Statistics with Spa  ows

Lecture 2

Julia Schroeder

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Learning Aims

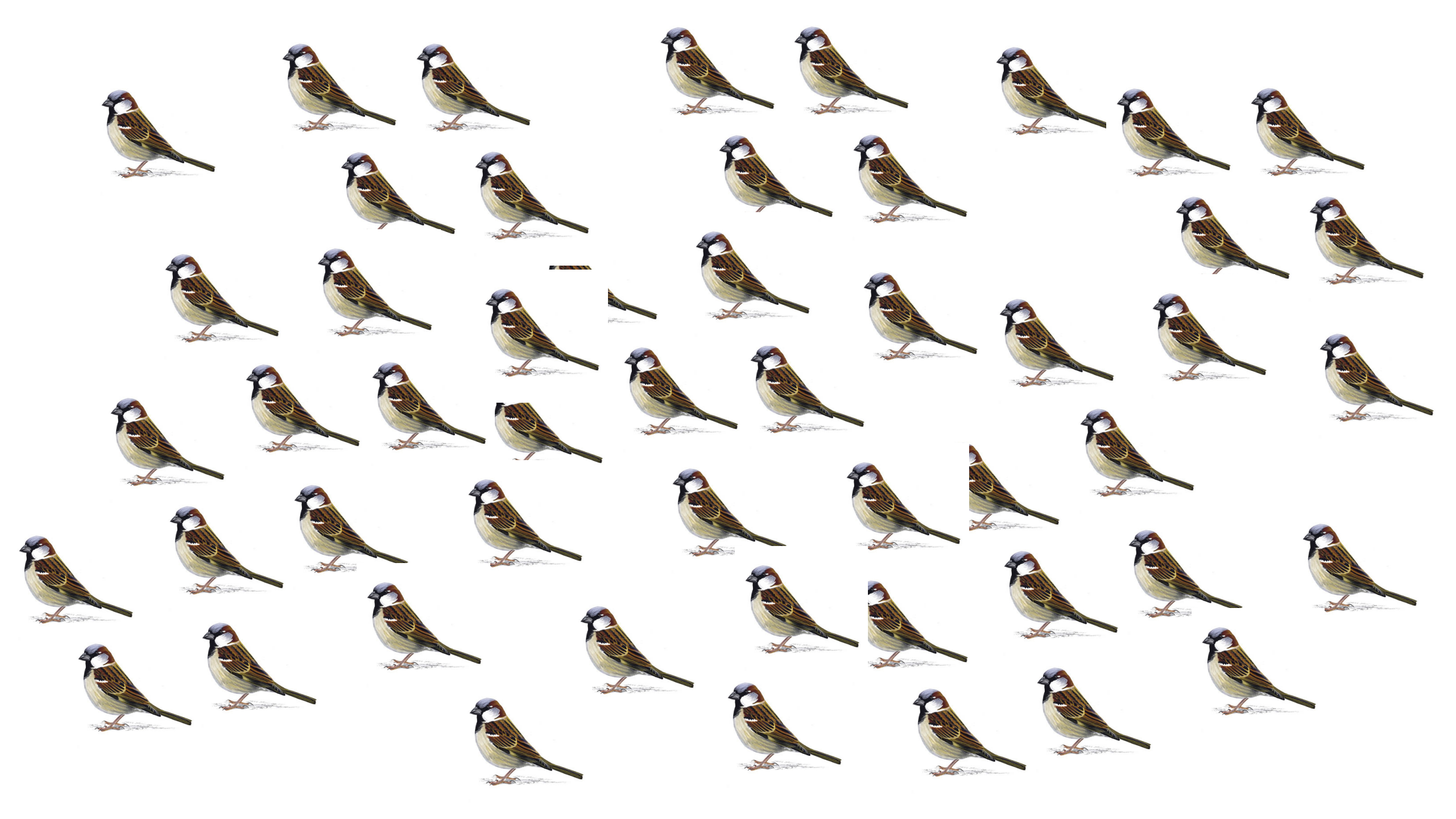
- Basic statistical concepts
  - Describing distributions
  - Describing sampling precision

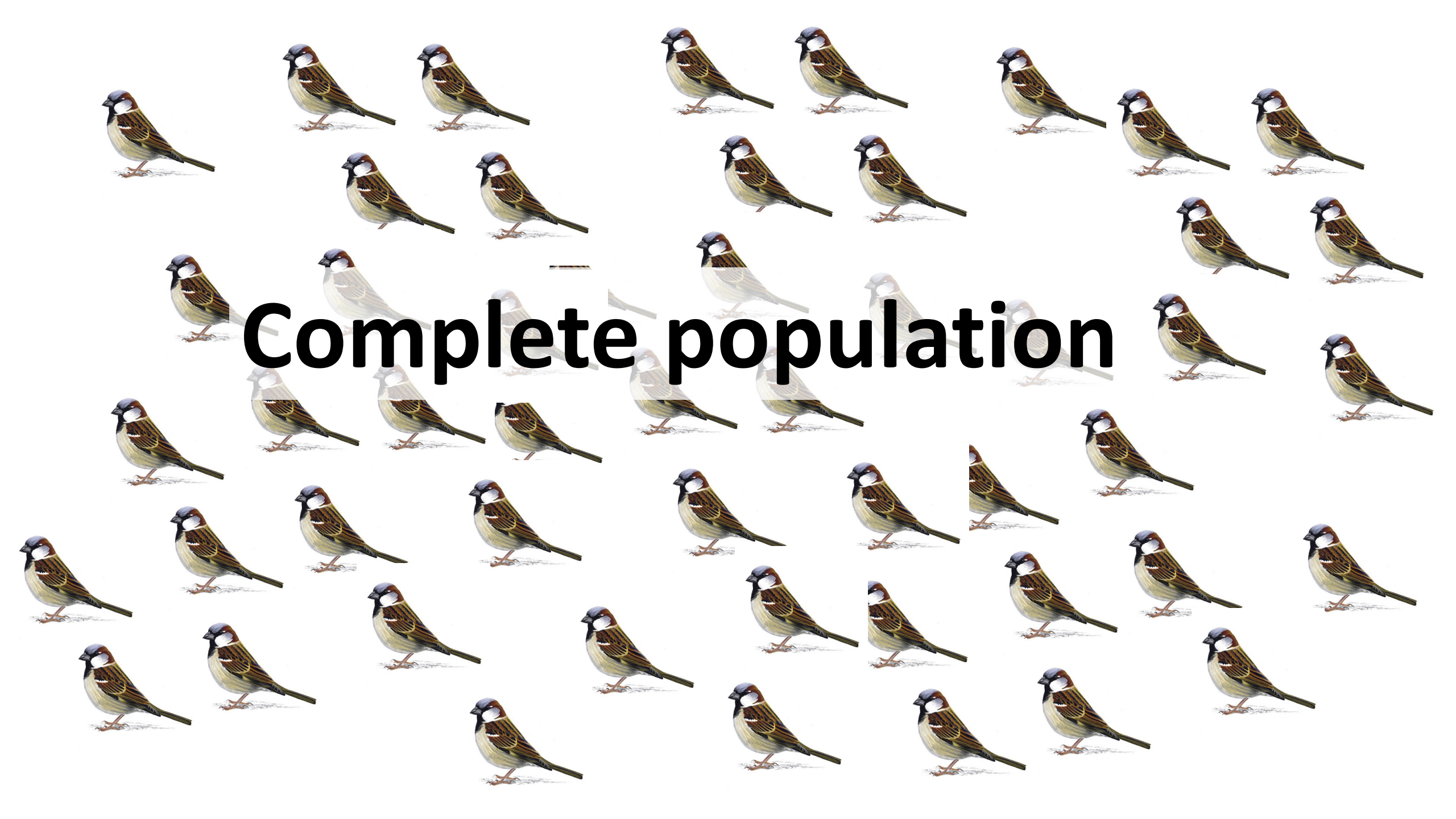
Basic statistical concepts

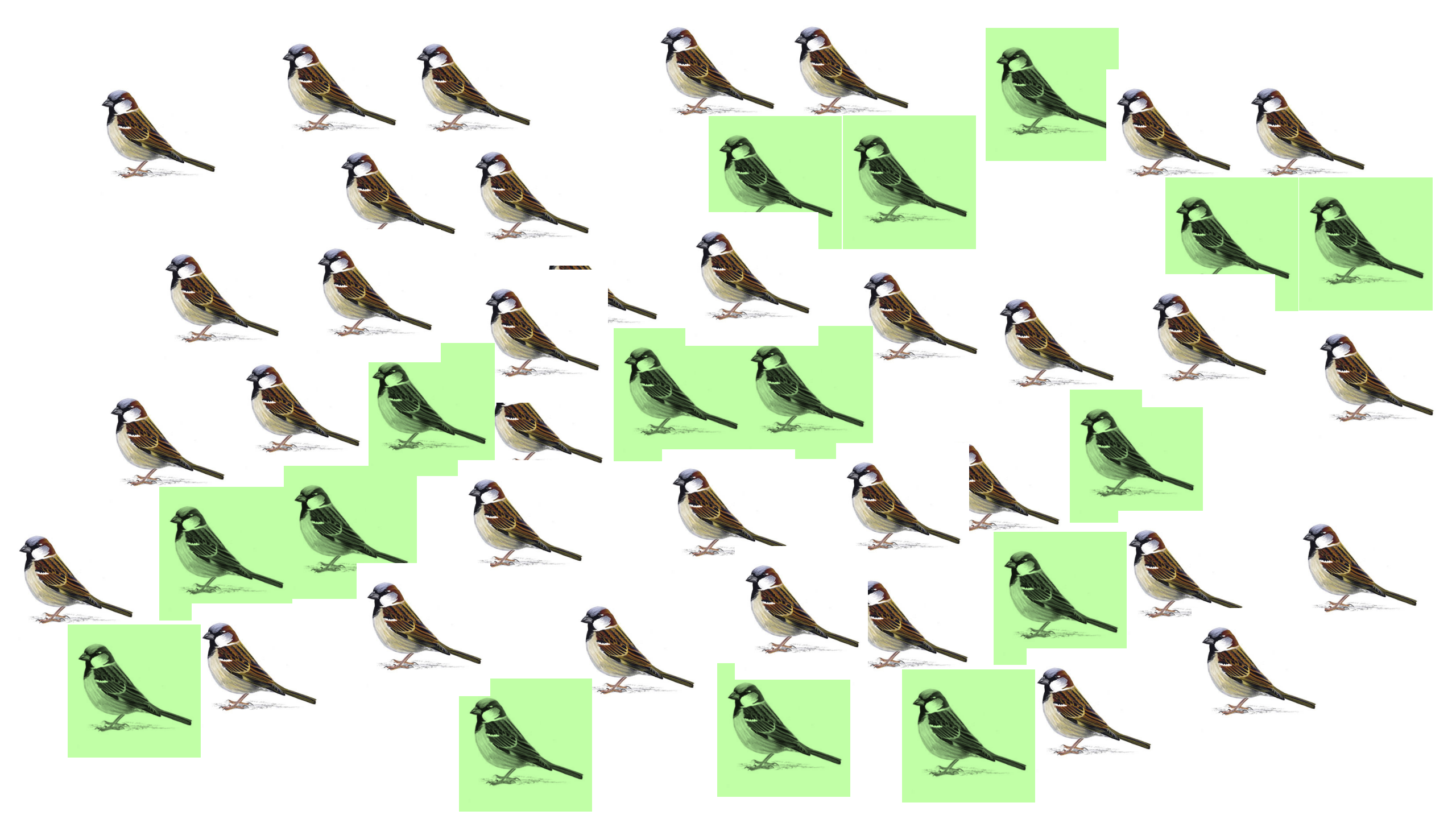
```
> head(d)
  BirdID Cohort CaptureDate CaptureTime Year Tarsus Bill Wing Mass Sex  Sex.1
1   4401   1991   21-Jun-00        <NA> 2000   18.9   NA    82 29.4   1   male
2   4401   1991   02-Oct-00        <NA> 2000   18.8   NA    79 31.6   1   male
3   4405   1994   20-Jun-00        <NA> 2000   19.1   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
>
```

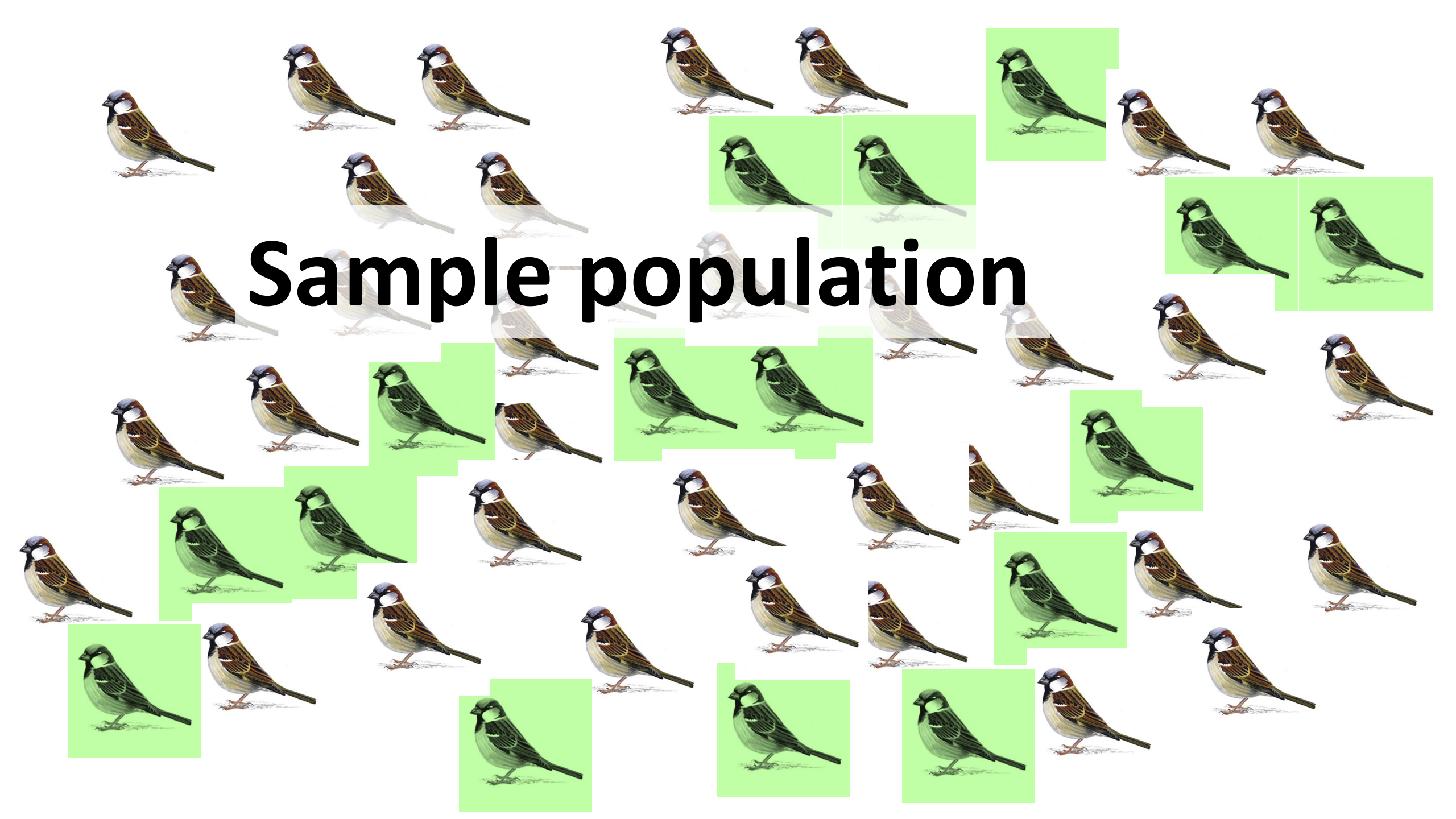
Lundy Sparrows

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

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1      4   2001   24-Jul-02        <NA>   16.9   NA   76 23.6   0 female
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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
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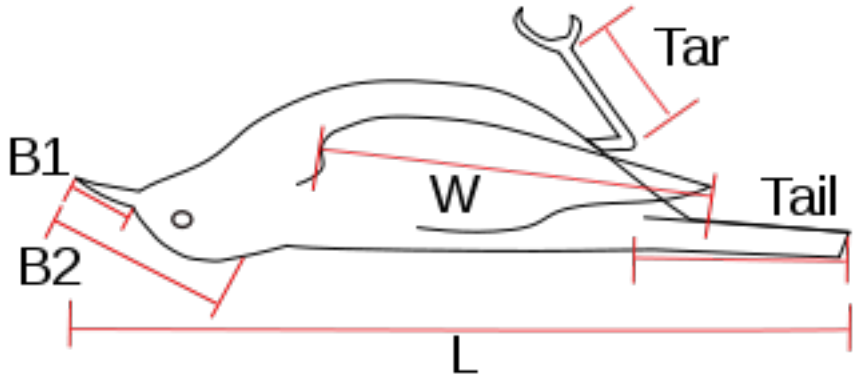
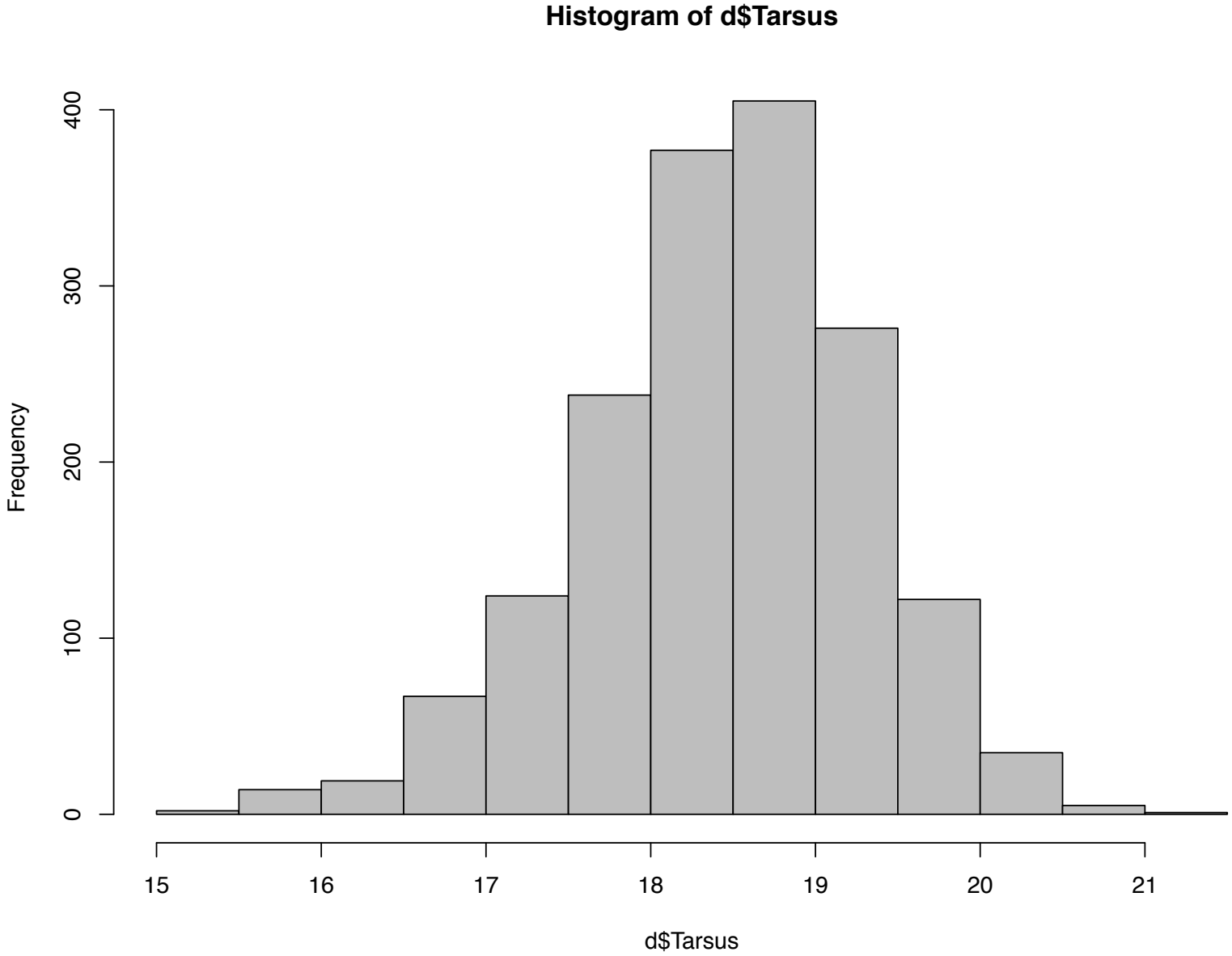
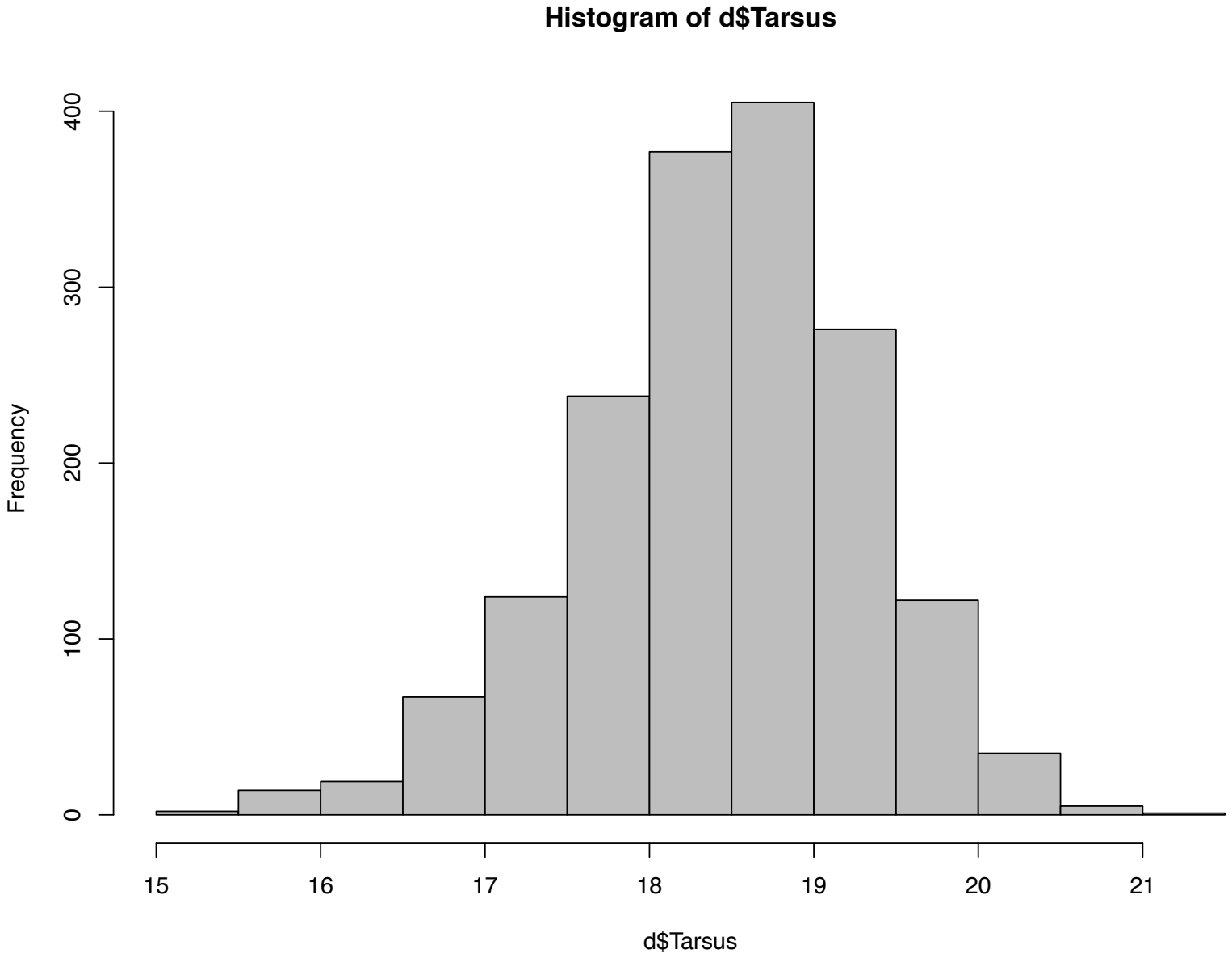


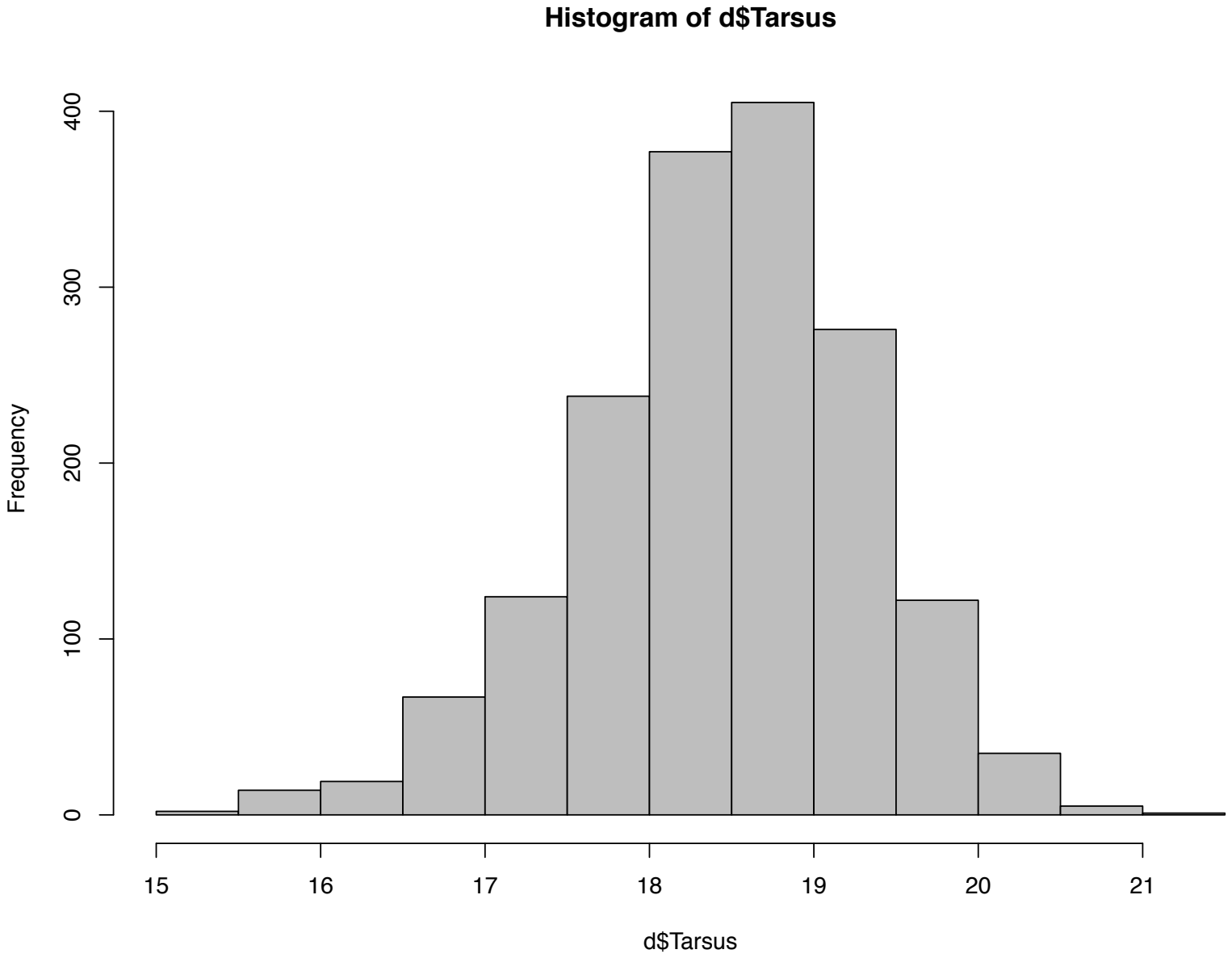
Basic statistical concepts


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)

Mean, median and mode

1	2	2	3	3	3	3	4	4	5

Mean = Median = Mode =

1	2	3	3	3	4	5	5	5	20

Mean = Median = Mode =

1.2	1.3	2.4	2.5	2.6	2.9	3.2	3.5	4.1	5.3

Mean = Median = Mode =

Mean, median and mode

1	2	2	3	3	3	3	4	4	5

Mean = 3 Median = 3 Mode = 3

1	2	3	3	3	4	5	5	5	20

Mean = Median = Mode =

1.2	1.3	2.4	2.5	2.6	2.9	3.2	3.5	4.1	5.3

Mean = Median = Mode =

Mean, median and mode

1	2	2	3	3	3	3	4	4	5

Mean = 3 Median = 3 Mode = 3

1	2	3	3	3	4	5	5	5	20

Mean = 5.1 Median = 3.5 Mode = 3 and 5

1.2	1.3	2.4	2.5	2.6	2.9	3.2	3.5	4.1	5.3

Mean = Median = Mode =

Mean, median and mode

1	2	2	3	3	3	3	4	4	5

Mean = 3 Median = 3 Mode = 3

1	2	3	3	3	4	5	5	5	20

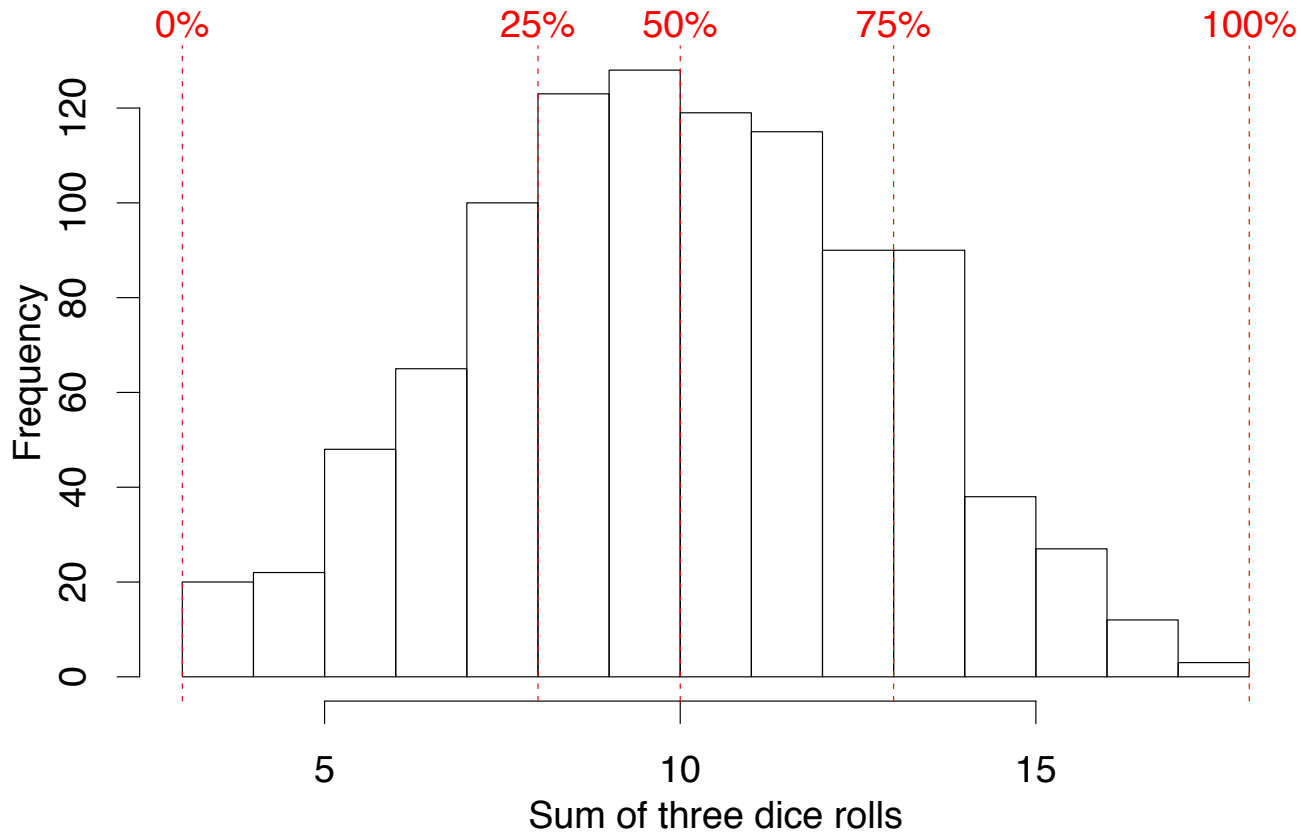
Mean = 5.1 Median = 3.5 Mode = 3 and 5

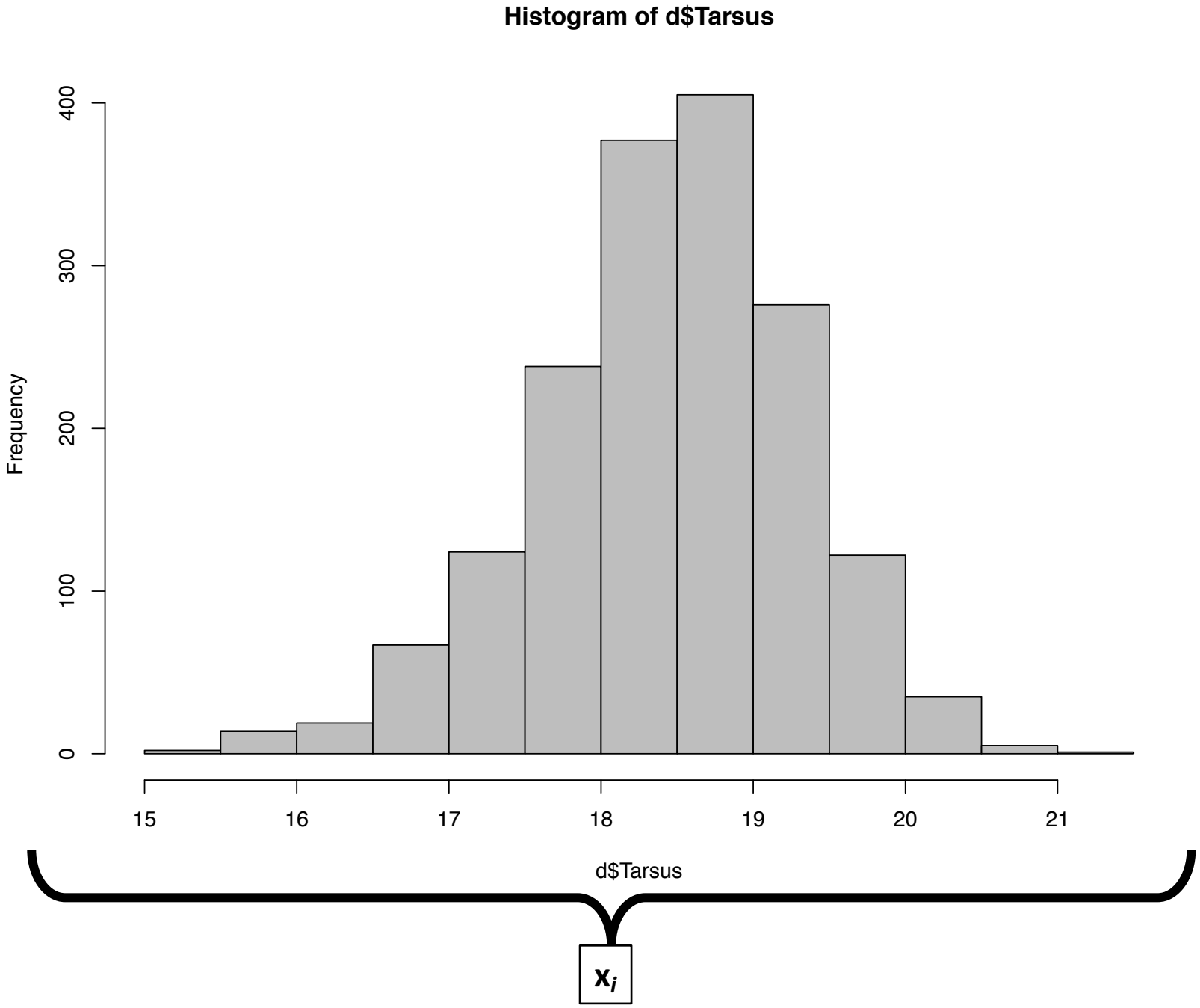
1.2	1.3	2.4	2.5	2.6	2.9	3.2	3.5	4.1	5.3

Mean = 2.9 Median = 2.75 Mode = ?!*

Quantiles

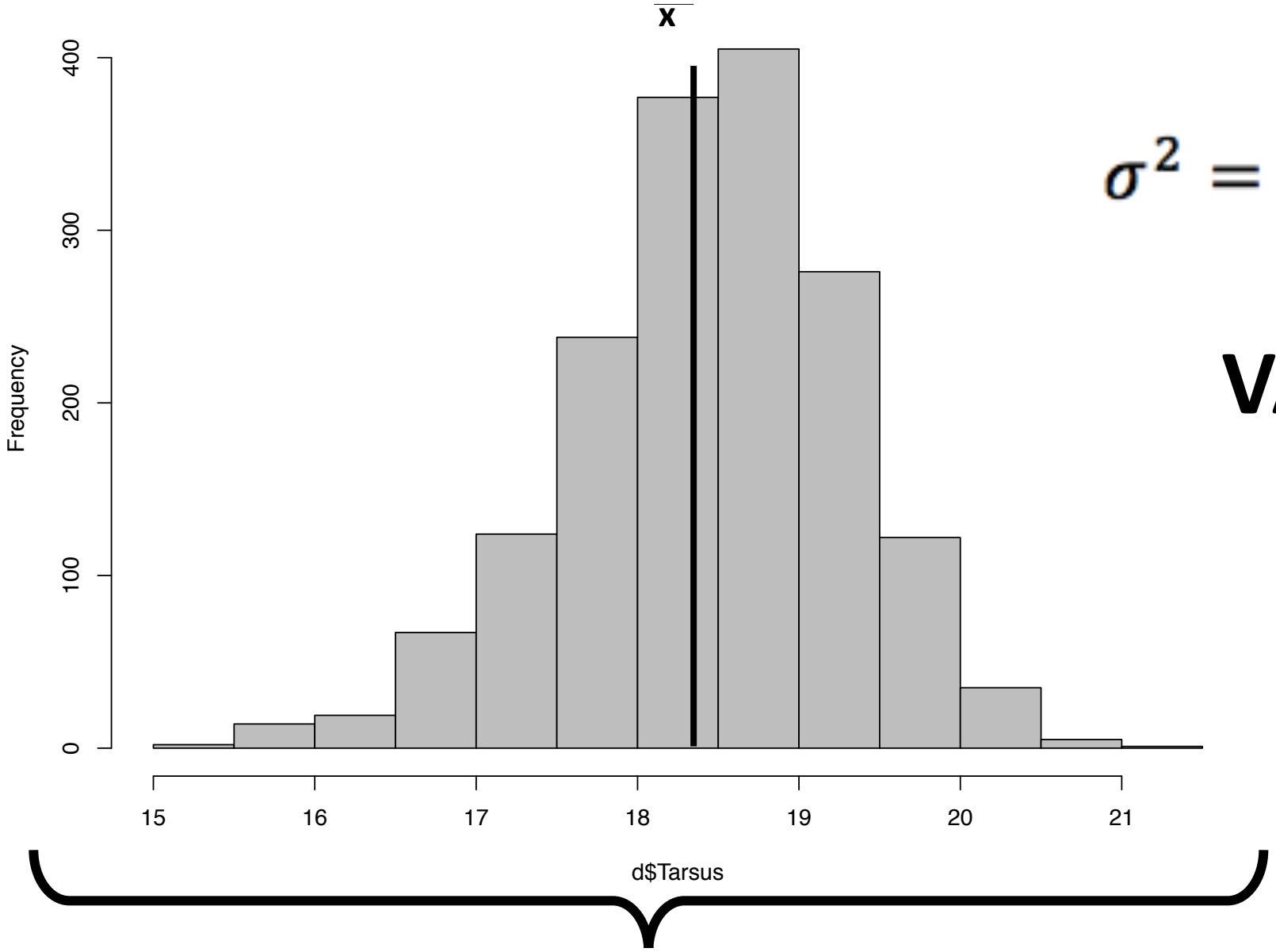
The value which a given percent of the data are smaller than or equal to.





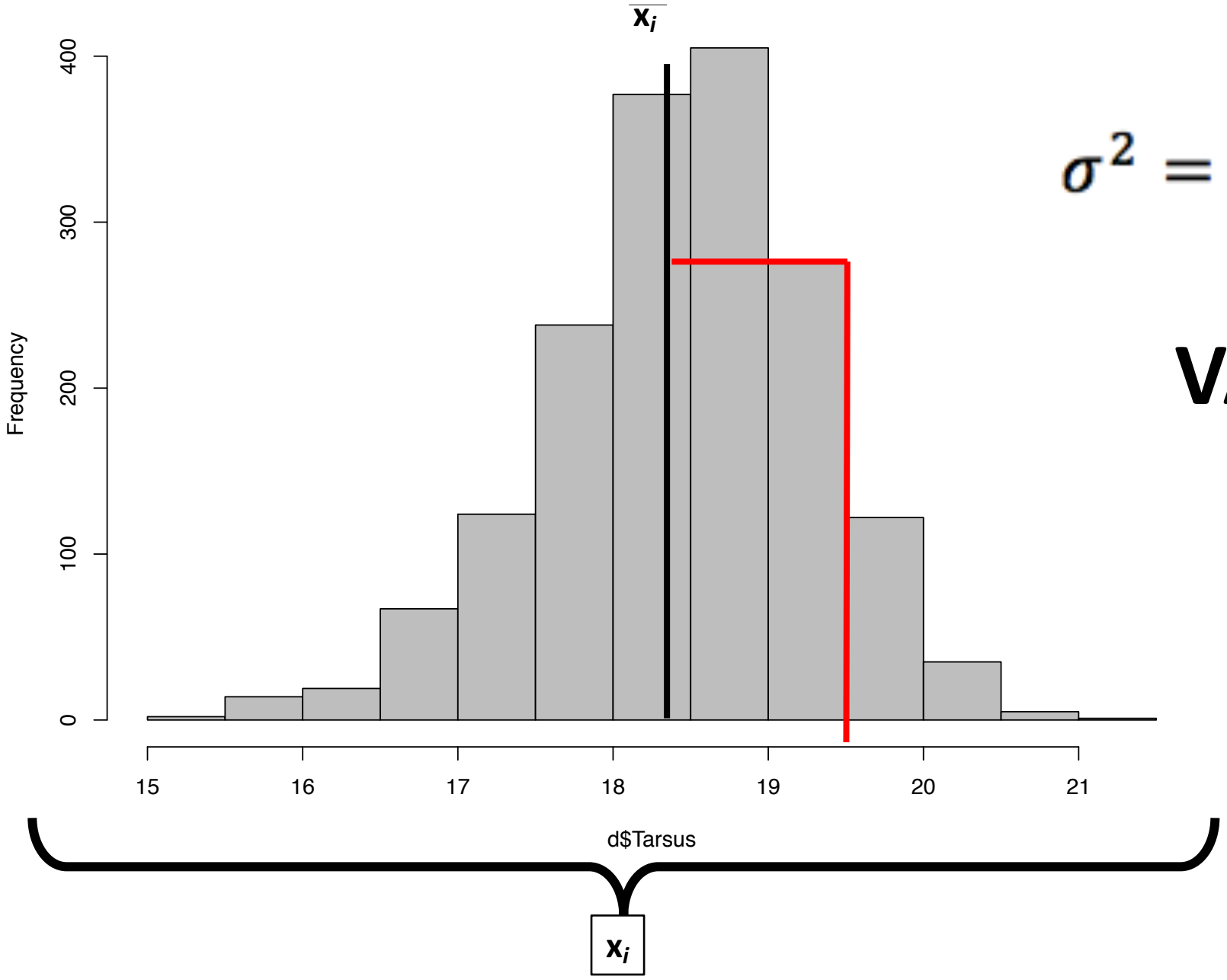
Describe data:

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



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

VARIANCE



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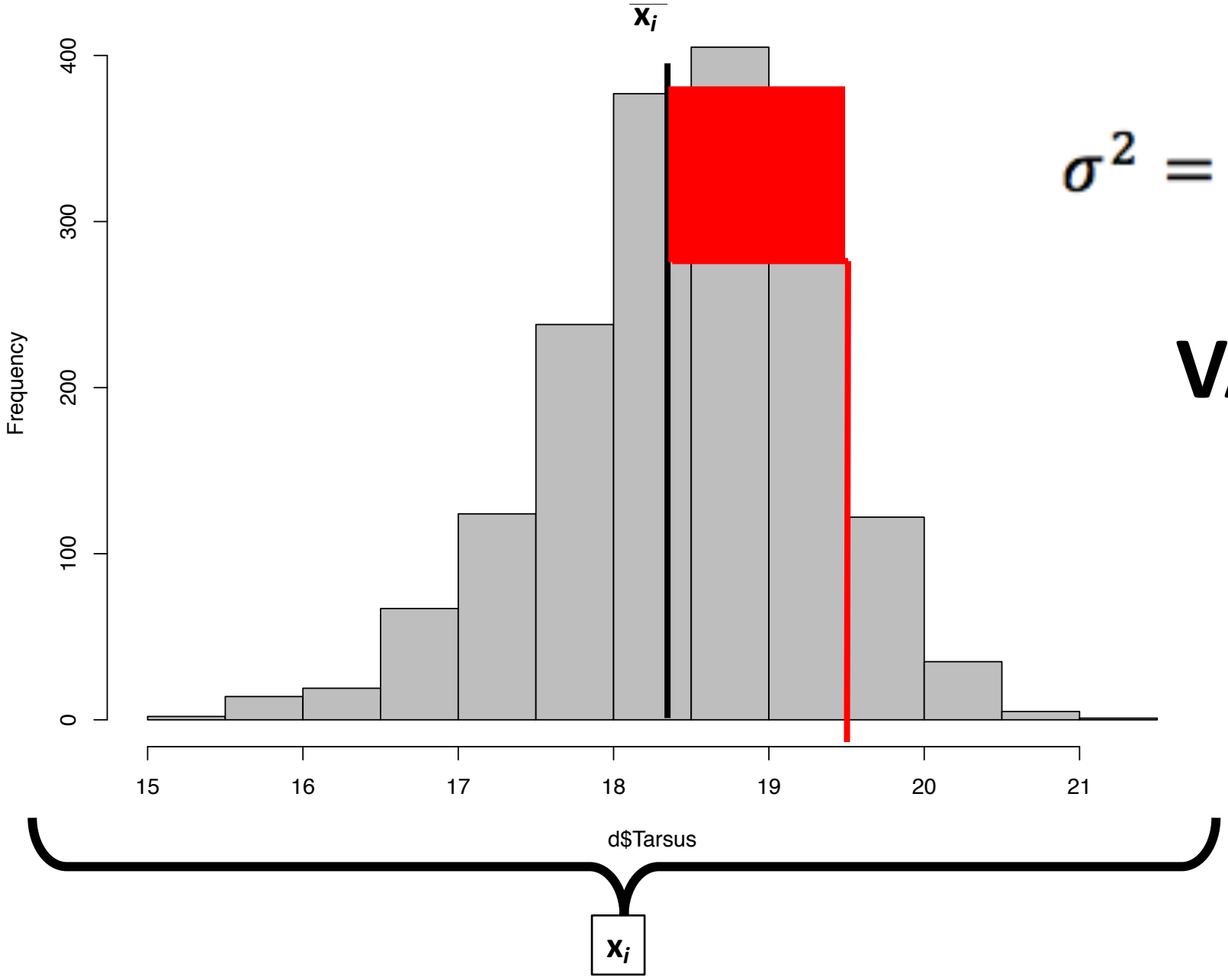

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VARIANCE

1.

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VARIANCE

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2.

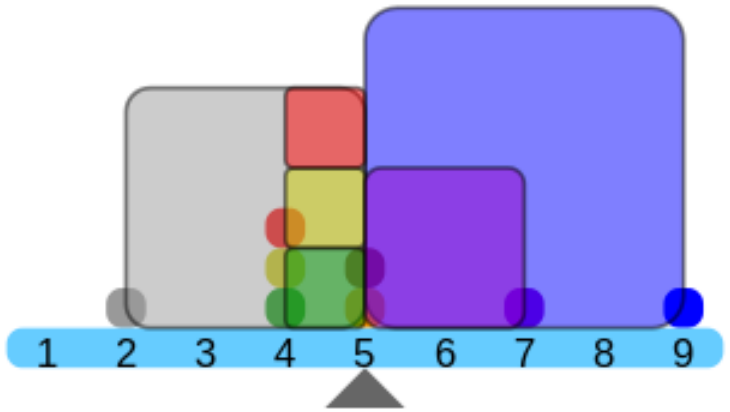
$$\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$$

VARIANCE

1.

2.

3.



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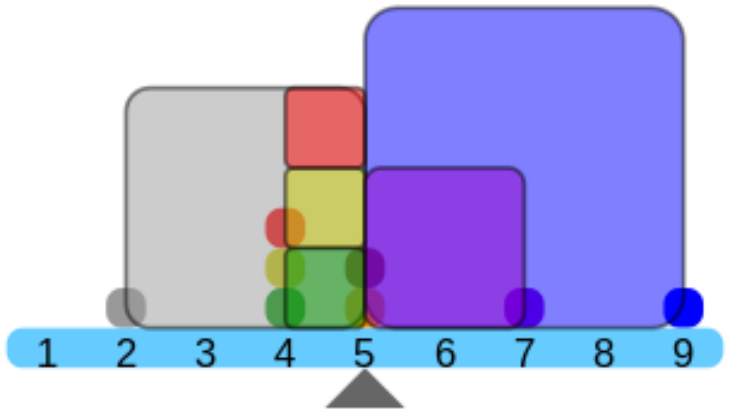
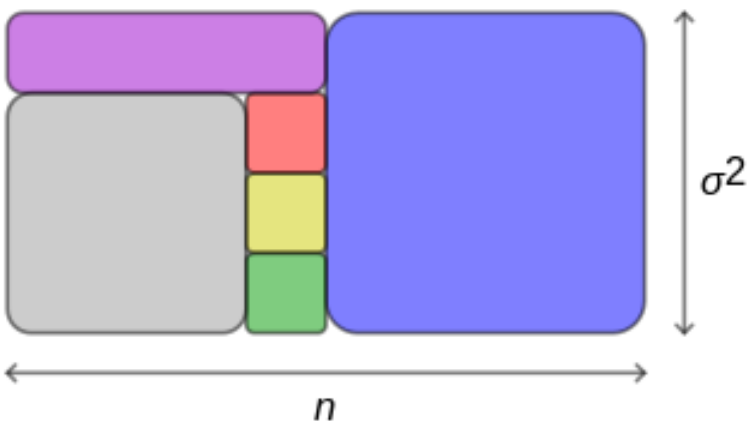


4.



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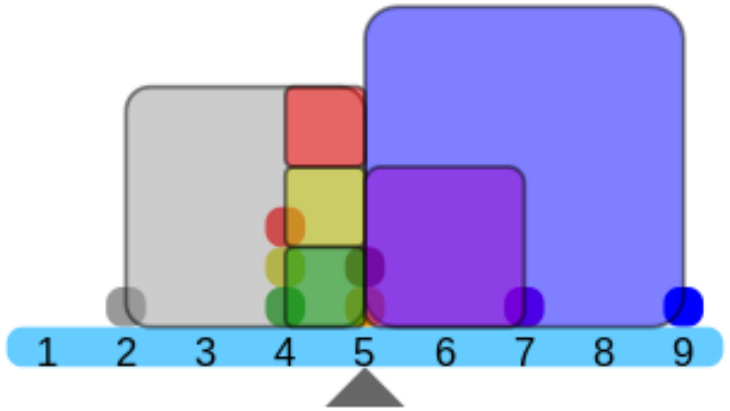

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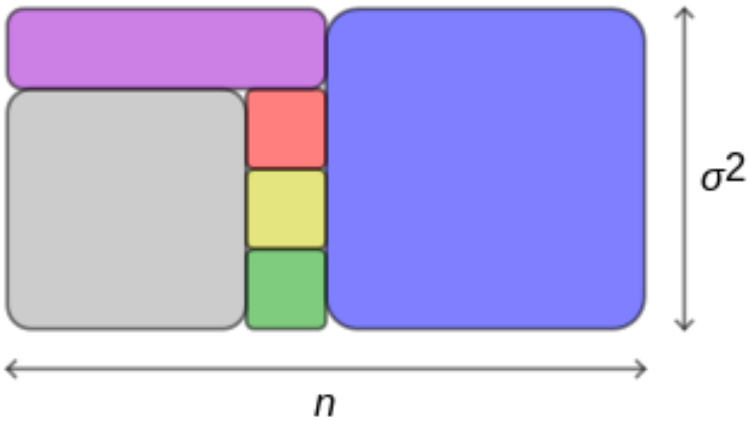

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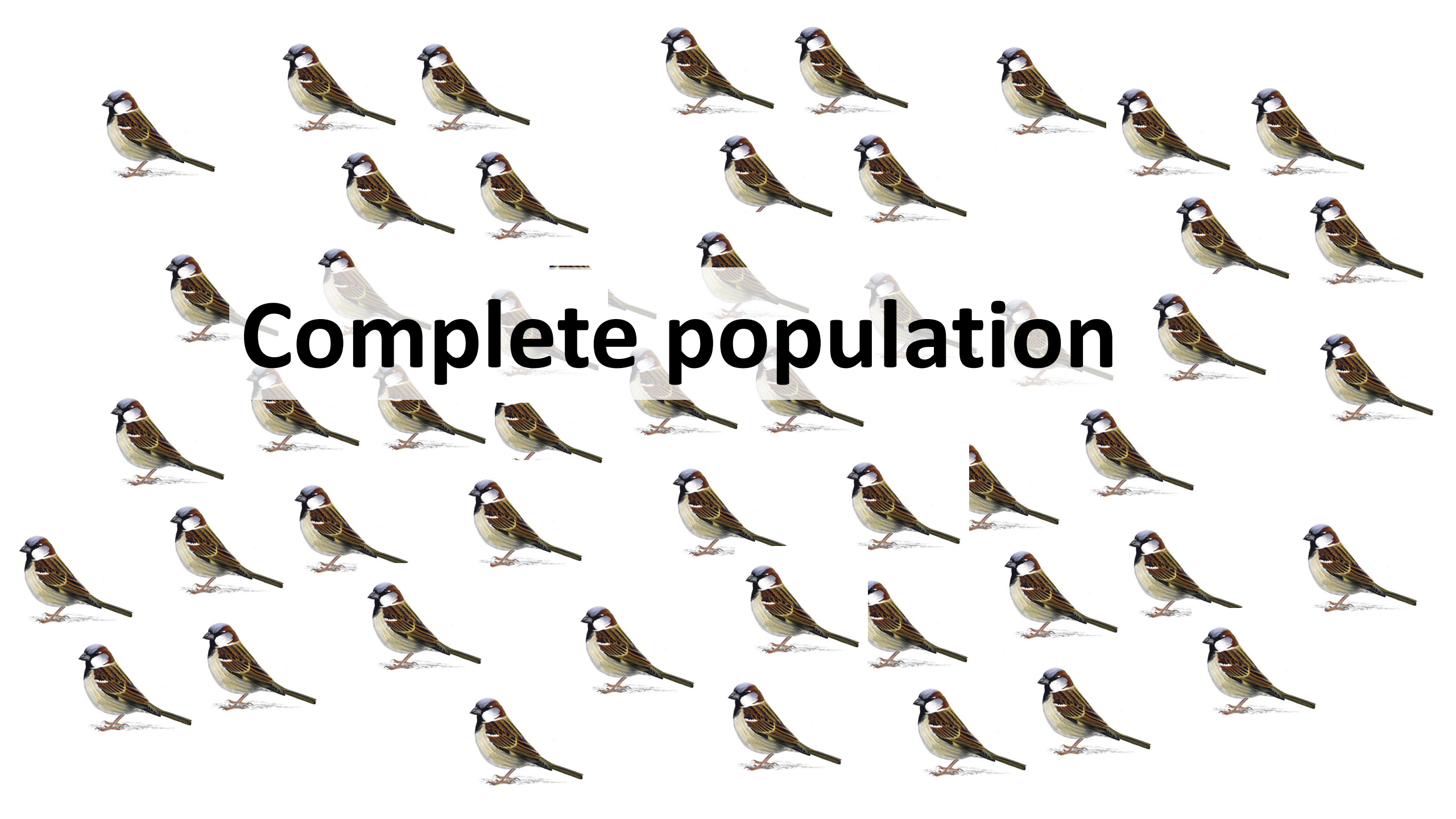
VARIANCE

Wait, WHAT?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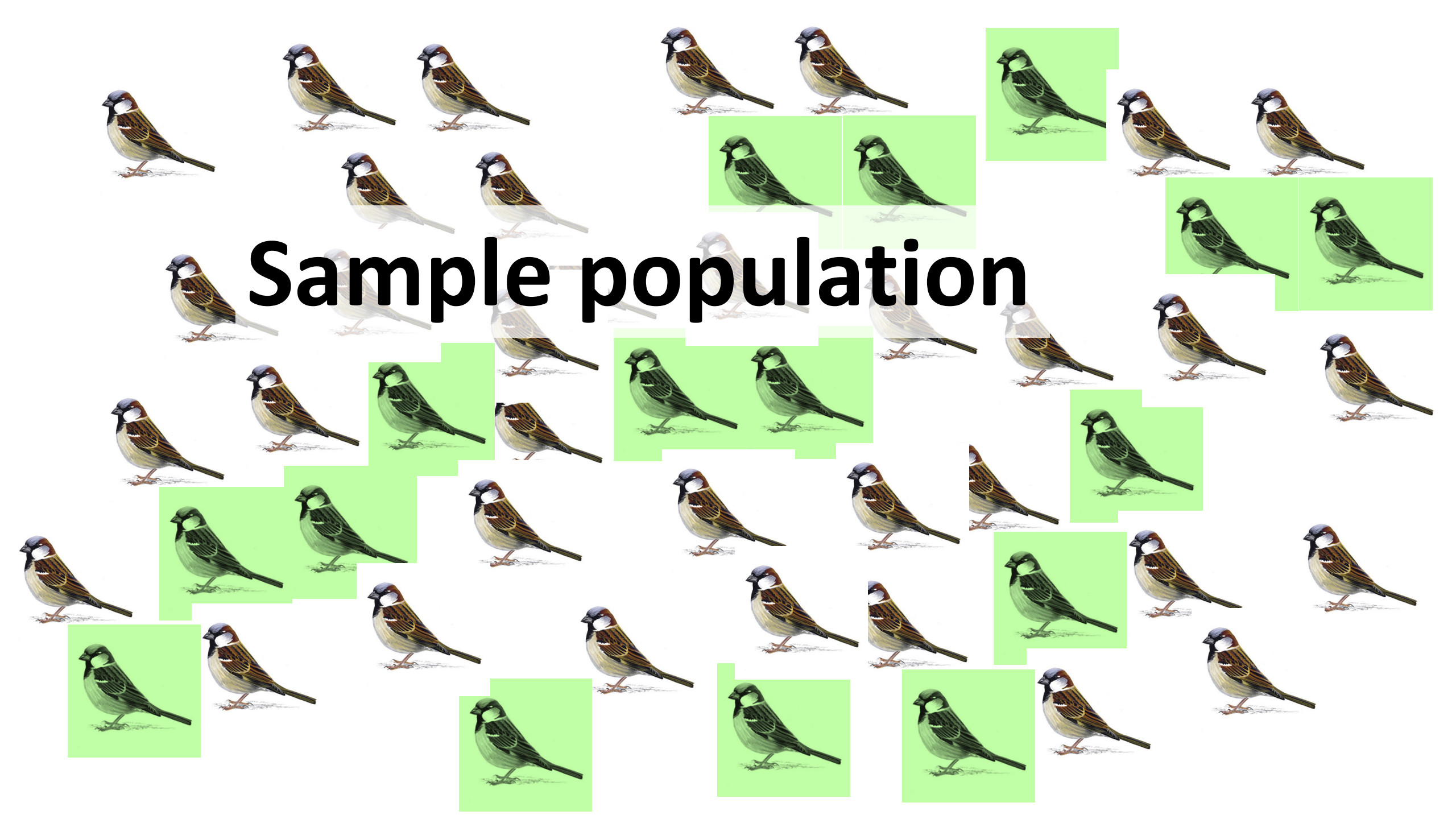
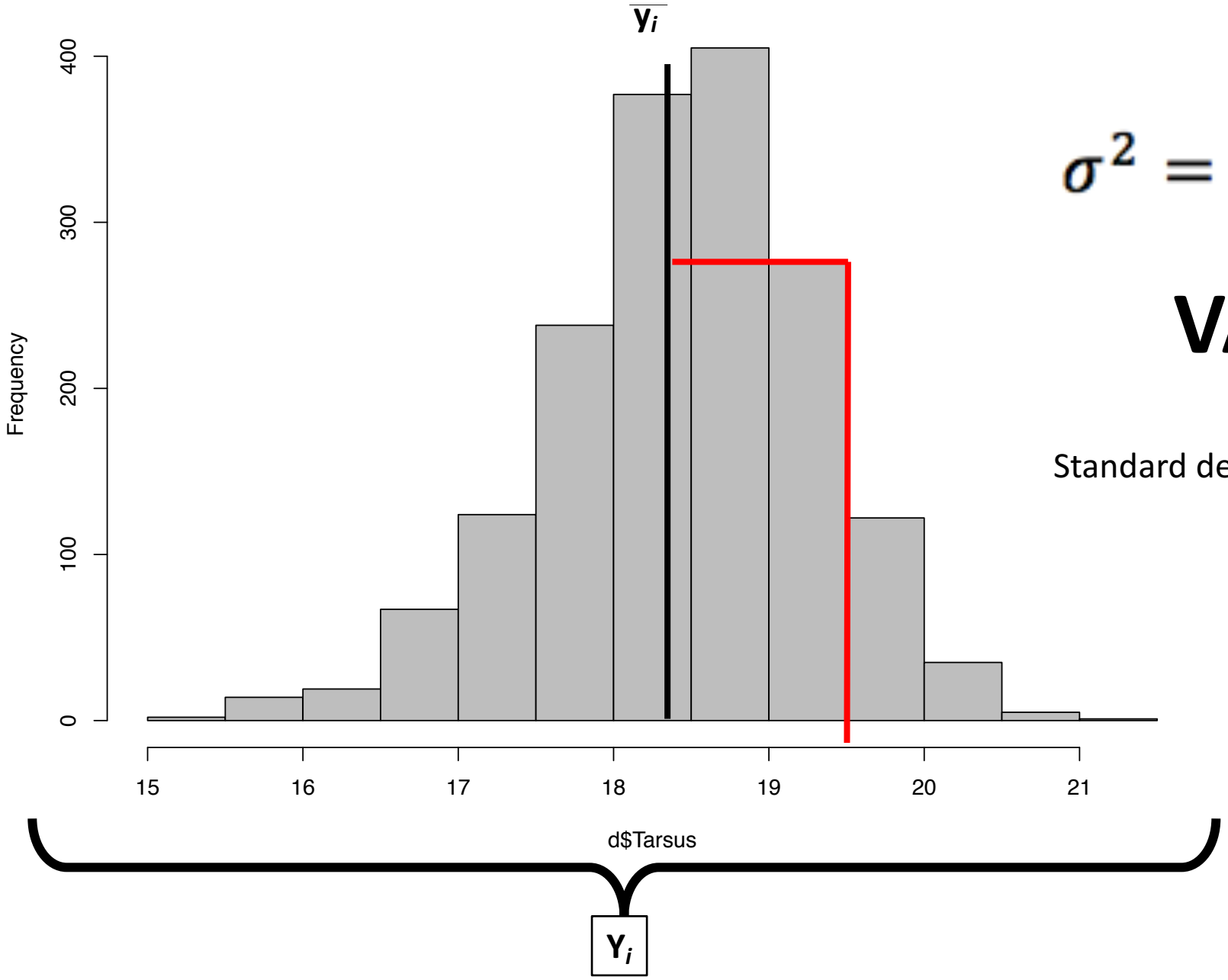

Sample population



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VARIANCE

Standard deviation is square root of variance

Standard deviation:

stdev video

http://ow.ly/3vC030fVxUs

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```

variance	0.74	?	?
sd	0.86	?	?
mean	18.52	?	?

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

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- What are the boxes, whiskers and circles in a boxplot?
- Explain the terms: sums of squares, mean of sum of squares