

Statistics with Spa OWS

Measures of precision of an estimate

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Outline

- Precision of sampling
- Standard error of mean
- How to improve statistical precision
- Square-root law of sample size
- 95CI

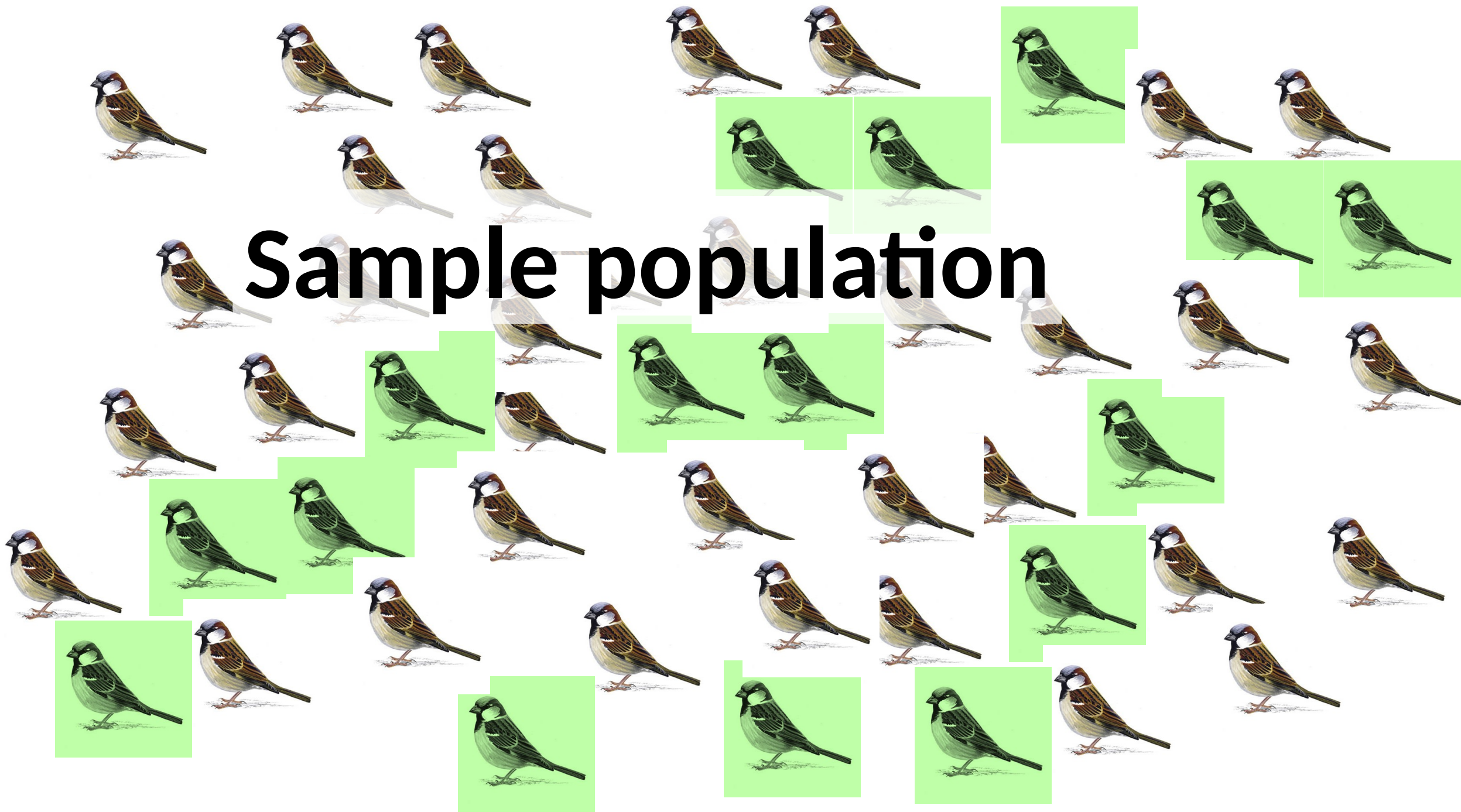
So what's the standard error then?

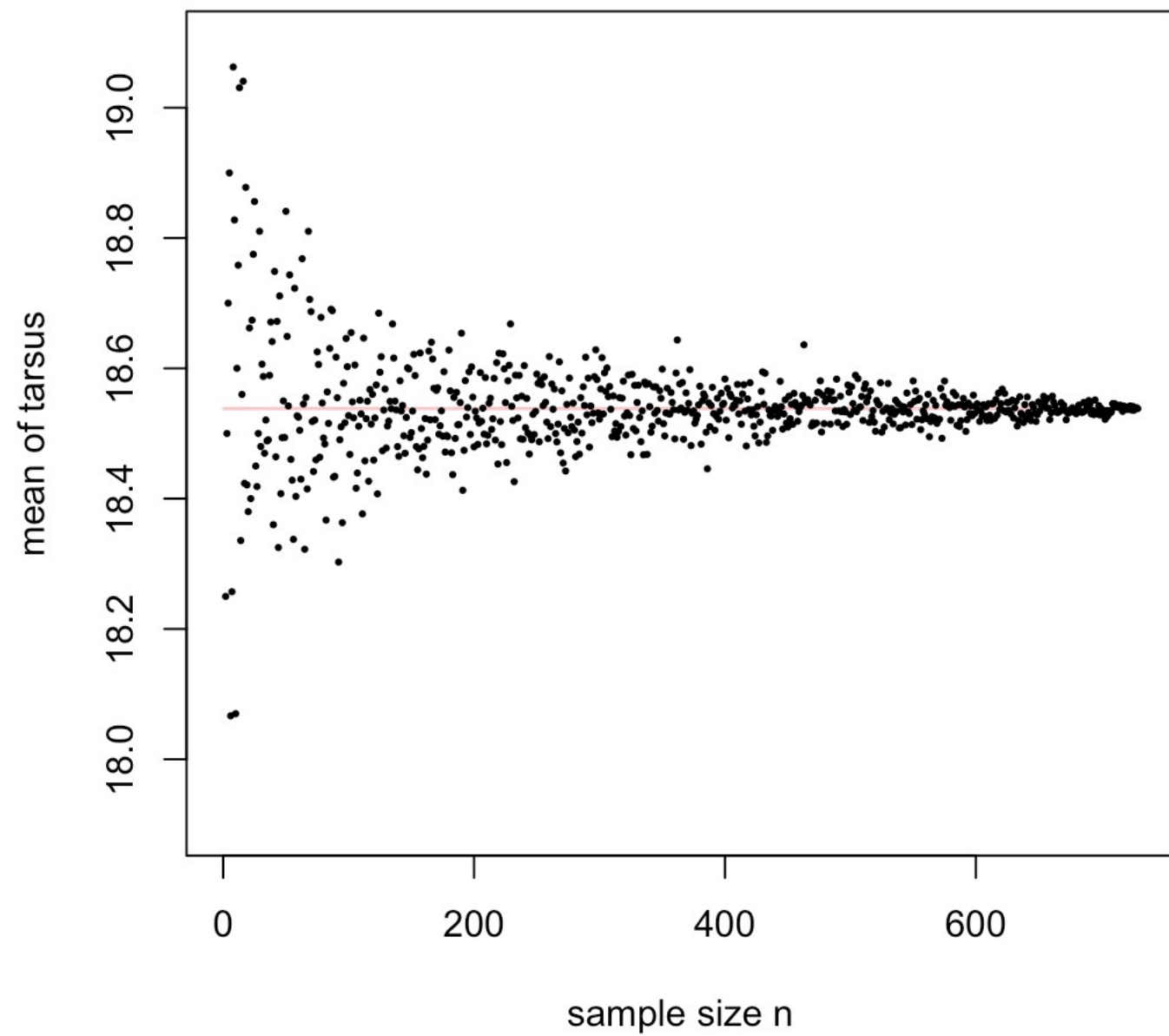
- Standard deviation describes the spread and variability of a distribution
- Standard errors describe the precision of the mean!
- It is really called: Standard error of the sampling distribution

The image features a large number of small, detailed illustrations of sparrows. They are arranged in a circular pattern around the central text, with some birds appearing in the foreground and others in the background, creating a sense of depth. The birds are shown in various poses, some facing left and some facing right. The central text is a large, bold, black sans-serif font that reads "Complete population".

Complete population

Sample population





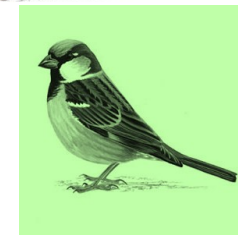
So what's the standard error the



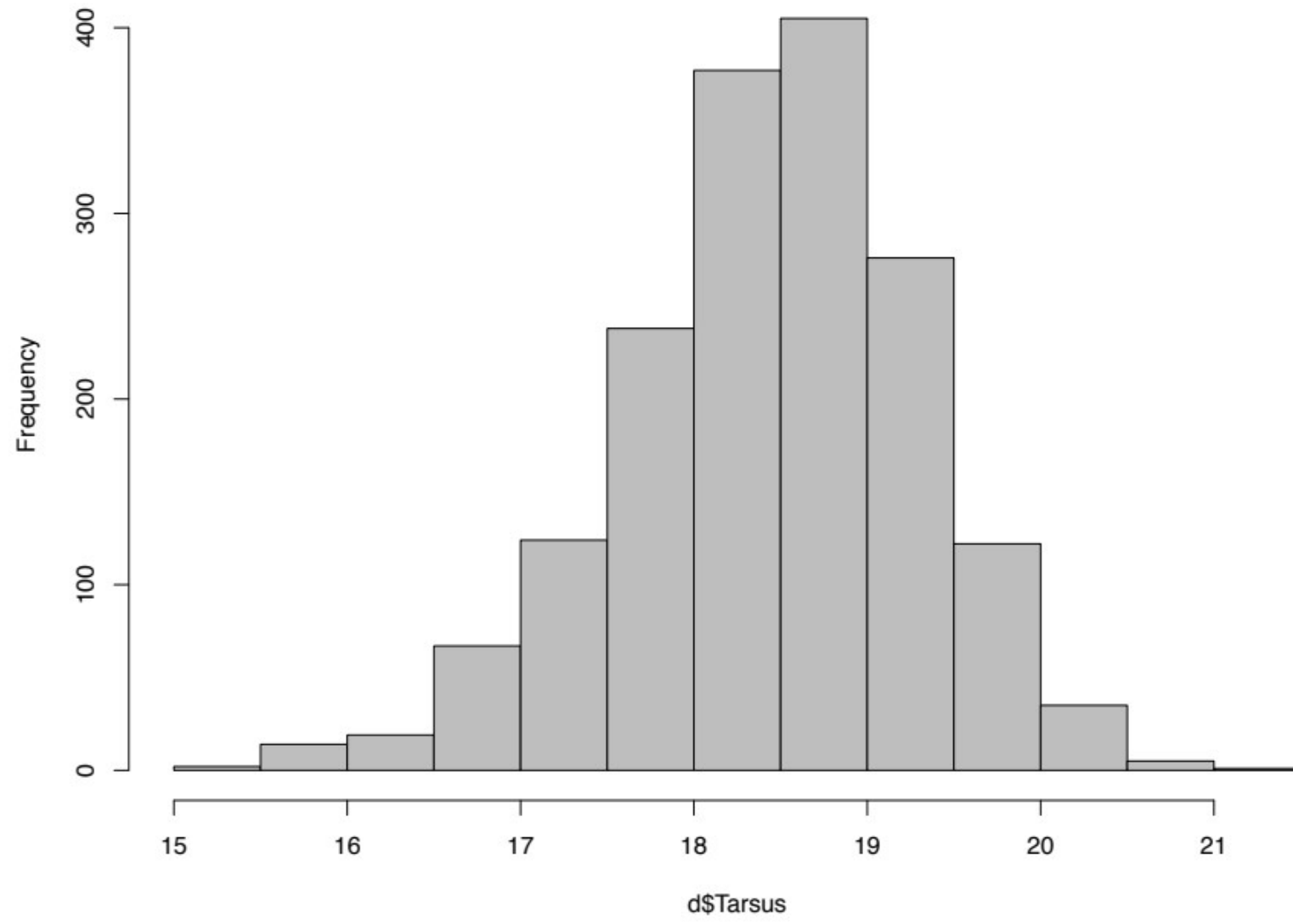
- It describes:



- How precise is the mean we calculate from a sample
- in comparison to the REAL mean?



Histogram of d\$Tarsus



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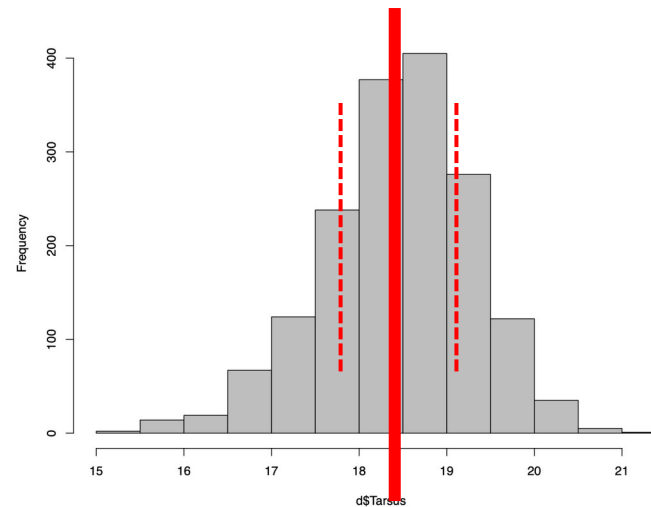
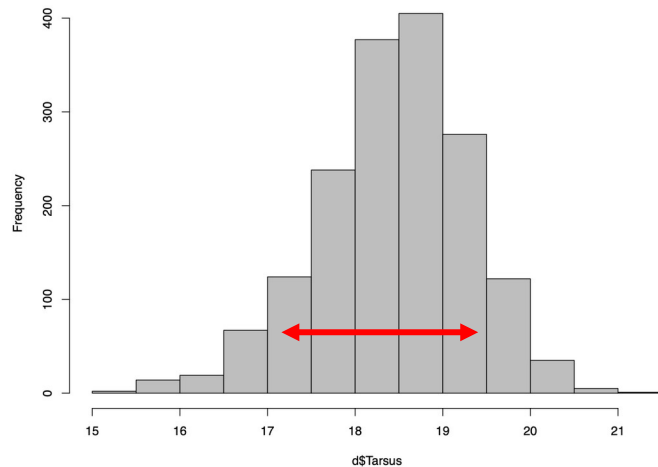
- Standard error of the mean
- Associated with the variance!
- Tied to the mean (or any mean-type estimate)!



$$SE = \sqrt{\frac{\sigma^2}{n}}$$

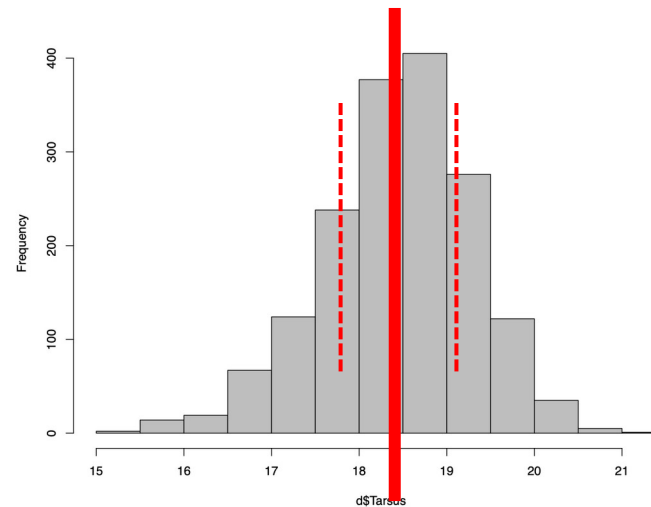
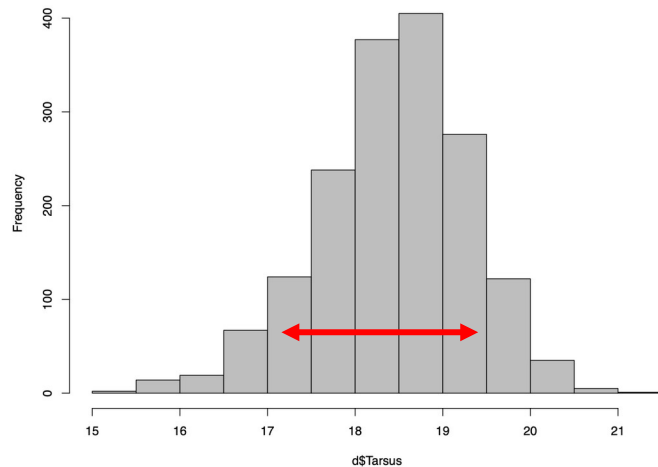
Standard error vs standard deviation

Standard deviation	Standard error
Describes the spread of the distribution	Quantifies the precision of an estimate



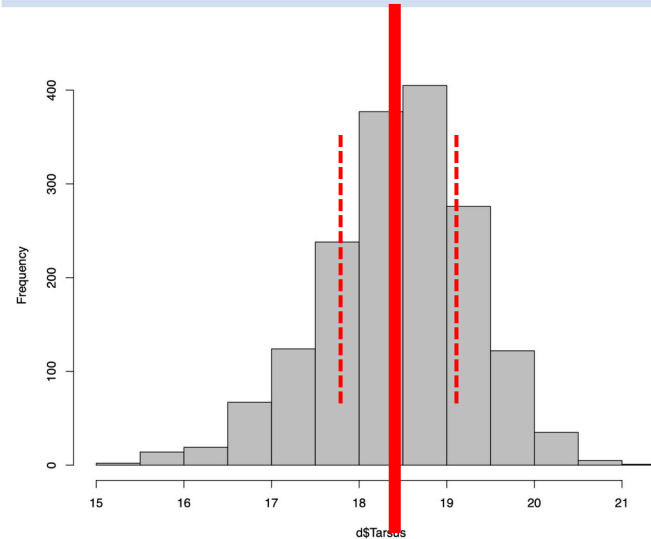
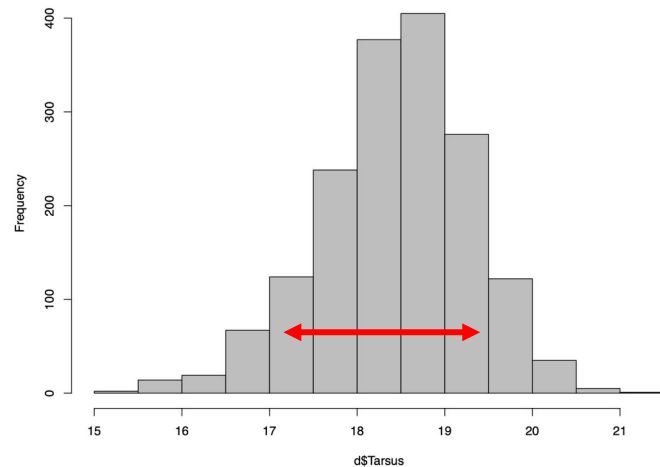
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Describes the spread of the distribution	Quantifies the precision of an estimate
The sqrt of the variance	
Descriptive of data	Descriptive of statistic (mean)



Standard error vs standard deviation

Standard deviation	Standard error
Describes the spread of the distribution	Quantifies the precision of an estimate (mean)
The sqrt of the variance	
Descriptive of data	Descriptive of statistic (mean)
	Quantifies our judgement
(mean, SD: 12.4, 3)	(mean \pm SE: 12.4 \pm 2.4)



Standard error is dependent on standard deviation and sample size!

$$SE = \sqrt{\frac{\sigma^2}{n}}$$

Standard error is dependent on
standard deviation and sample size!

Let's have a look at how that looks in R:

Standard error is dependent on standard deviation and sample size!

How can we double the precision?

Standard error is dependent on standard deviation and sample size!

How can we double the precision?

By its squared term!

Another measure of precision: 95CI

- The 95% confidence interval

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- Encompasses the population “true” value

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$$95\text{ }CI = \pm 1.96\text{ }se$$

Another measure of precision: 95CI

- The 95% confidence interval
- Encompasses the population true mean Guesstimate: 2 SE

$$95\text{ }CI = \pm 1.96\text{ }se$$

Centrality and spread:

- Most popular:
 - mean
 - Measure of precision:
 - SE
 - Mean \pm SE
- Two similarly meaningful measures:
 - Variance
 - Standard deviation
 - Measure of precision:
 - ? none

SE \neq SD

- SE

- Measure of precision of mean
- Secondary statistic
- (primary is mean)

- Mean, variance
- Mean \pm SE, variance

- SD

- Measure of spread of data
- Primary statistic

- Mean, SD
- Mean \pm SE, SD

- ~~Mean \pm SD~~ WRONG

Descriptive statistics

- a measure of mean, plus uncertainty (SE, 95CI)
 - a measure of spread (variance or SD)
 - sample size
-
- Missing values
 - Data structure

Exercise. (no hand out – flying solo!):

Exercise:

- How can we calculate SE in R? Is there a package?
- Calculate SE of Tarsus
- Then, calculate SE for Tarsus of a subset the dataset – only 2001 data
- Do the same for the variables Wing length, Bill length, Body mass
- Have a think: can we calculate the SE of variance? Discuss on module board

Learning aims:

- How to calculate SE
- SE is a measure of precision
- SE is dependent on sample size
- To improve precision, we have to improve sample size by the square value!
- 95CI
- Know the difference between SD and SE
- Know the difference between describing data and describing statistics