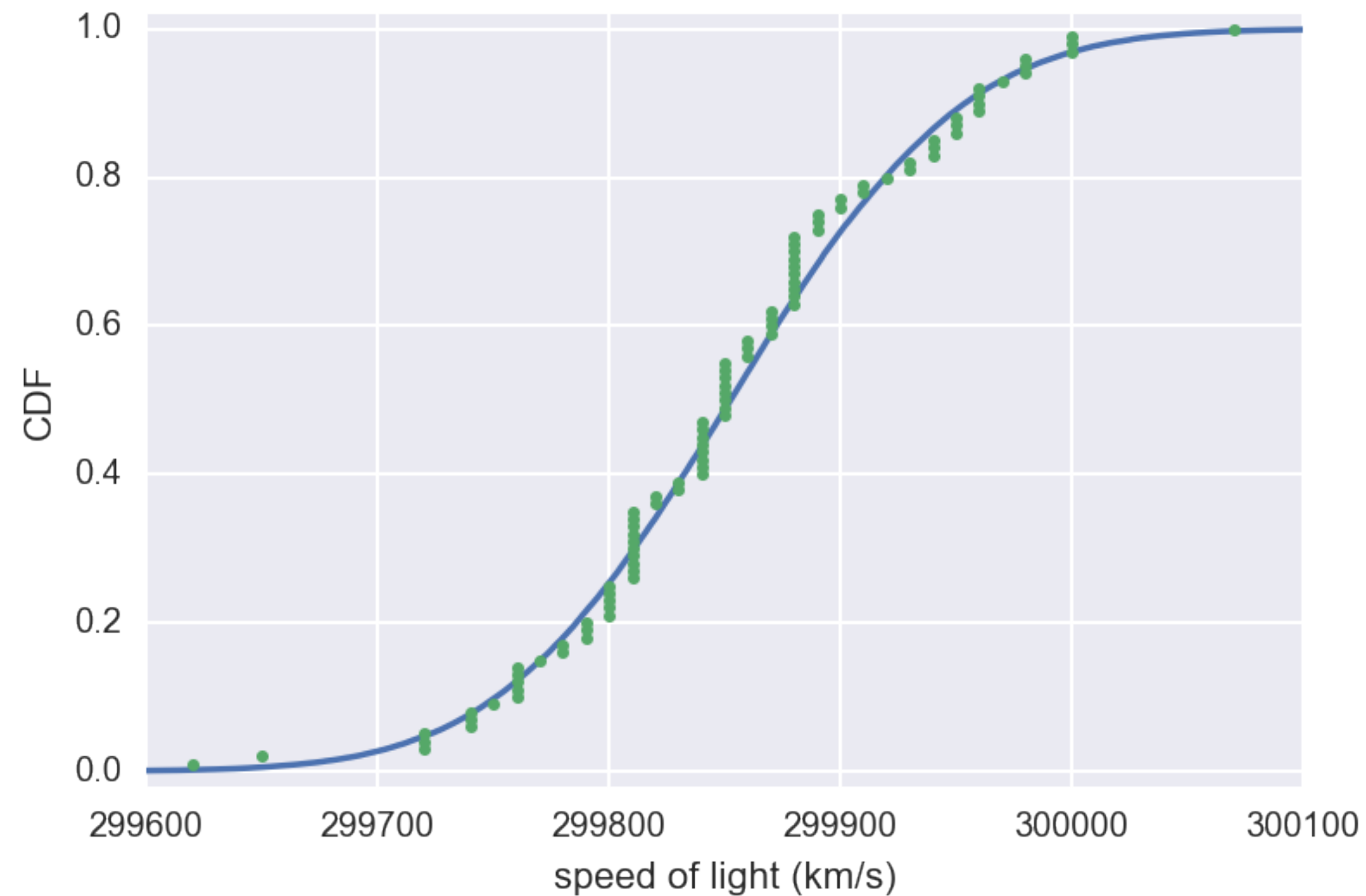
In [3]: mean = np.mean(michelson_speed_of_light)

In [4]: std = np.std(michelson_speed_of_light)

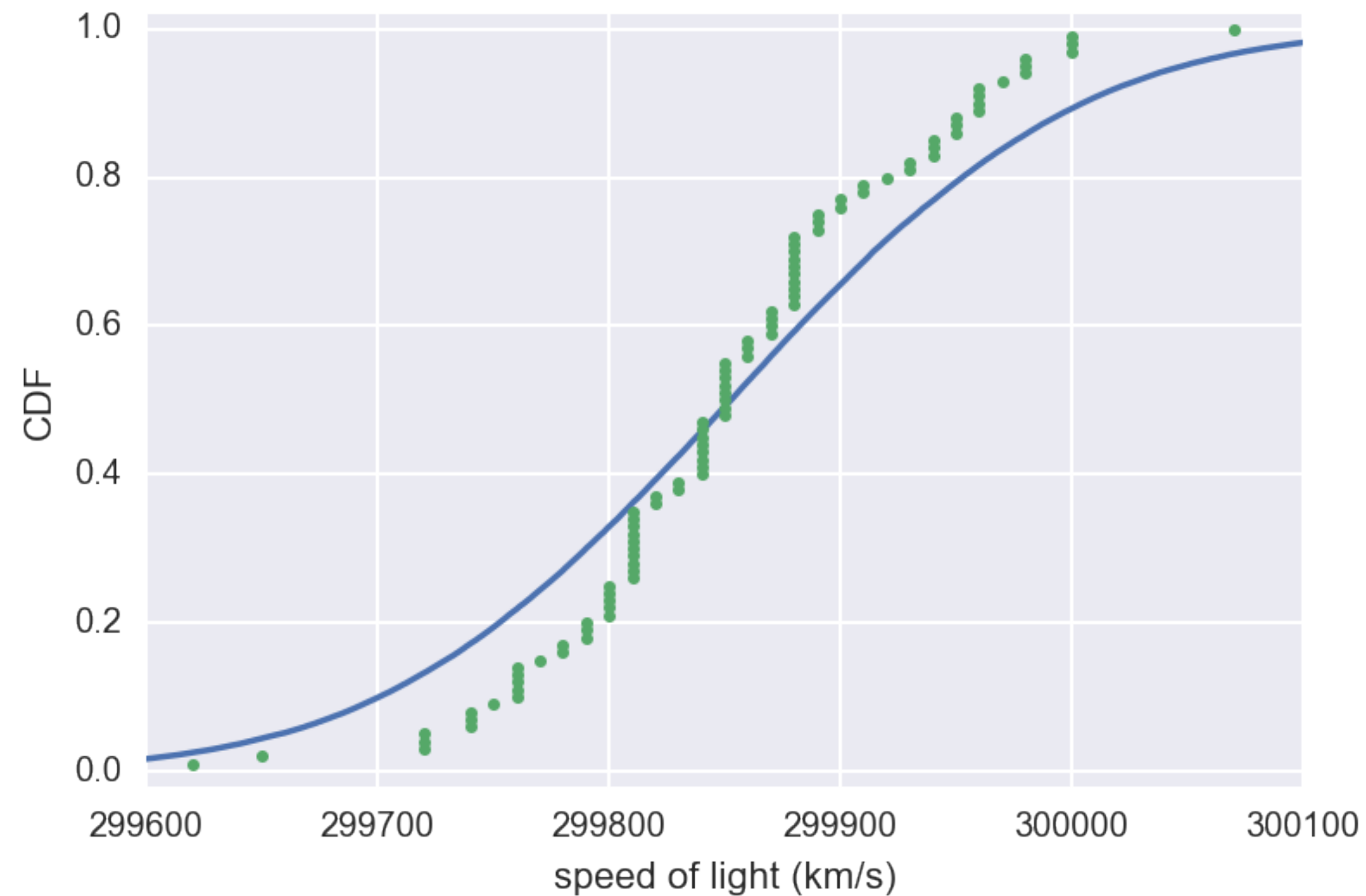
In [5]: samples = np.random.normal(mean, std, size=10000)
```



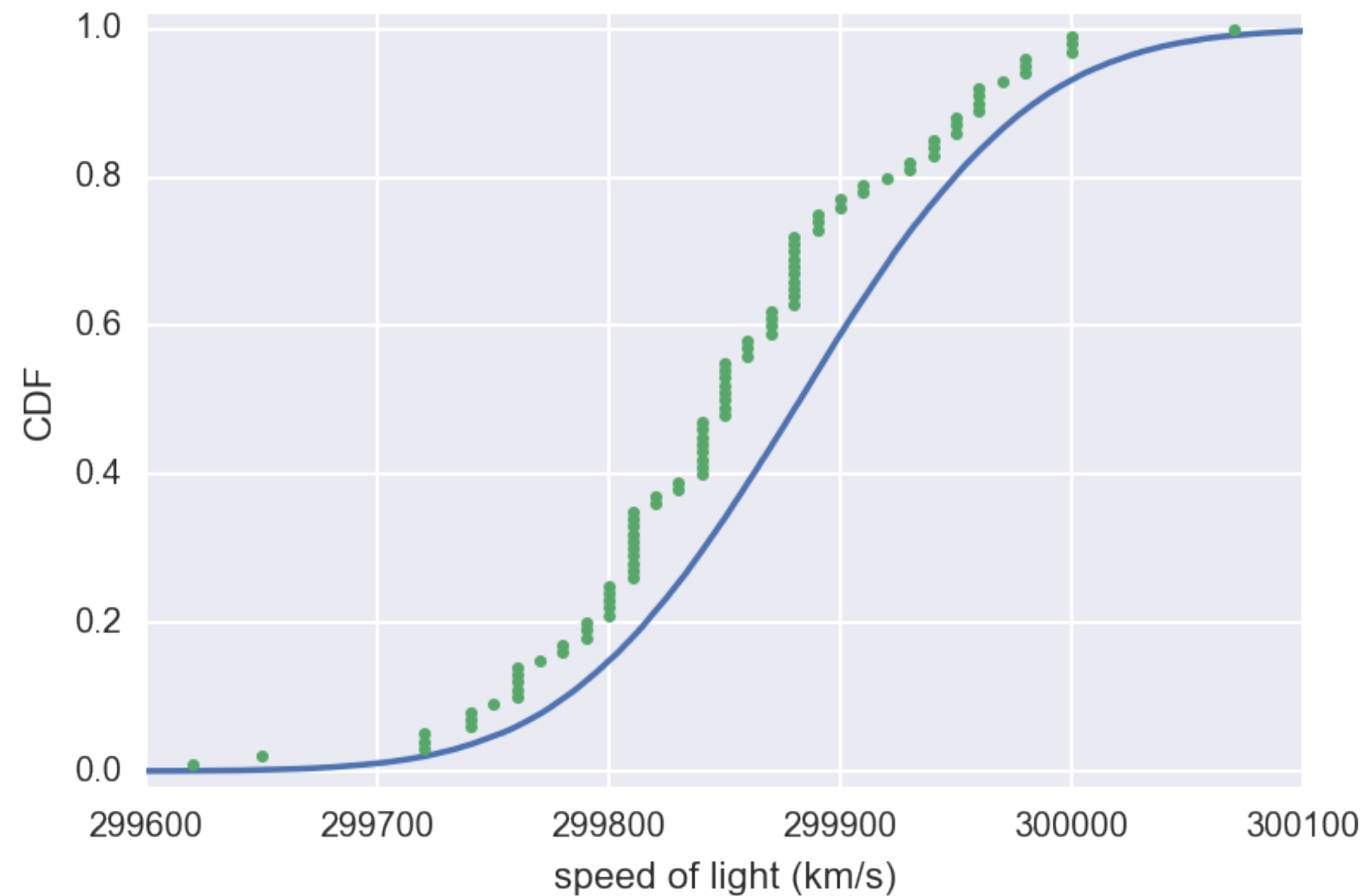
CDF of Michelson's measurements



CDF with bad estimate of st. dev.



CDF with bad estimate of mean

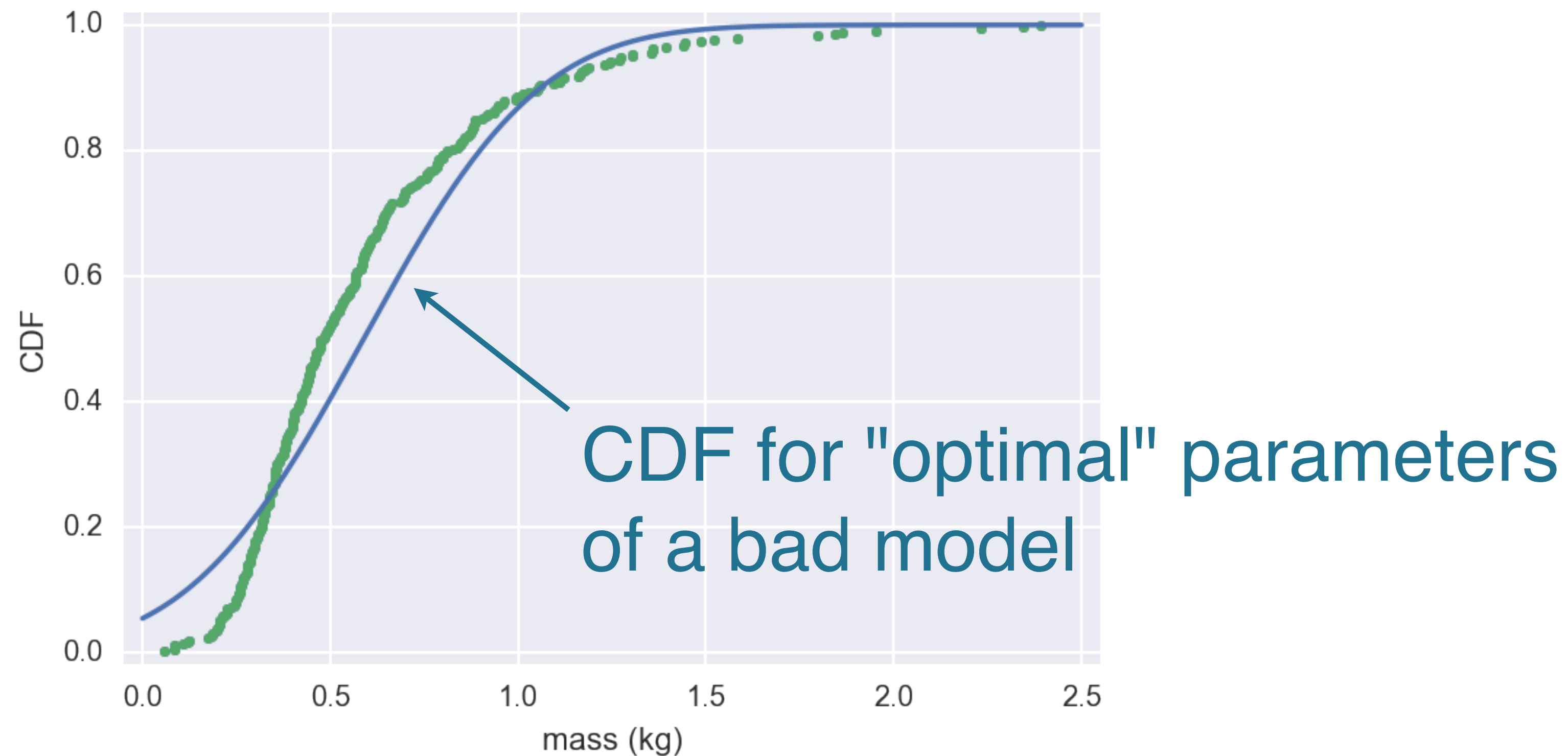


Optimal parameters

- Parameter values that bring the model in closest agreement with the data



Mass of MA large mouth bass





Packages to do statistical inference



`scipy.stats`



`statsmodels`



`hacker stats`
`with numpy`



STATISTICAL THINKING IN PYTHON II

Let's practice!

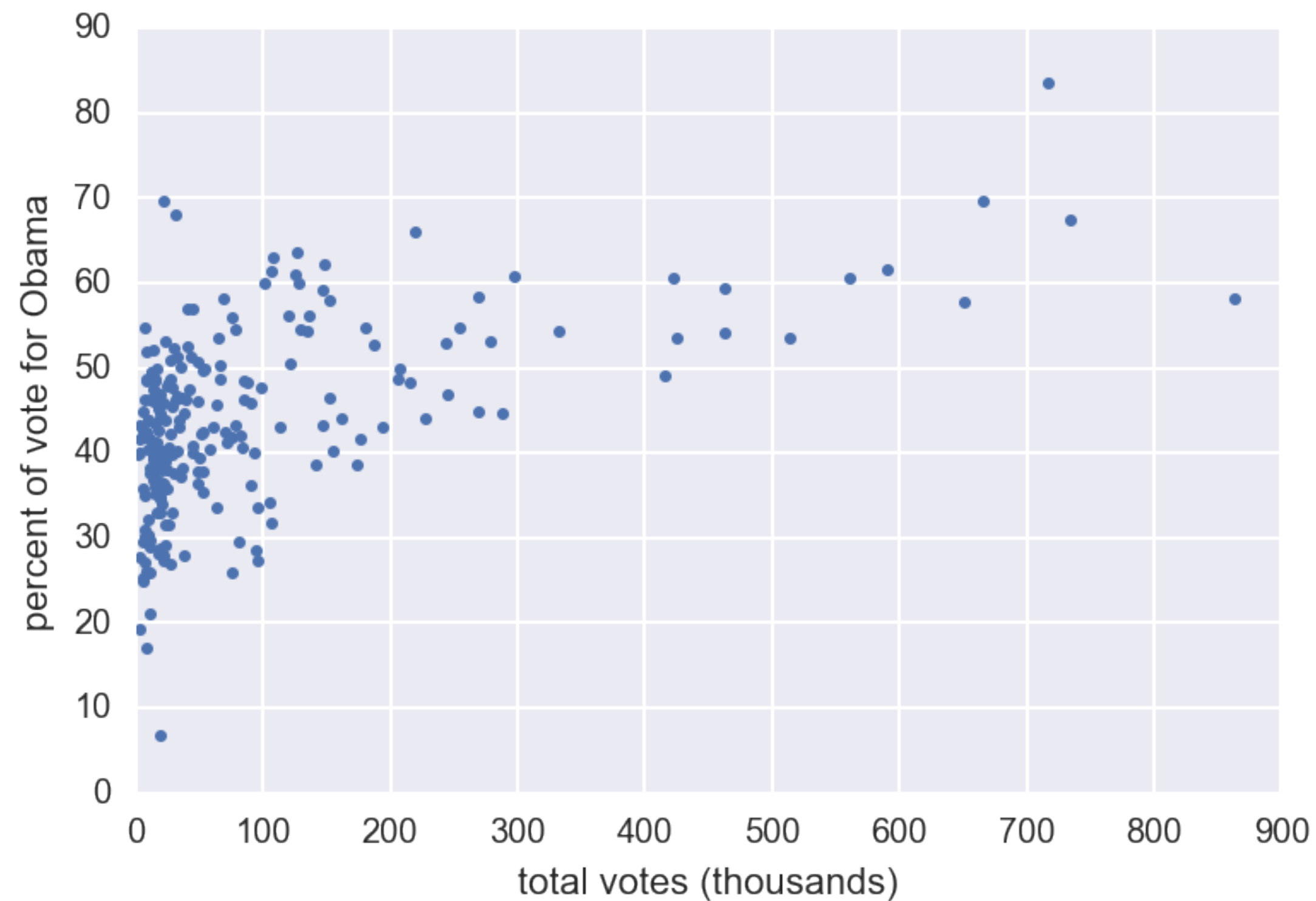


STATISTICAL THINKING IN PYTHON II

Linear regression by least squares



2008 US swing state election results



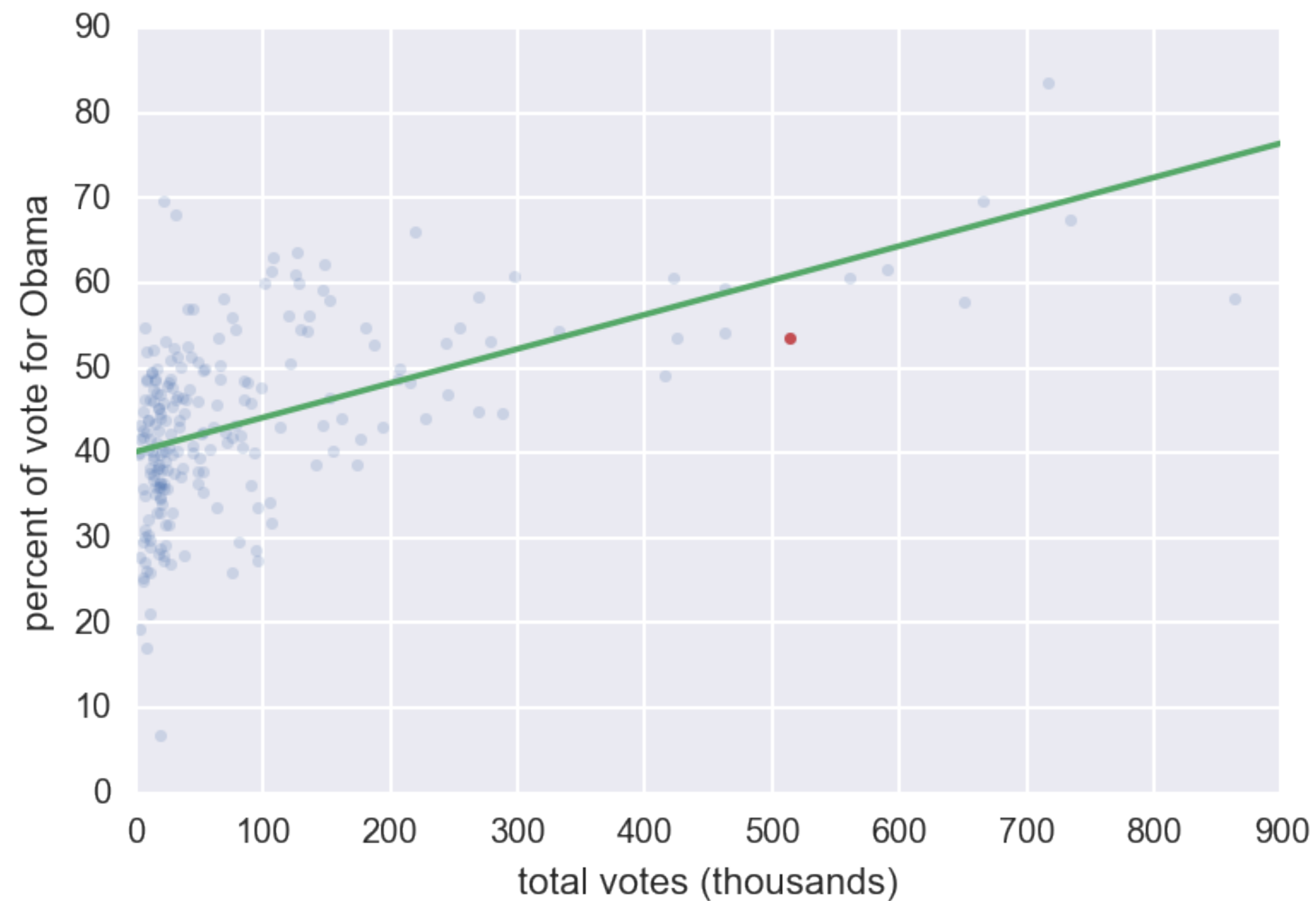


2008 US swing state election results



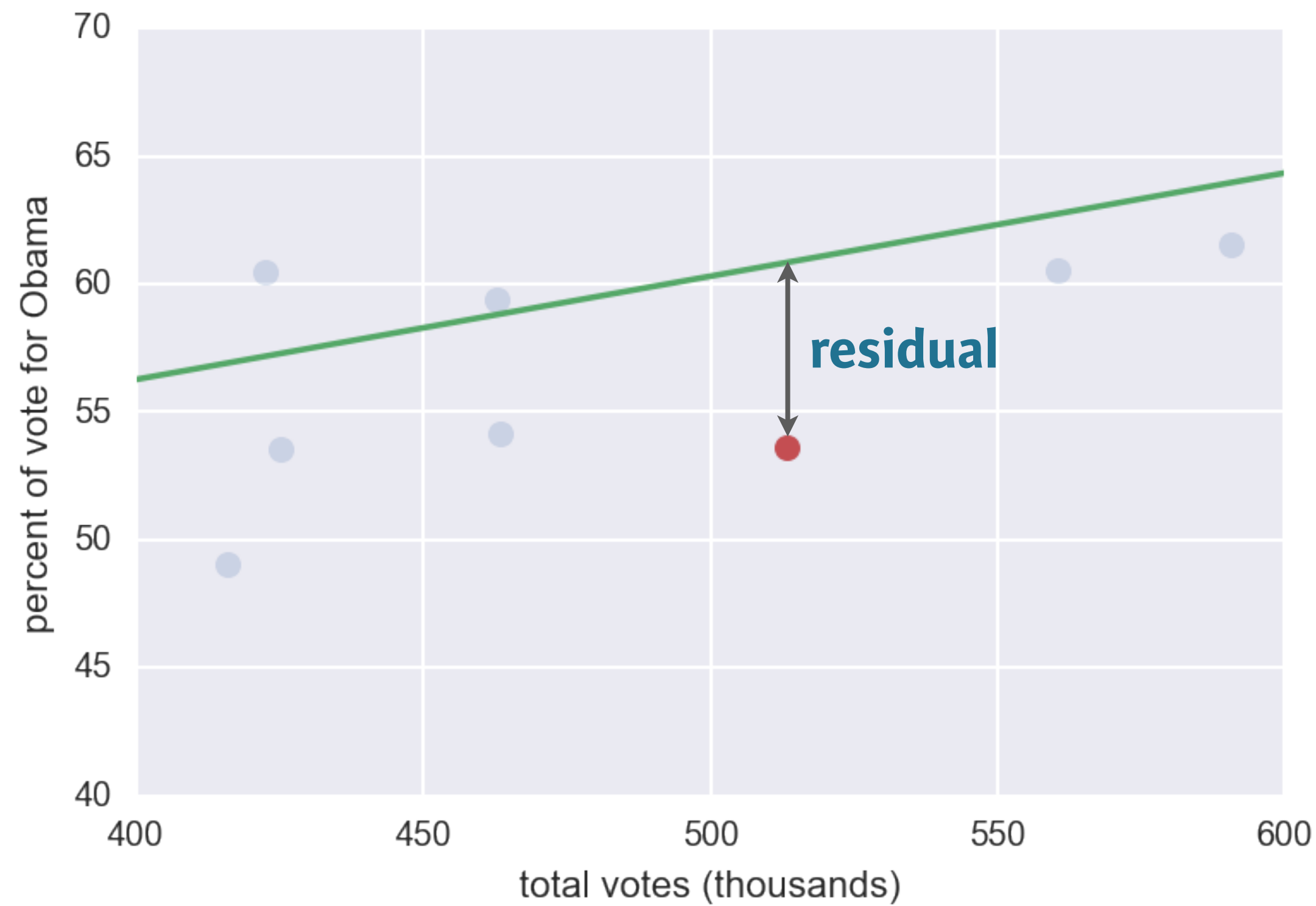


2008 US swing state election results





Residuals



Least squares

- The process of finding the parameters for which the sum of the squares of the residuals is minimal



Least squares with `np.polyfit()`

```
In [1]: slope, intercept = np.polyfit(total_votes,  
    ....:                             dem_share, 1)
```

```
In [2]: slope  
Out[2]: 4.0370717009465555e-05
```

```
In [3]: intercept  
Out[3]: 40.113911968641744
```



STATISTICAL THINKING IN PYTHON II

Let's practice!

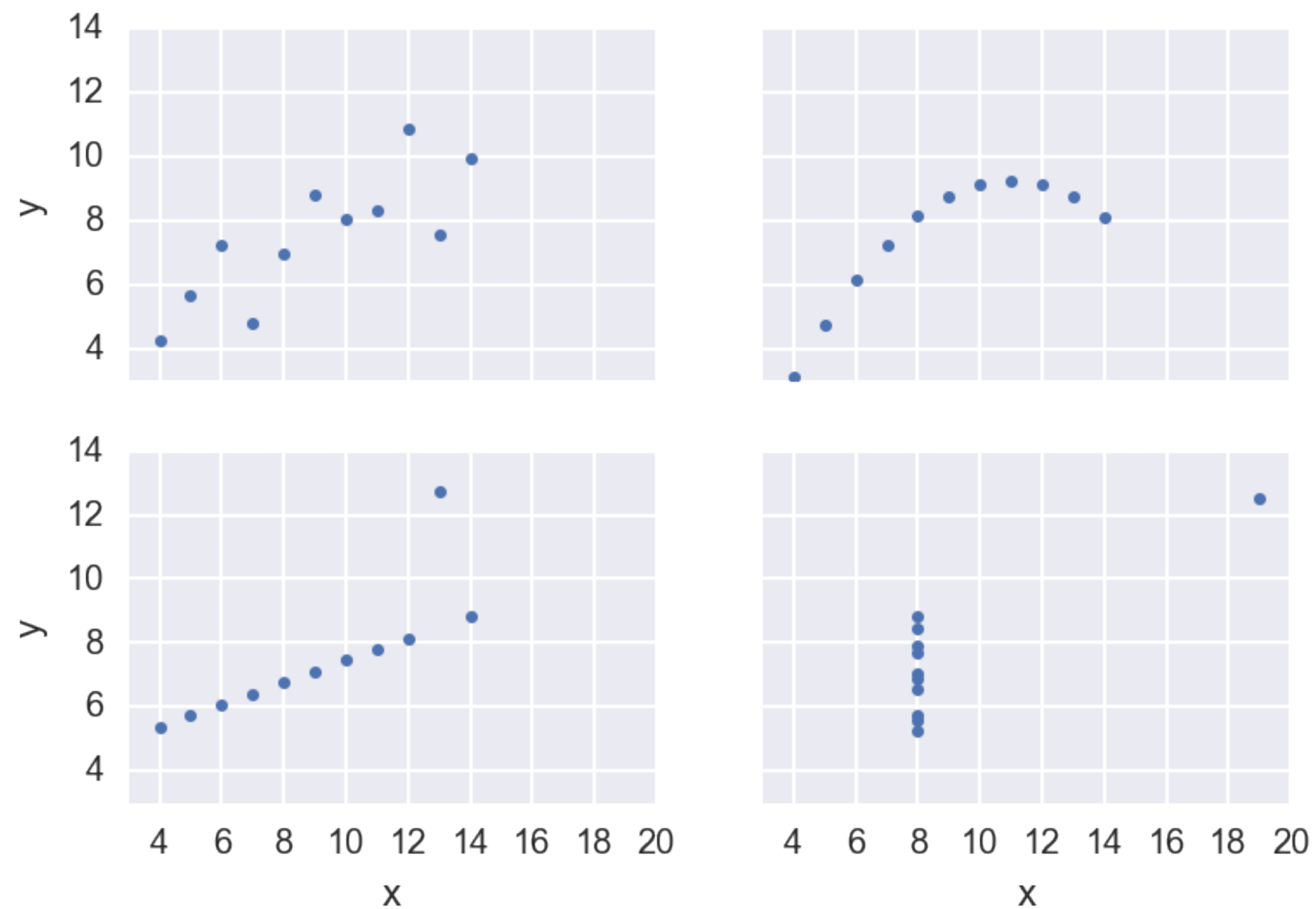


STATISTICAL THINKING IN PYTHON II

The importance of EDA: Anscombe's quartet

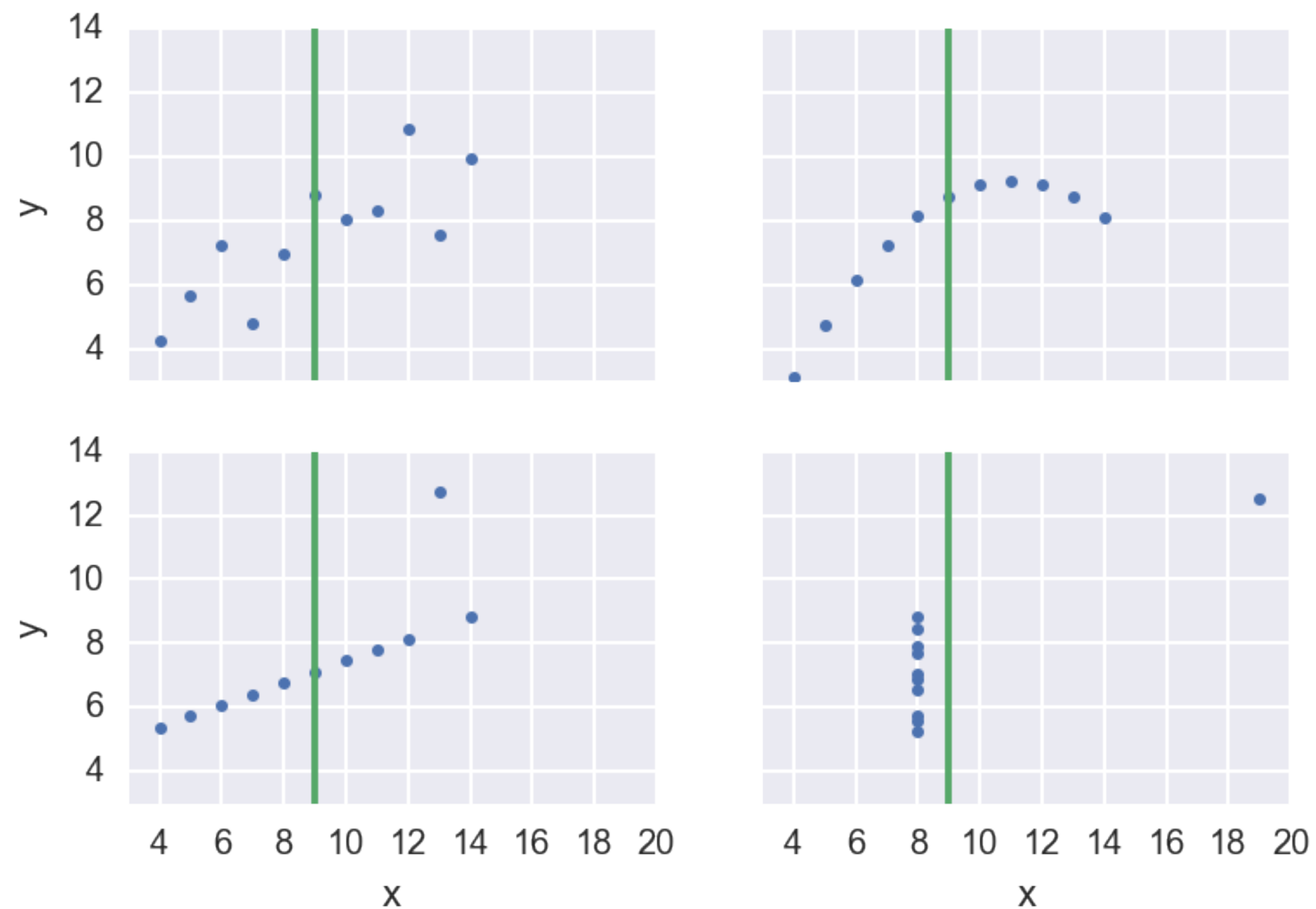


Anscombe's quartet



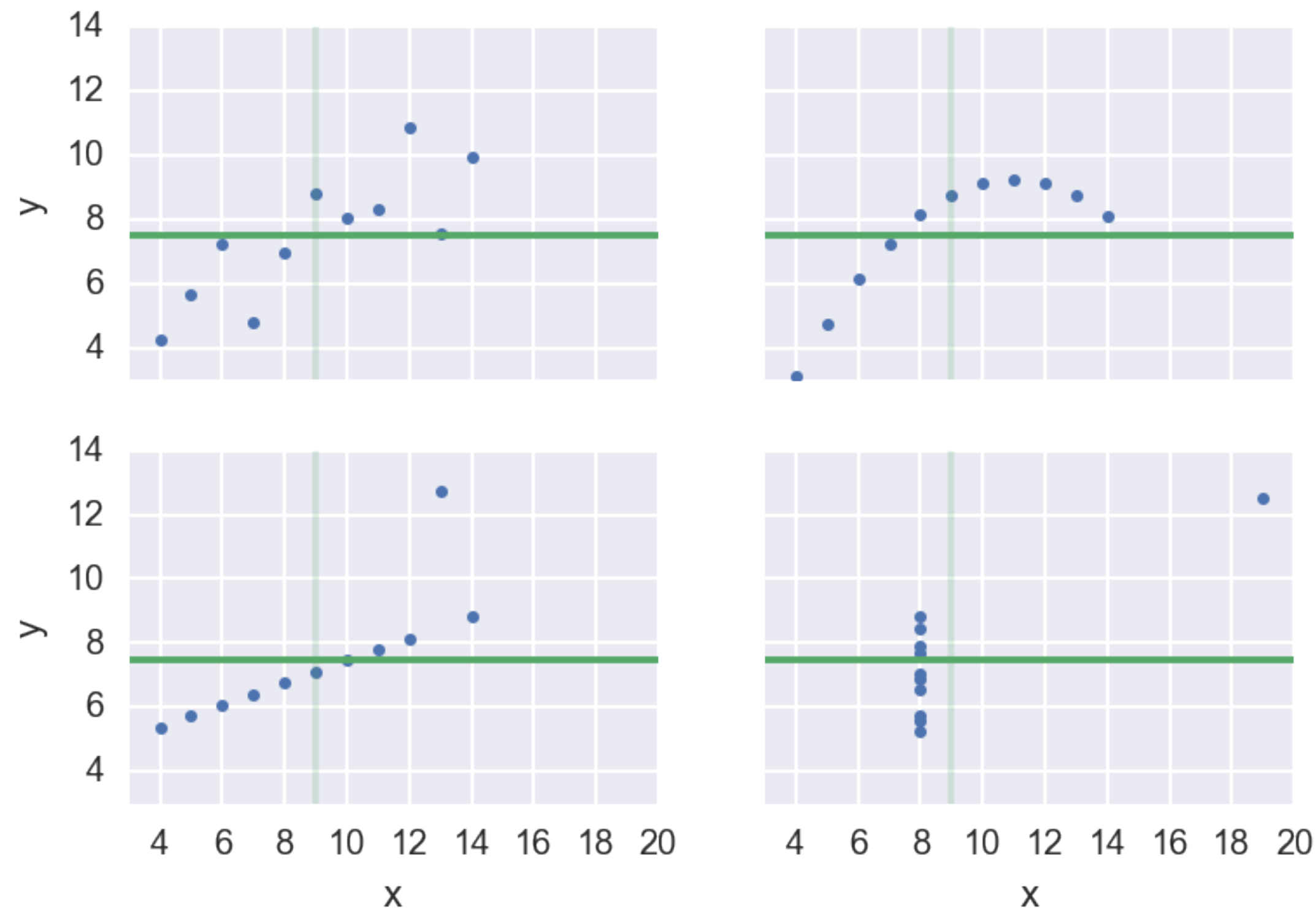


Anscombe's quartet



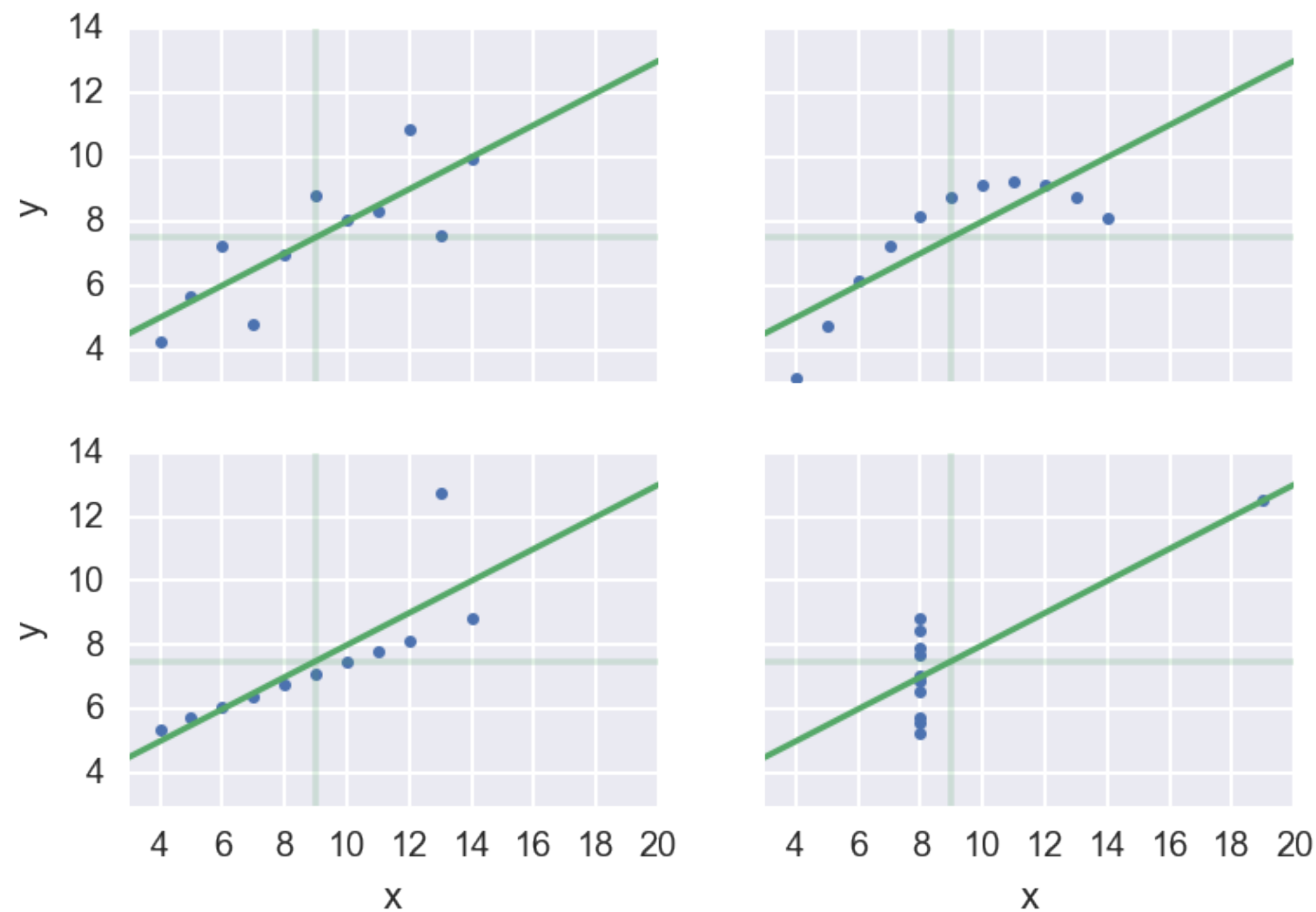


Anscombe's quartet



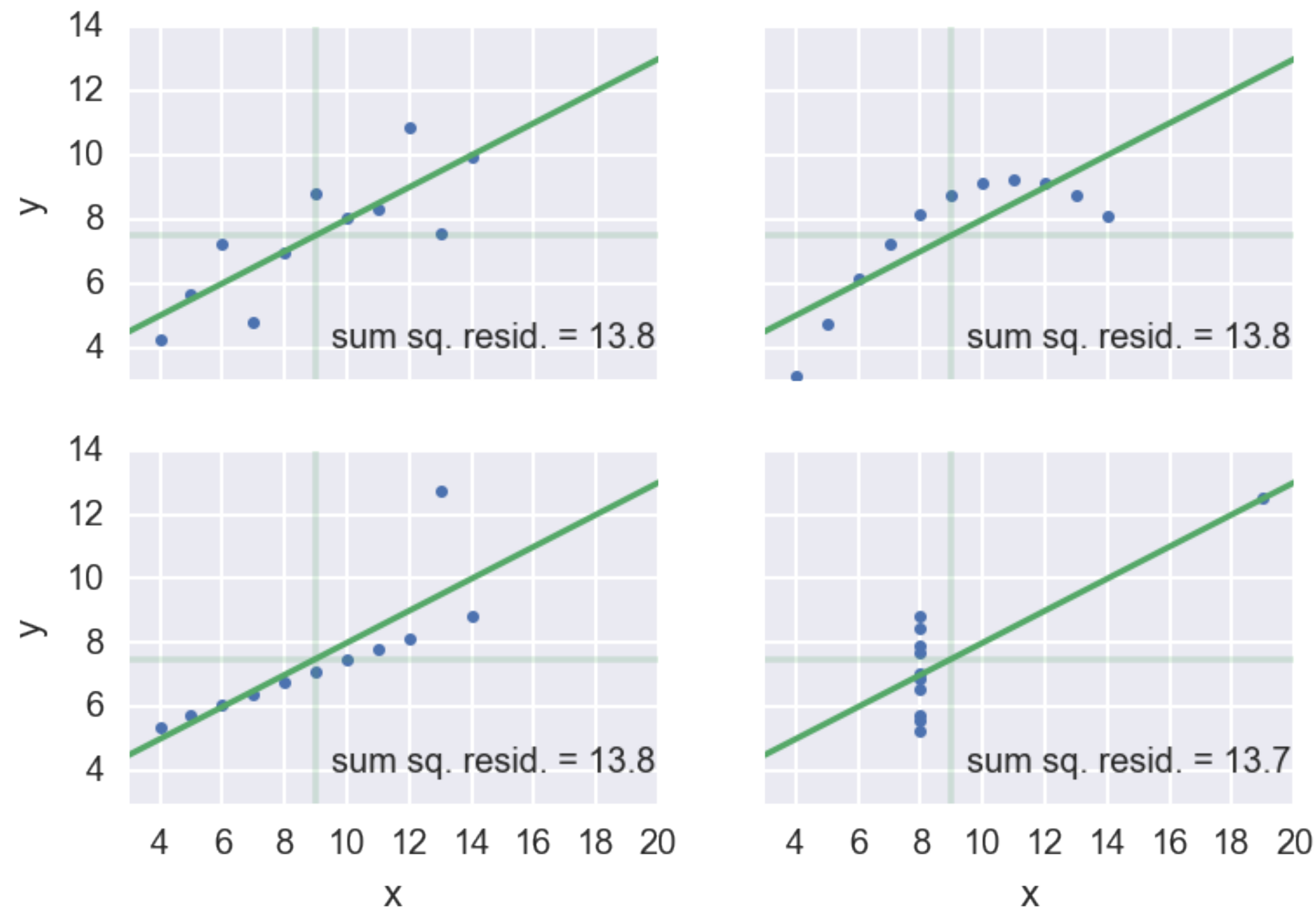


Anscombe's quartet





Anscombe's quartet

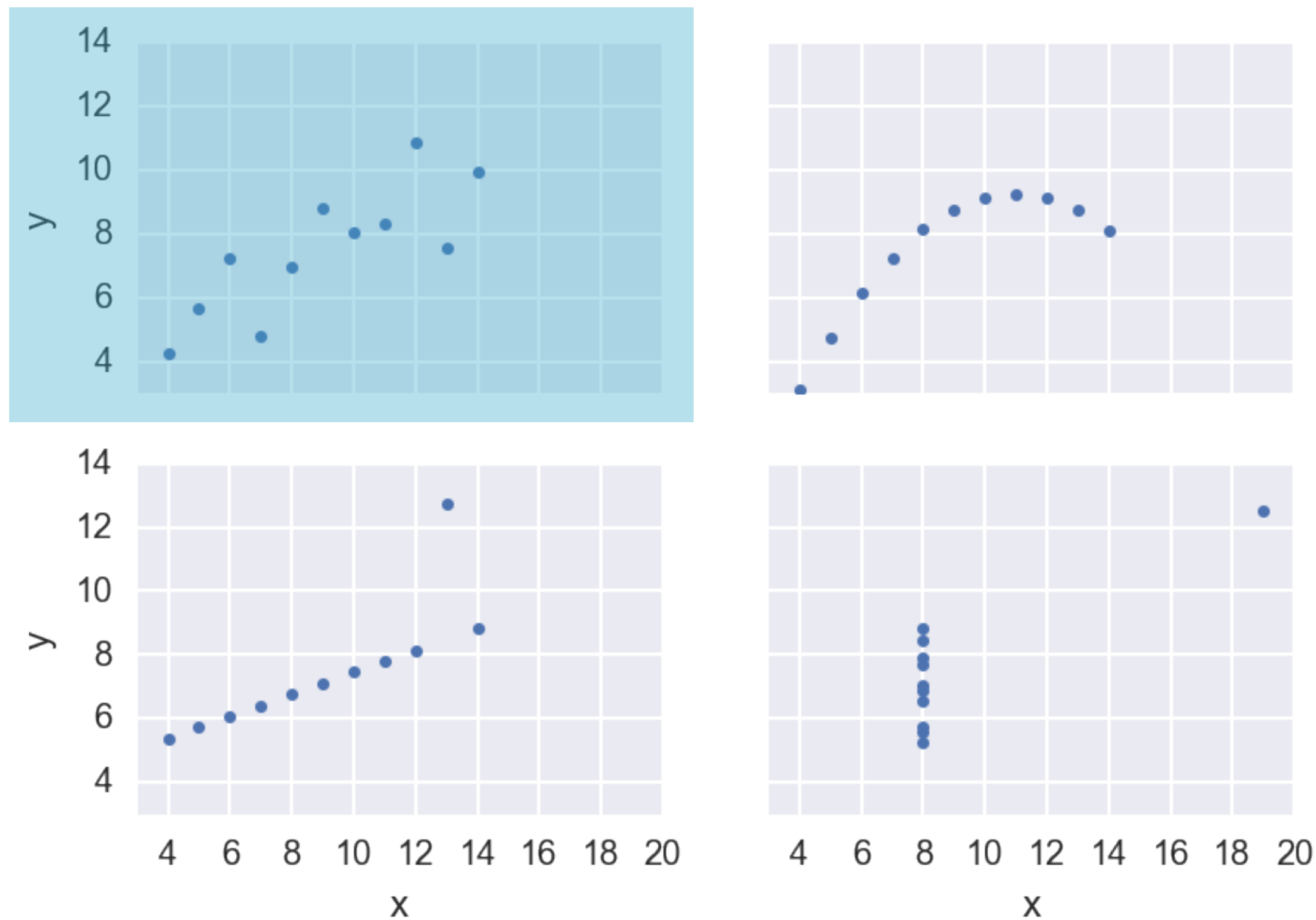


Look before you leap!

- Do graphical EDA first

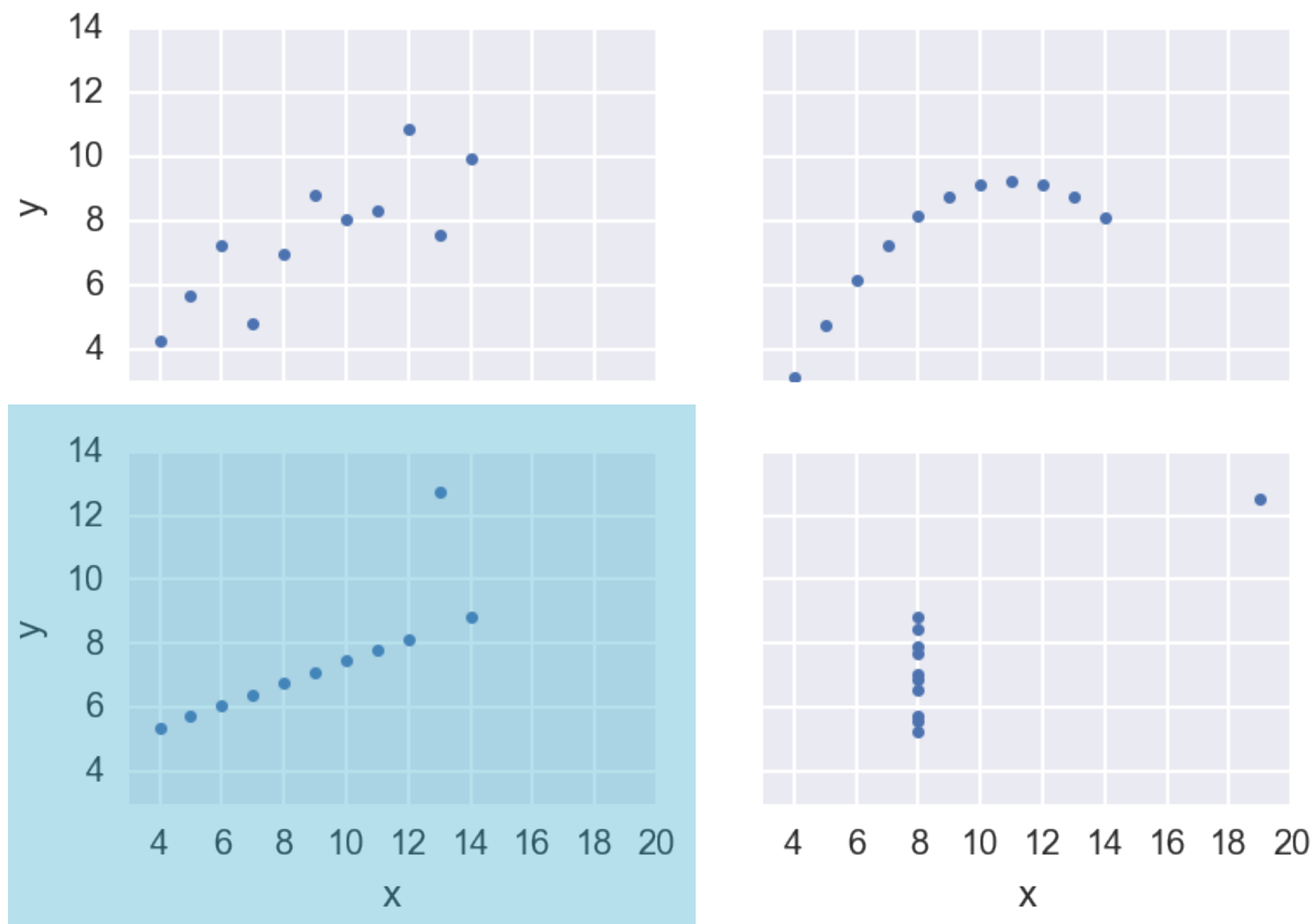


Anscombe's quartet



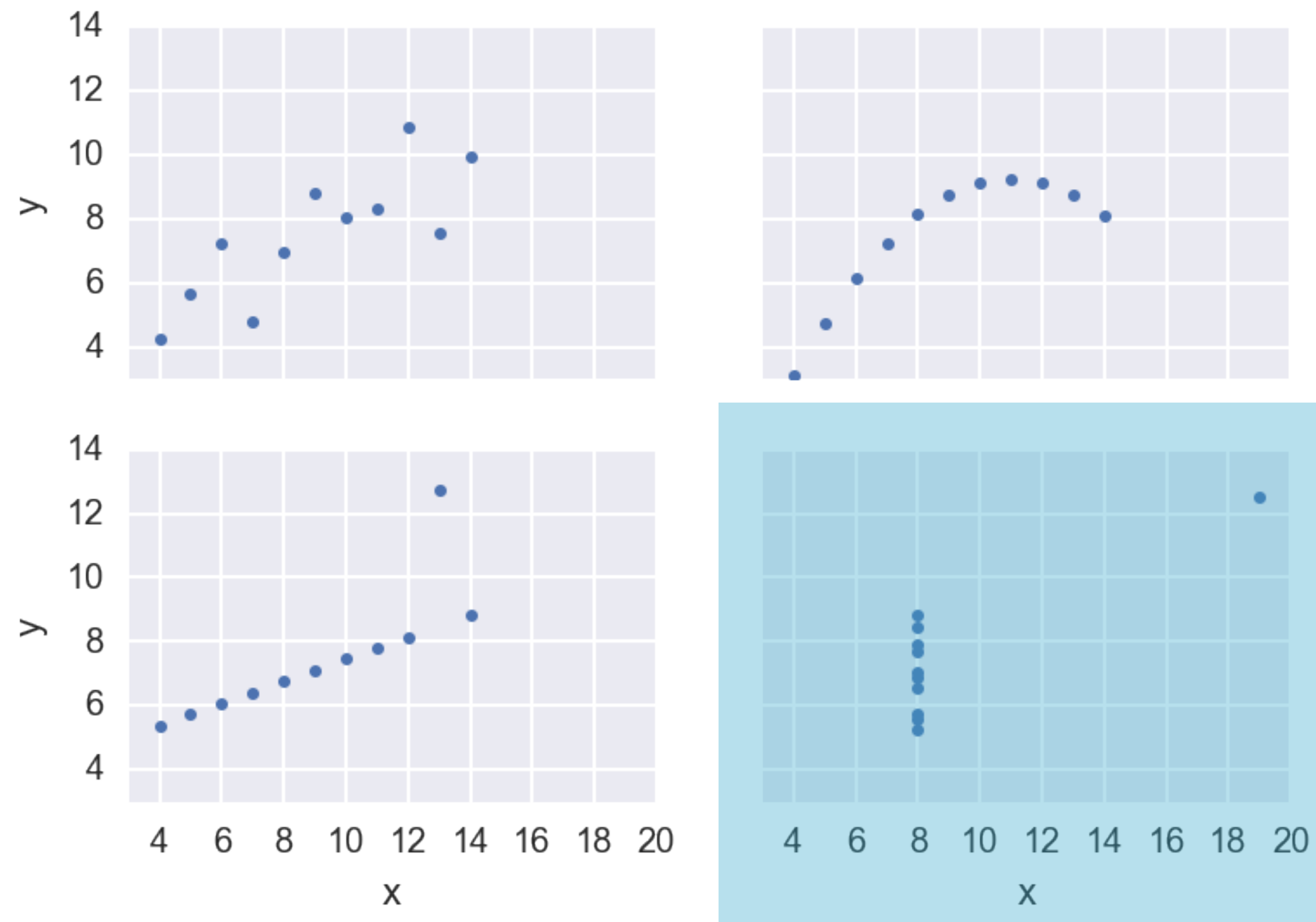


Anscombe's quartet



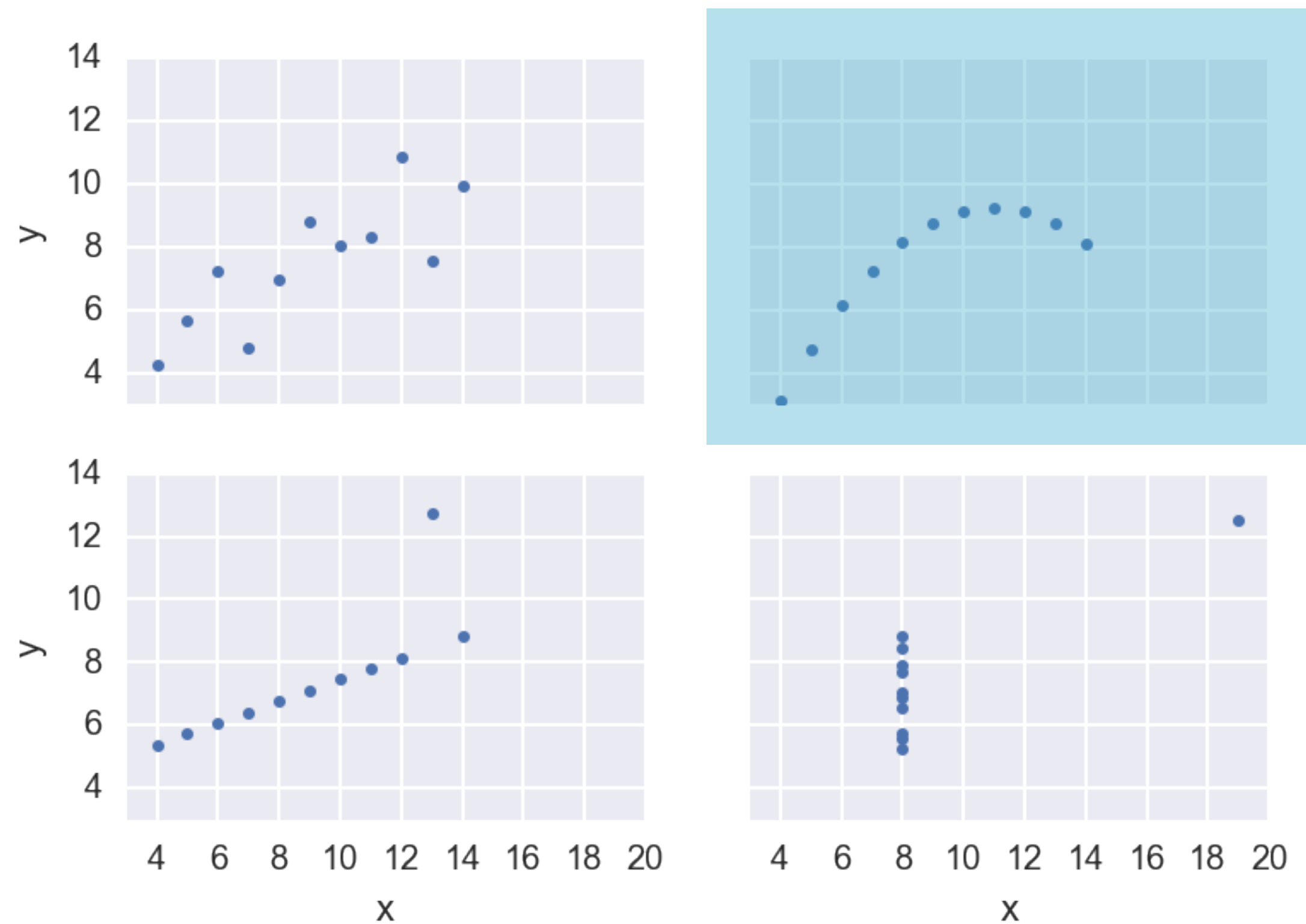


Anscombe's quartet





Anscombe's quartet





STATISTICAL THINKING IN PYTHON II

Let's practice!