Statistics with Spa ows

Lecture 2

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Outline

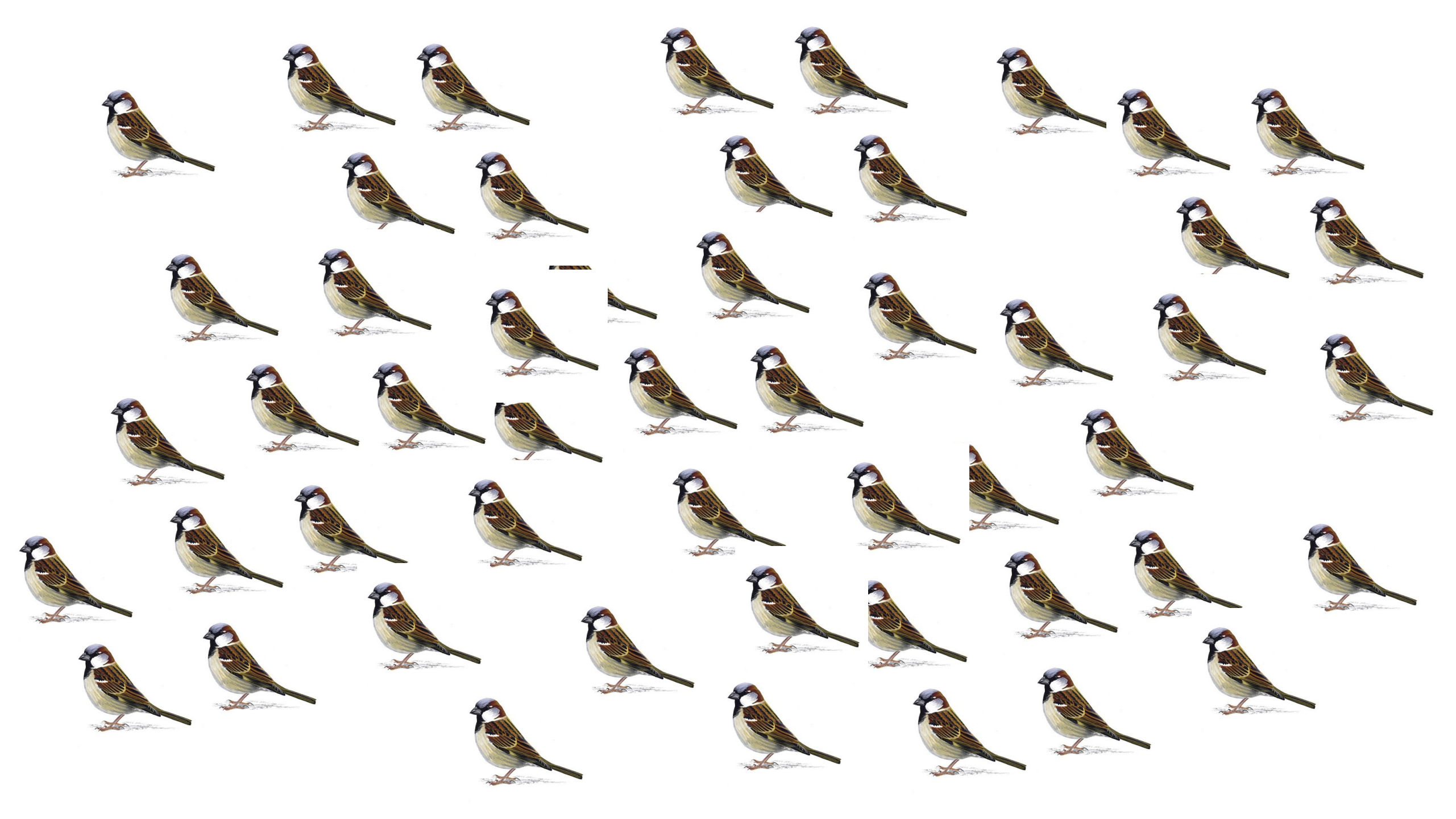
- Basic statistical concepts
  - Describing distributions
  - Describing sampling precision

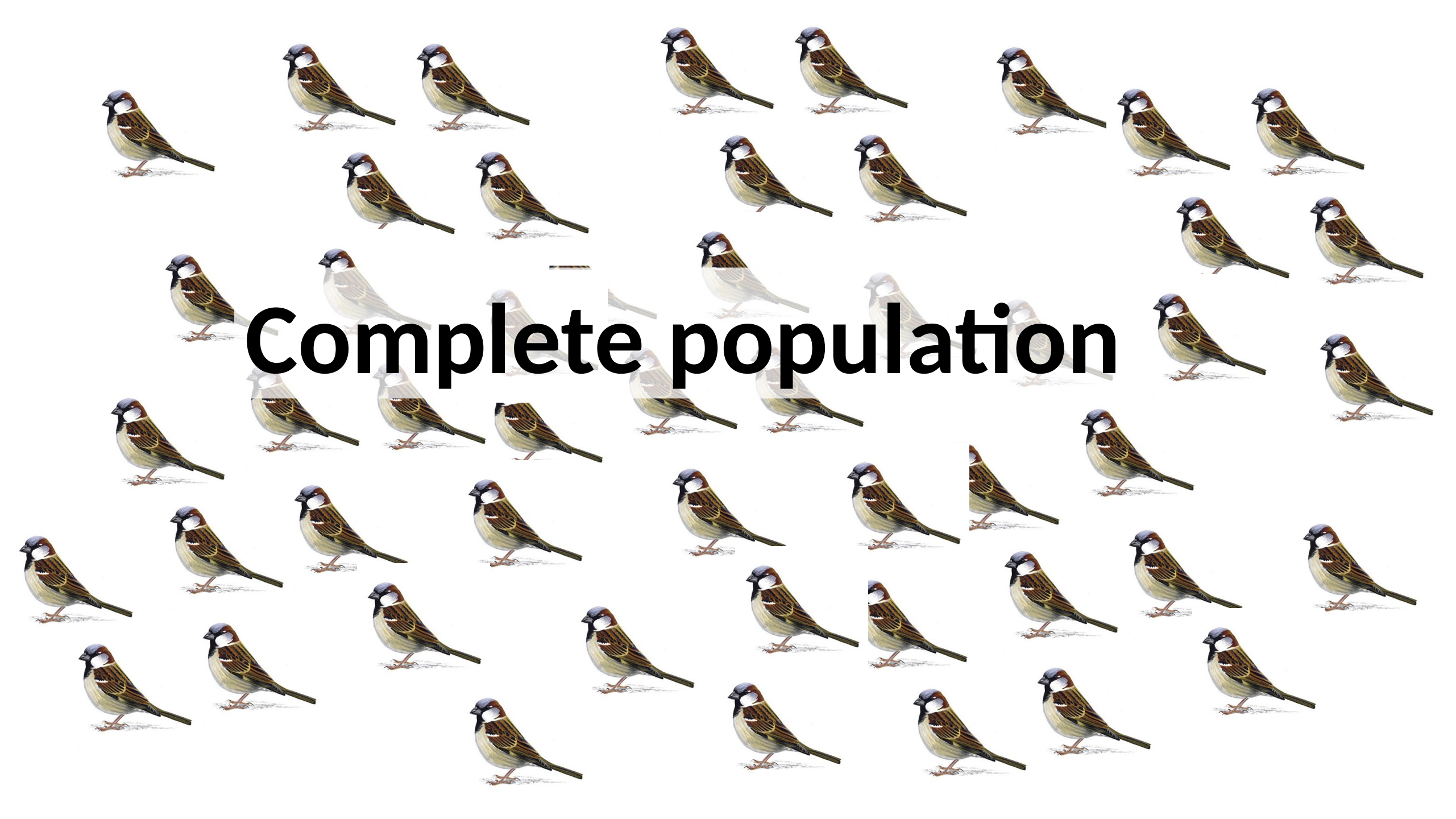
Basic statistical concepts

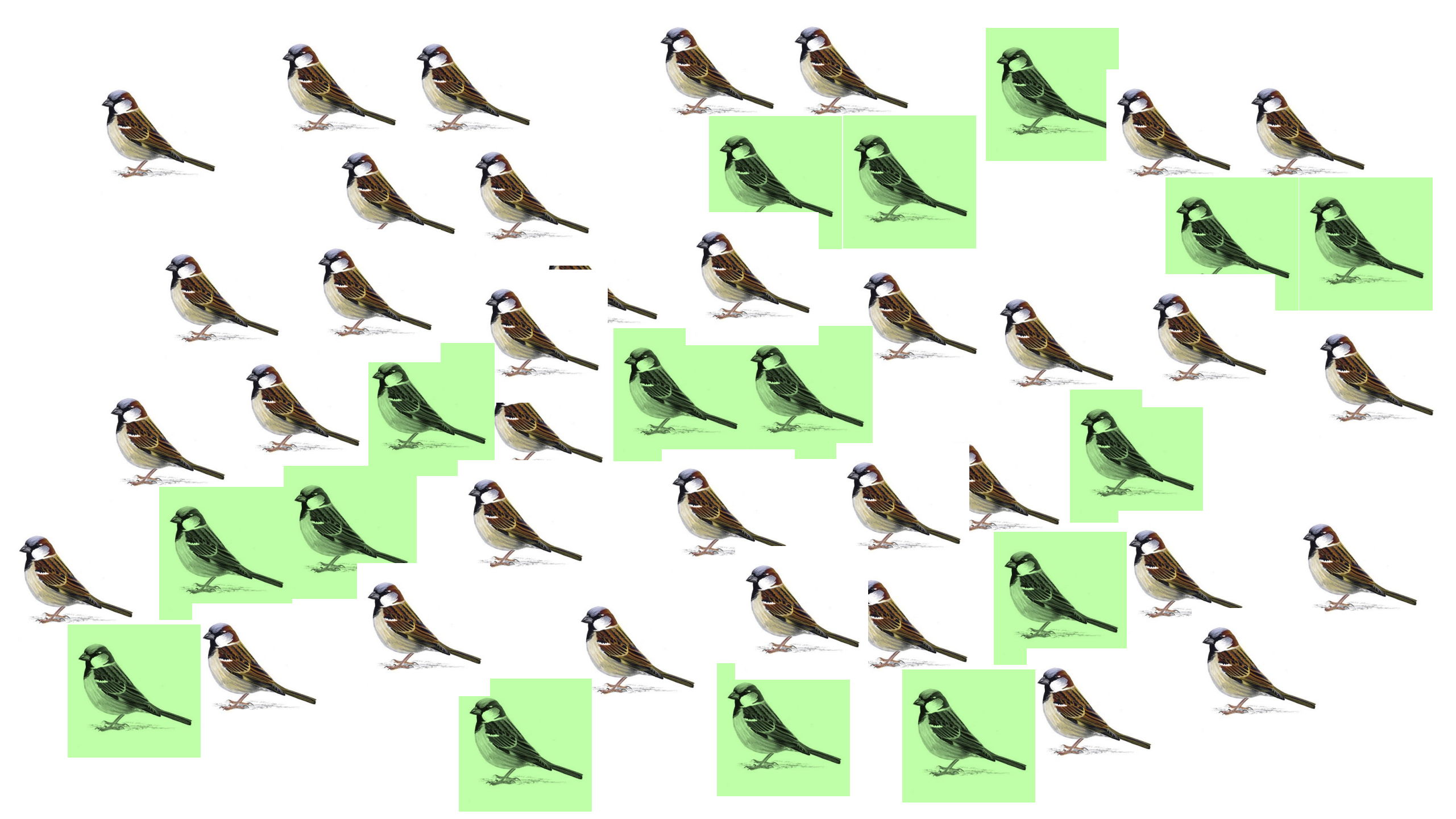
```
> head(d)
  BirdID Cohort CaptureDate CaptureTime Year Tarsus Bill Wing Mass Sex  Sex.1
1   4401   1991   21-Jun-00        <NA> 2000   18.9   NA   82 29.4   1   male
2   4401   1991   02-Oct-00        <NA> 2000   18.8   NA   79 31.6   1   male
3   4405   1994   20-Jun-00        <NA> 2000   19.1   NA   77 29.9   0 female
4   4405   1994   04-Oct-00        <NA> 2000   19.0   NA   78 31.6   0 female
5   4405   1994   07-Oct-00        <NA> 2000   19.1   NA   77 31.0   0 female
6   4409   1994   23-Mar-00        <NA> 2000   18.0   NA   76 28.1   1   male
>
```

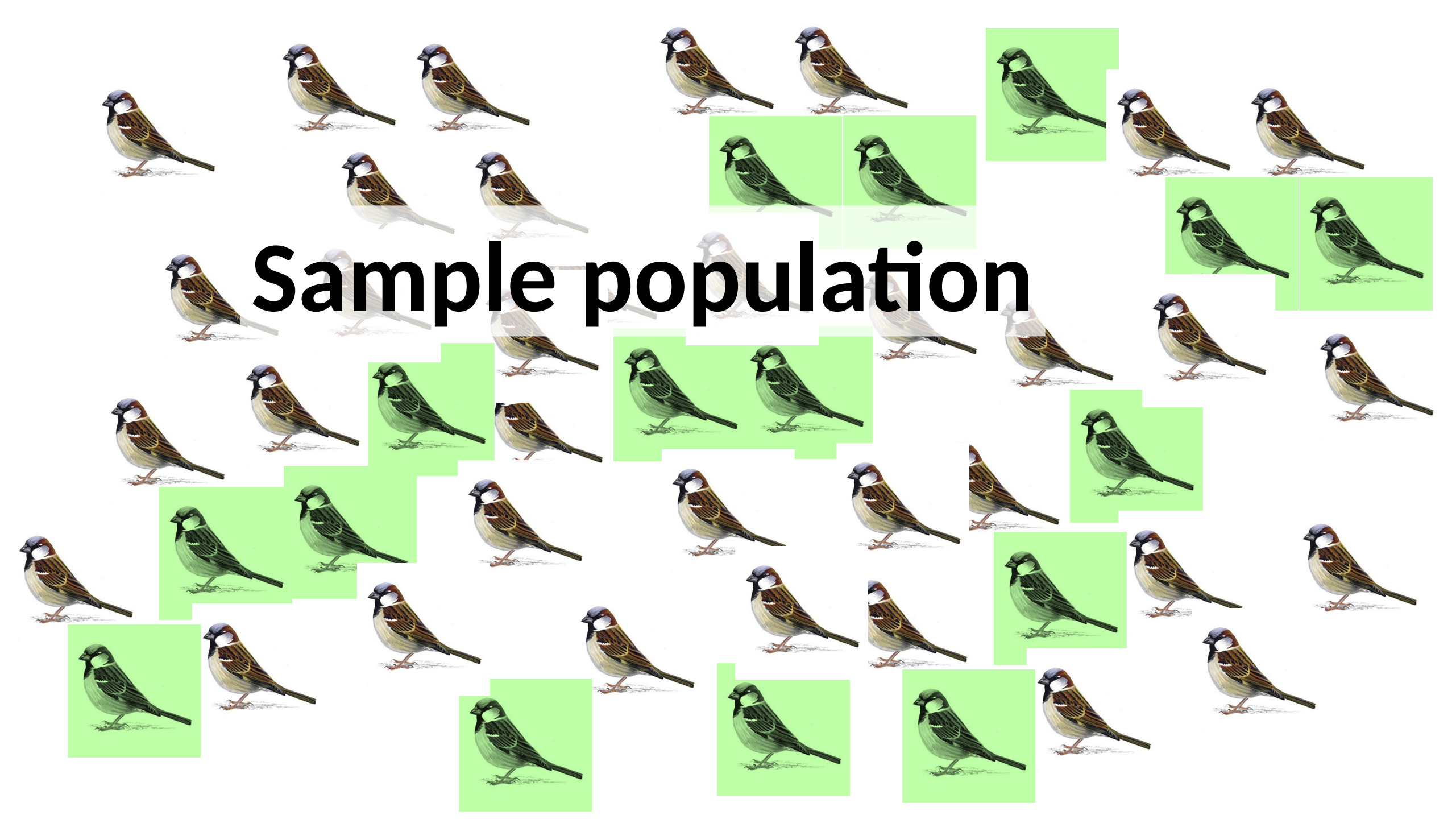
Lundy Sparrows

Griffith et al., 2000,
Nakagawa et al., 2007,
Cleasby et al., 2010,
Schroeder et. al 2011, 2013,
2015



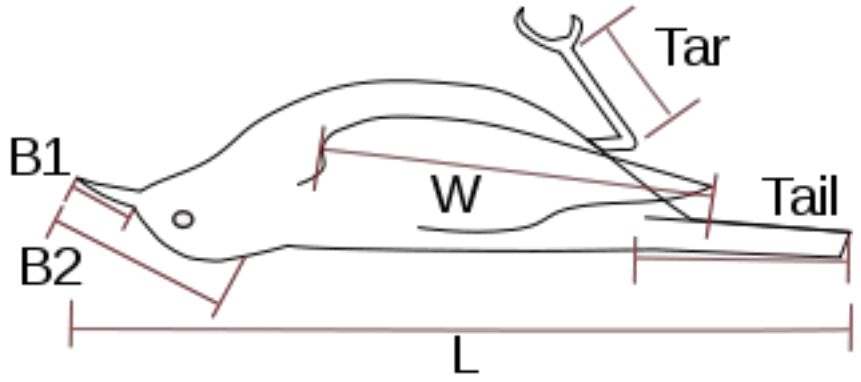

Complete population




Sample population

Basic statistical concepts

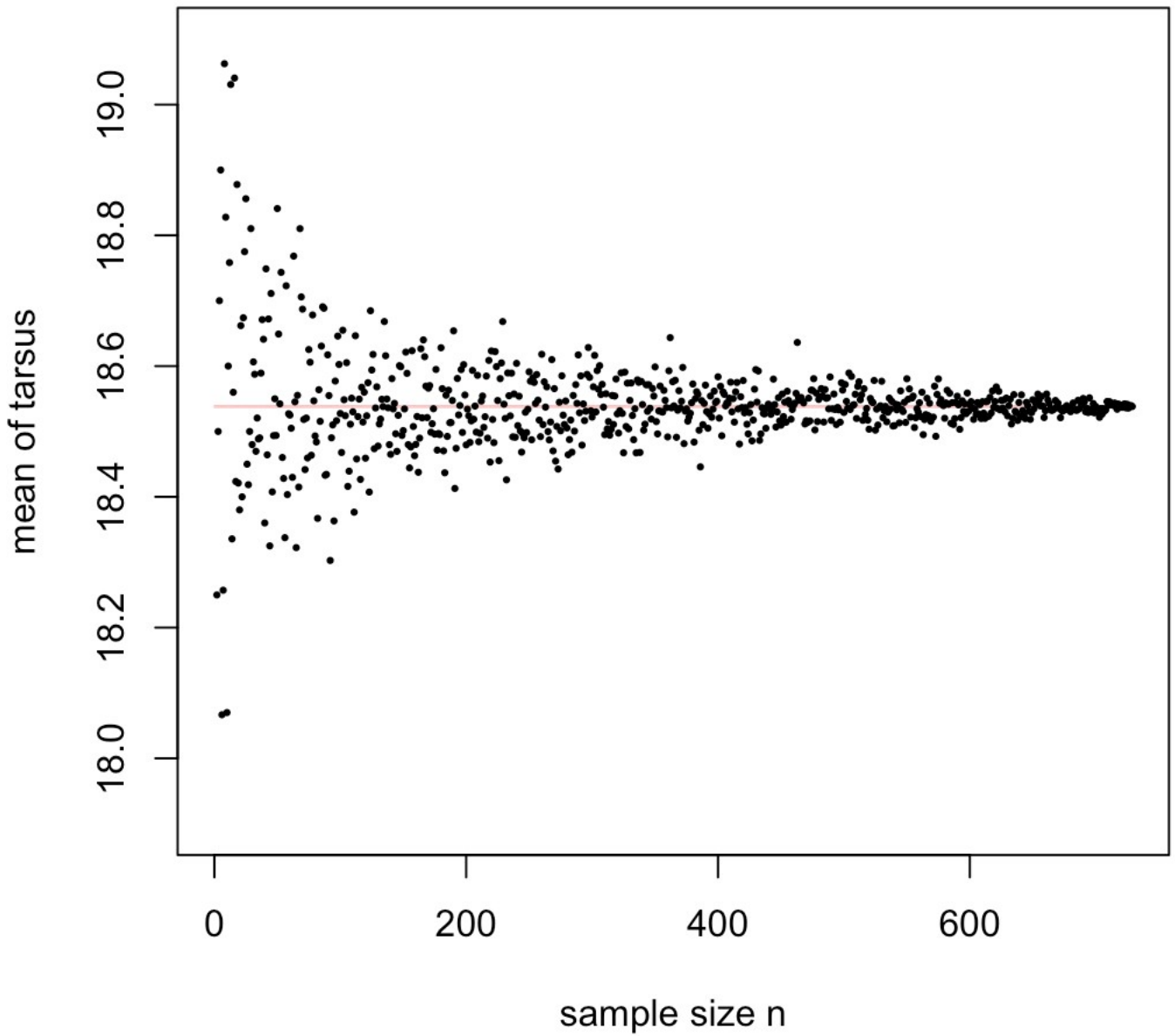
```
> head(d)
  BirdID Cohort CaptureDate CaptureTime Tarsus Bill Wing Mass Sex  Sex.1
1      4   2001   24-Jul-02        <NA>   16.9   NA   76 23.6   0 female
2     28   2001   22-Mar-02        <NA>   19.0   NA   77 26.2   0 female
3     29   2001   03-Jun-02        <NA>   18.5   NA   77 28.0   0 female
4     32   2001   11-Oct-01        <NA>   17.9   NA   75 28.1   0 female
5     32   2001   13-Aug-03       08:00   18.8 13.9   75 25.5   0 female
6     32   2001   09-May-04       12:00   18.9 13.9   76 25.6   0 female
>
```

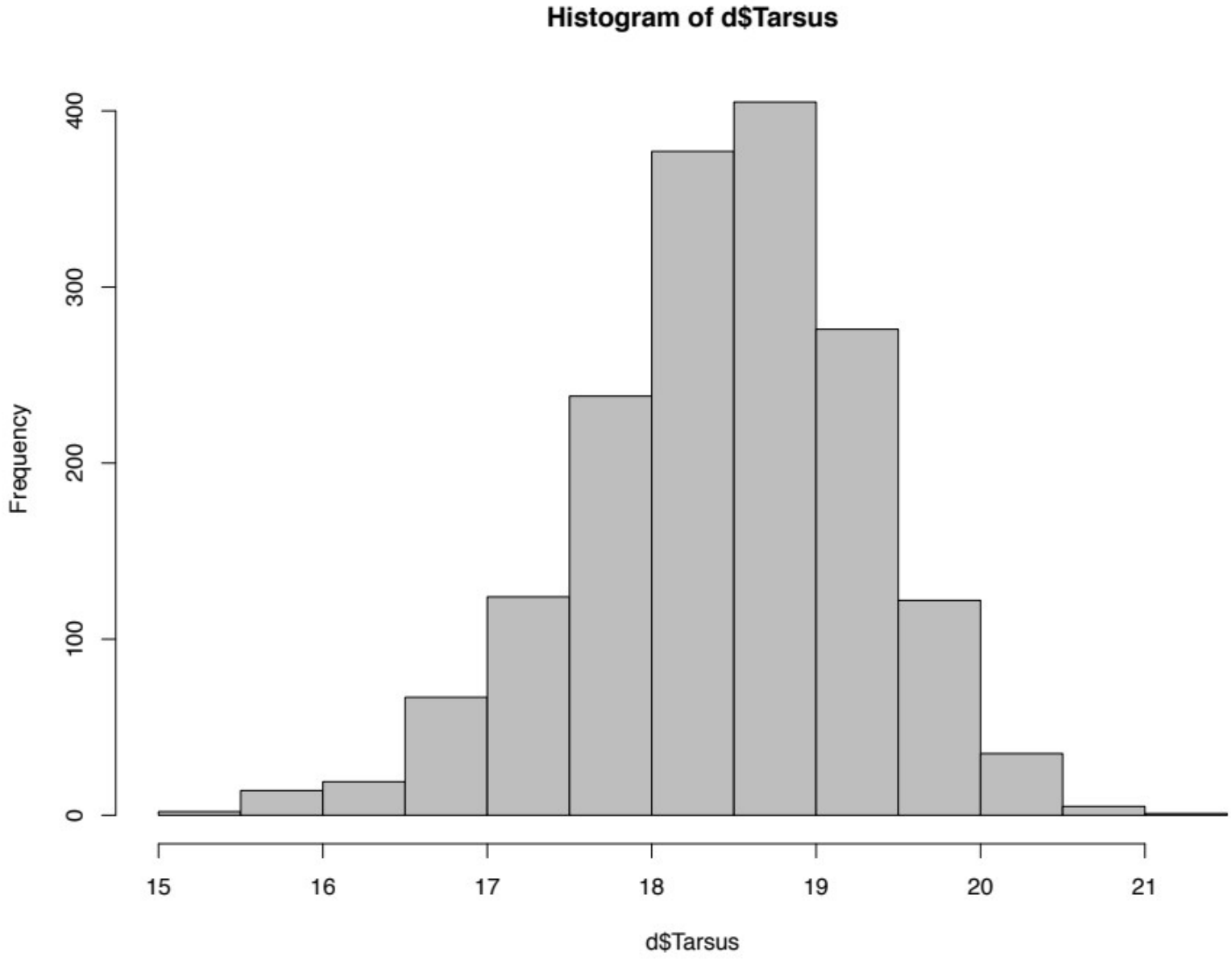


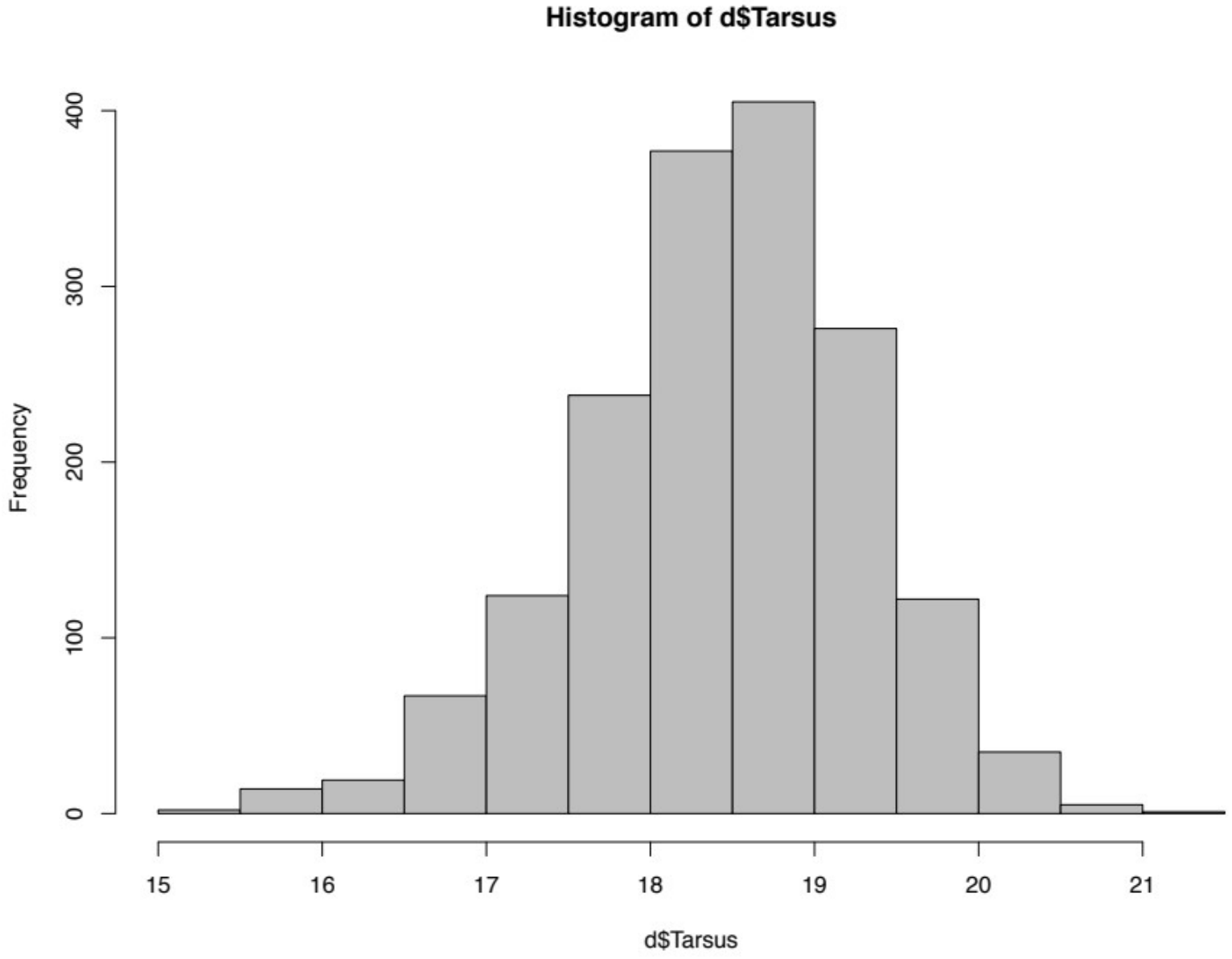
Estimate

- Any parameter measured and computed from a sample is an estimate
- As such, it is not perfectly precise – there is unknown error
- We want to know how precise, and how reliable the parameter is

CAMLAB

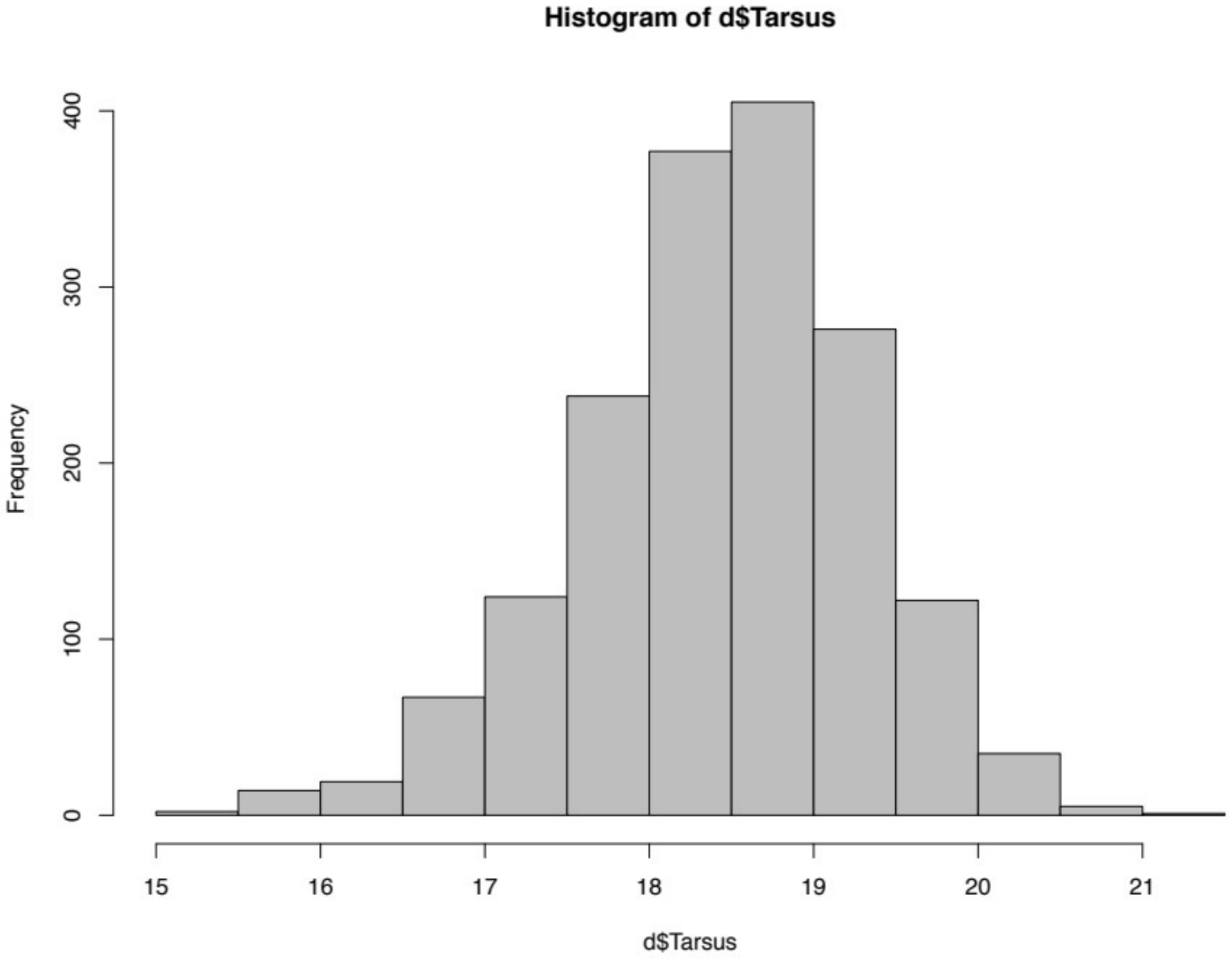

mean of tarsus
18.0
18.2
18.4
18.6
18.8
19.0
0
200
400
600
sample size n


Histogram of d$Tarsus
Frequency
0
100
200
300
400
15
16
17
18
19
20
21
d$Tarsus



Describe data:

- Centrality
- Spread



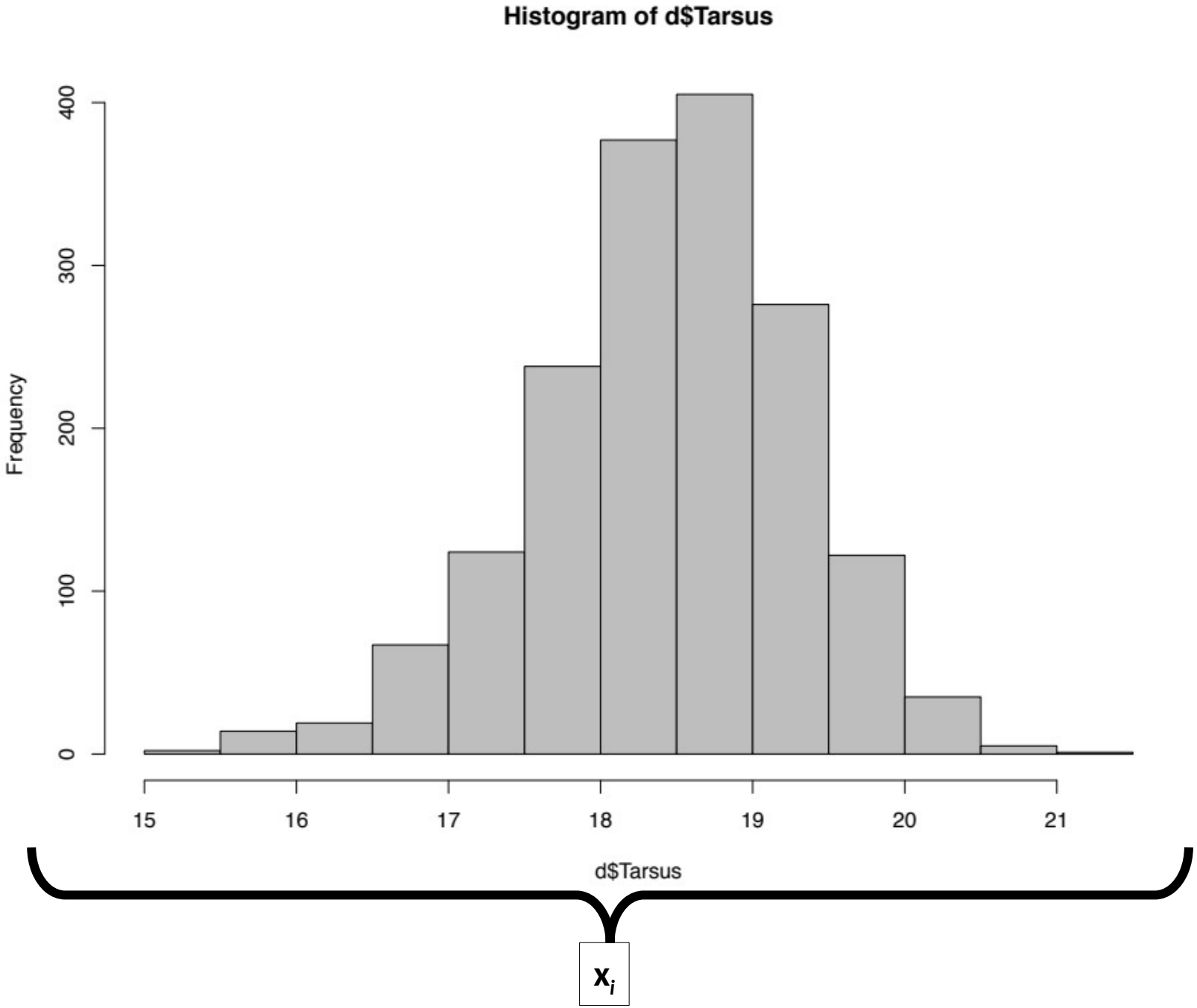
Describe data:

- Centrality
- Spread

WHERE is the MIDDLE?

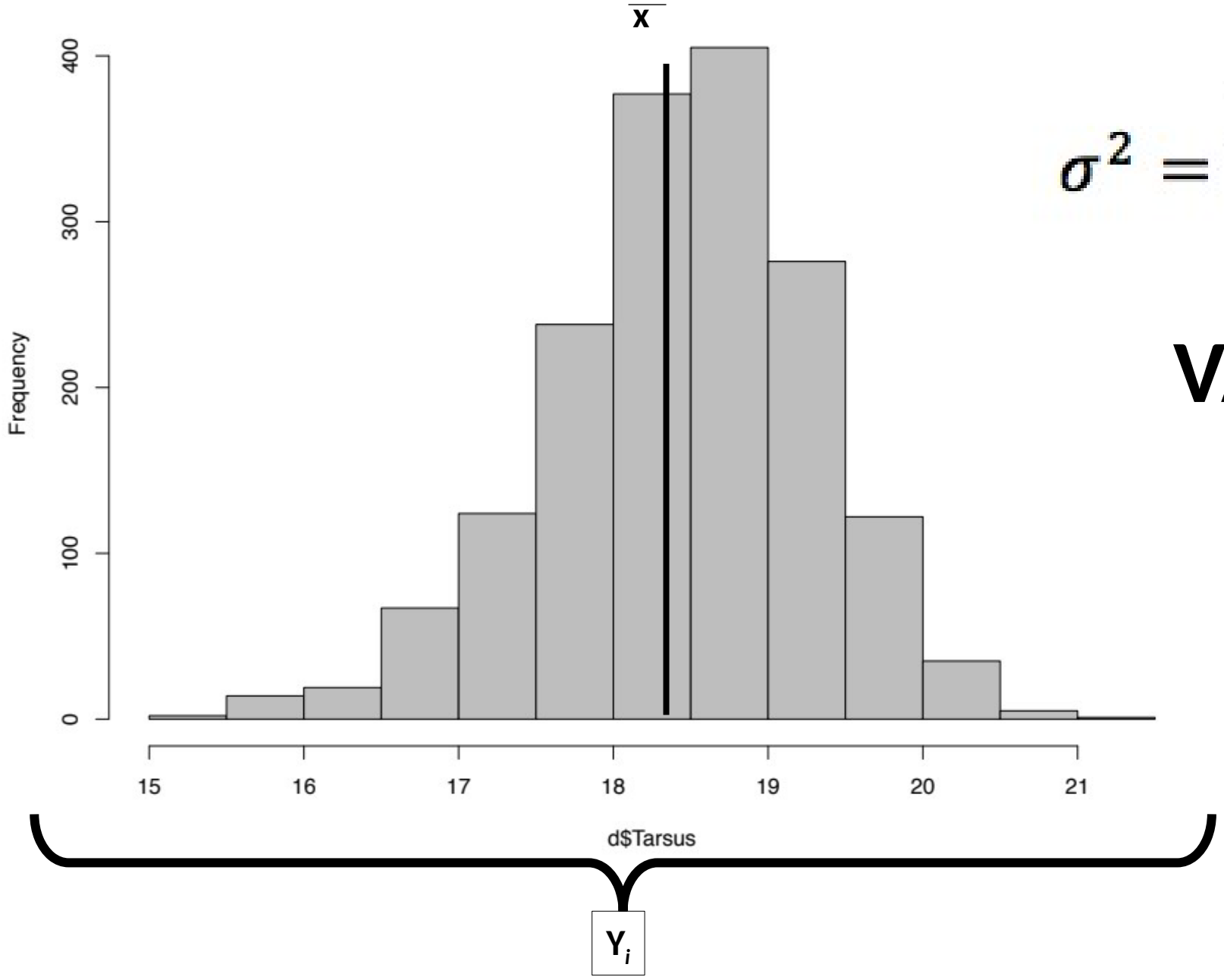
Mean, median and mode

Mean	$\frac{\text{Sum of values}}{\text{Number of values}}$
Median	Middle data value or midpoint of two middle values
Mode	Most frequent value(s)



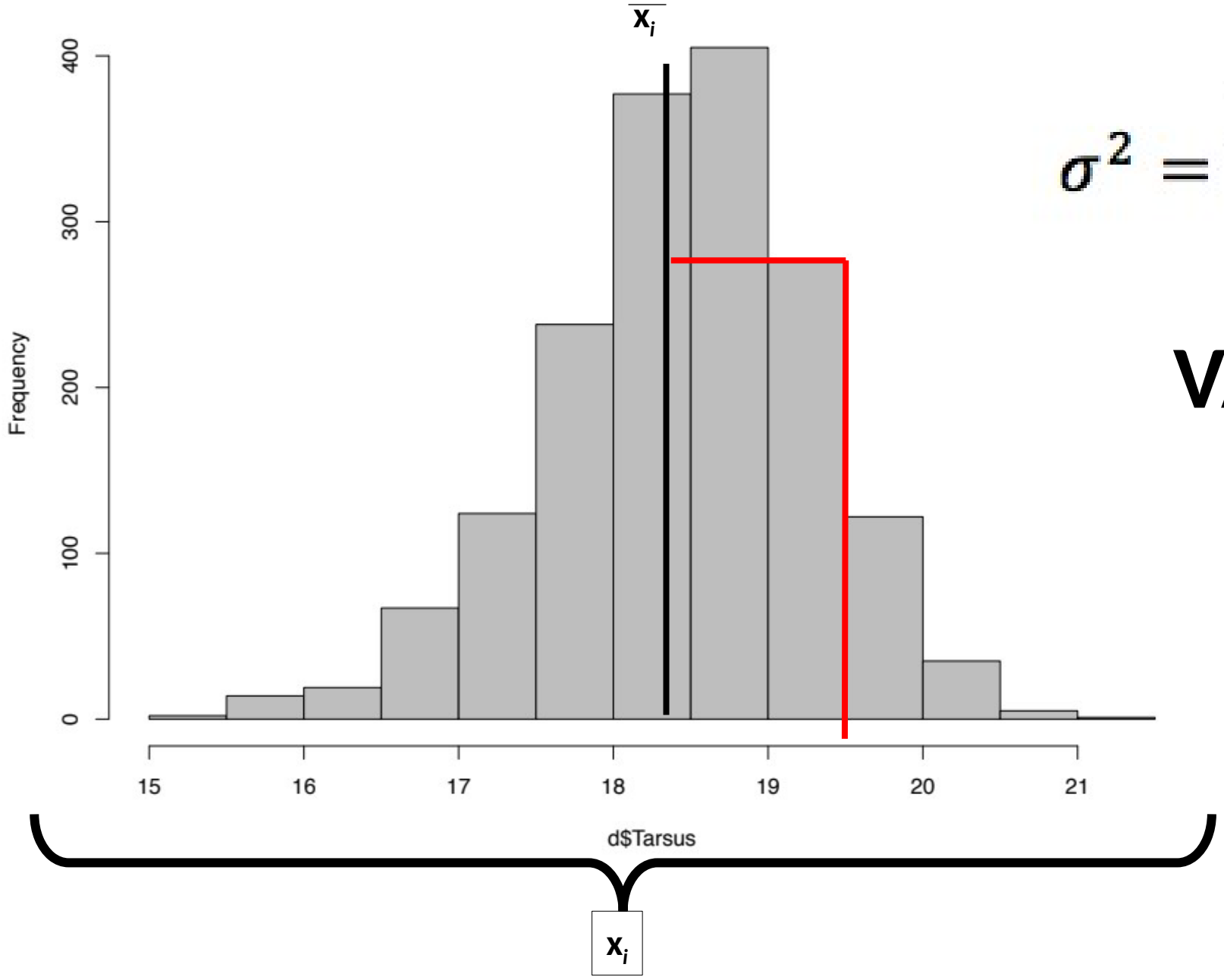
Describe data:

- Centrality
  - Mean
  - Median
  - Mode
- Spread
  - Range (min/max)
  - Variance



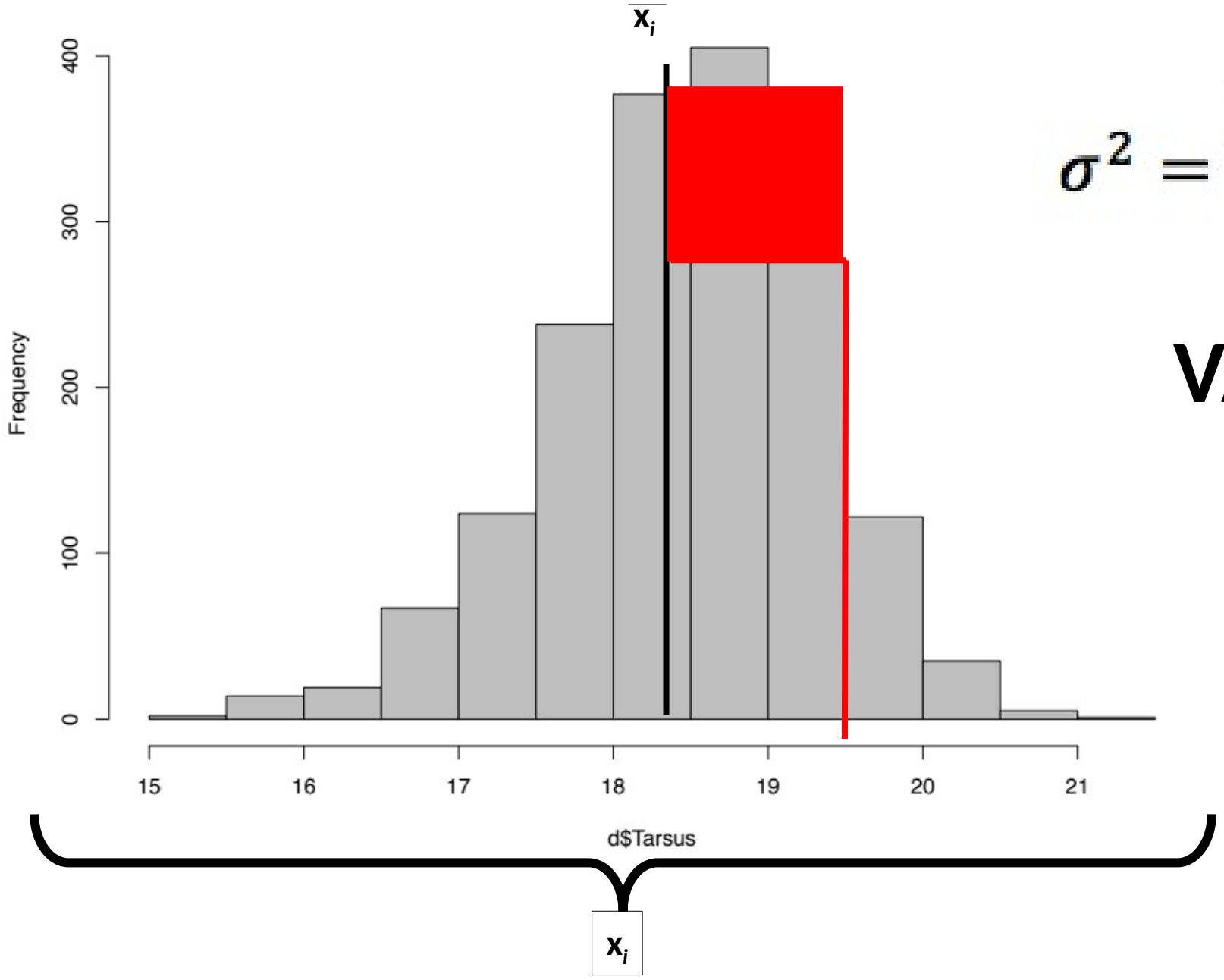
$$\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$$

VARIANCE



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

VARIANCE



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

VARIANCE

1.

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

VARIANCE

1.

2.

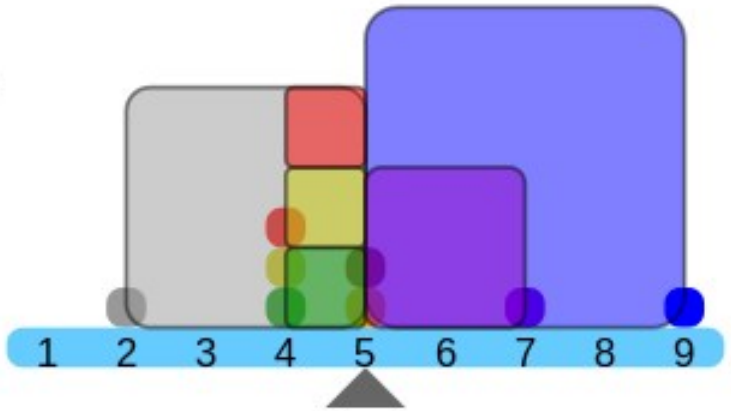
$$\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$$

VARIANCE

1.

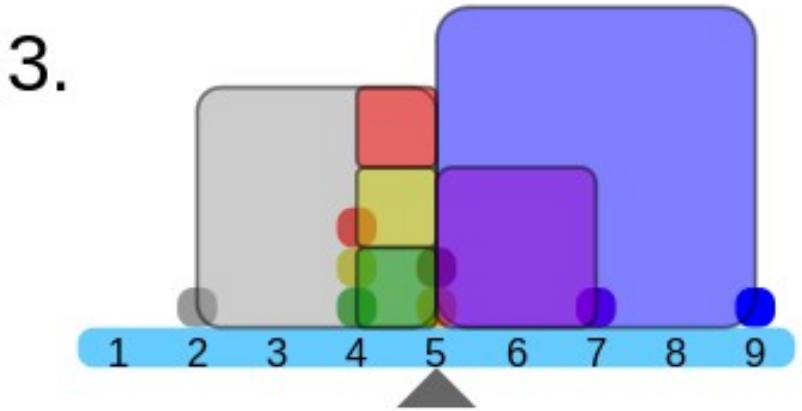
2.

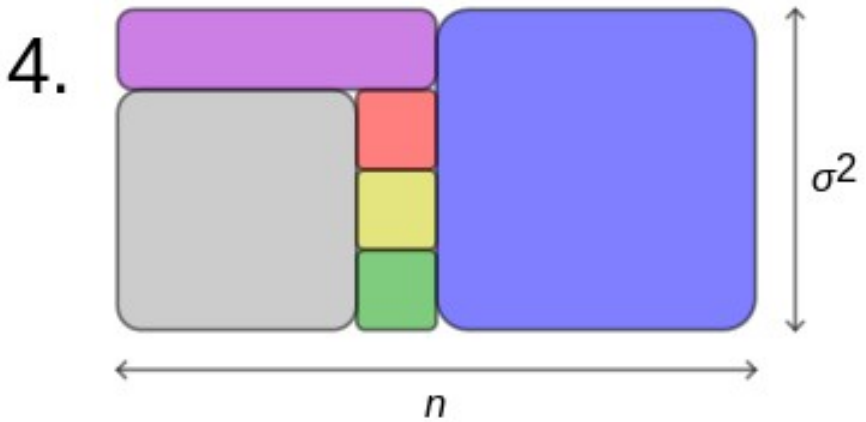
3.



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

VARIANCE



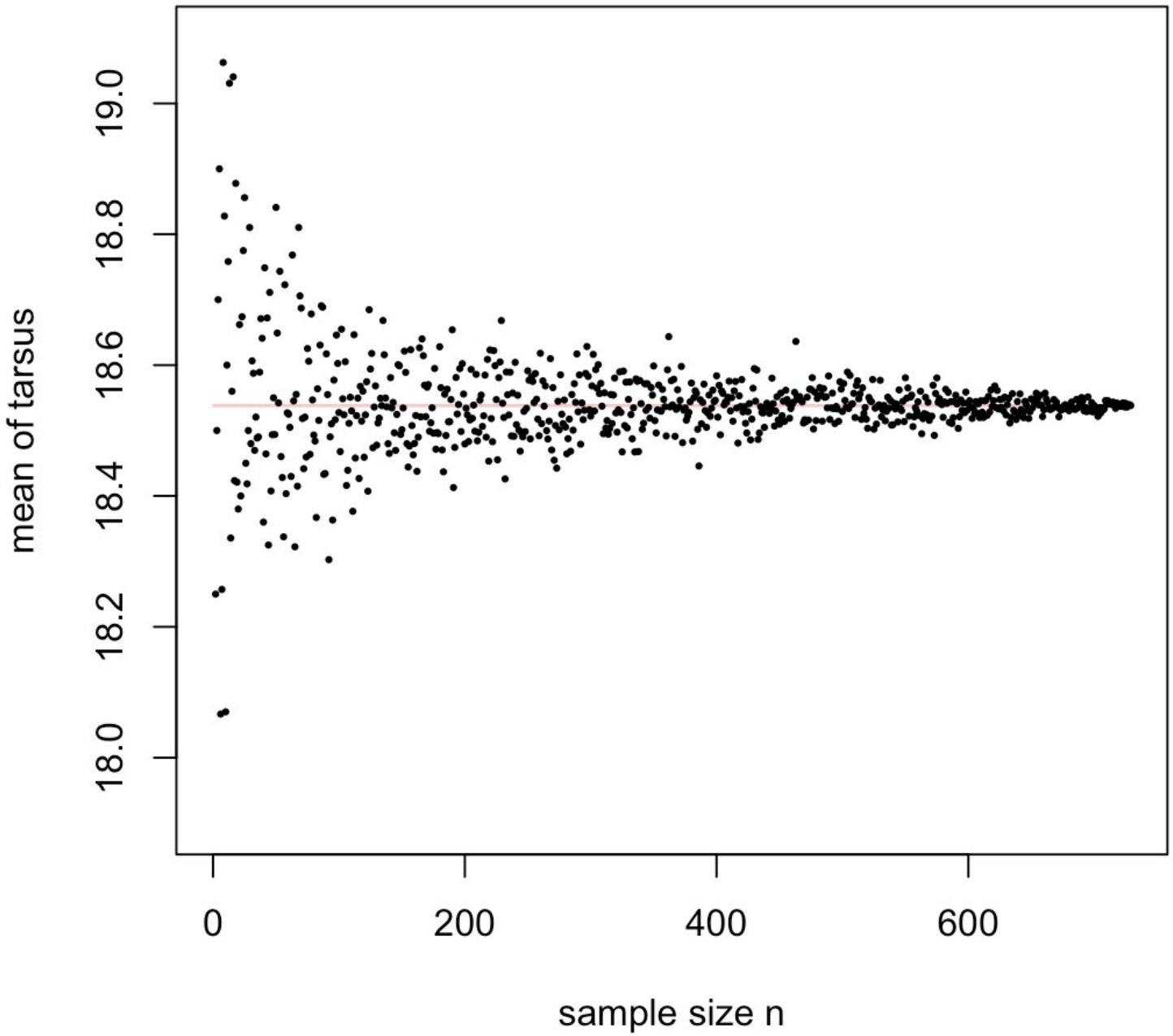


$$\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$$

VARIANCE

Standard deviation:

stdev video


mean of tarsus
18.0
18.2
18.4
18.6
18.8
19.0
0
200
400
600
sample size n

Learning aims

- Difference between population and sample
- Centrality: Mean, median, mode
- Spread: Range, quantiles, variance, standard deviation
- Sum of squares

Exercise – DO IT NOW – HO 2

Calculate mean, variance and standard deviation of

- Bill length
- Body mass
- Wing length in R.

- Plot all four histograms in a multi-panel figure

- What does it mean when statisticians talk about the “sum of squares” (often abbreviated to SS)?

Exercise – DO IT NOW

- What are NA?
- How can we deal with missing values? There are two ways!
- Why are there odd gaps in the histogramms when we set breaks to larger numbers?
- What do these gaps tell us about how precise we should report results?
- Explain the warnings we got for mlv(d2$Tarsus)
- What is the variance of normally distributed data with a mean of 0 and a standard deviation of 1?
- What is the function in R to z-standardize data?
- Explain what quantiles are
- What are the boxes, whiskers and circles in a boxplot?
- Explain the terms: sums of squares, mean of sum of squares