Measures of spread

STATISTICAL TECHNIQUES IN TABLEAU

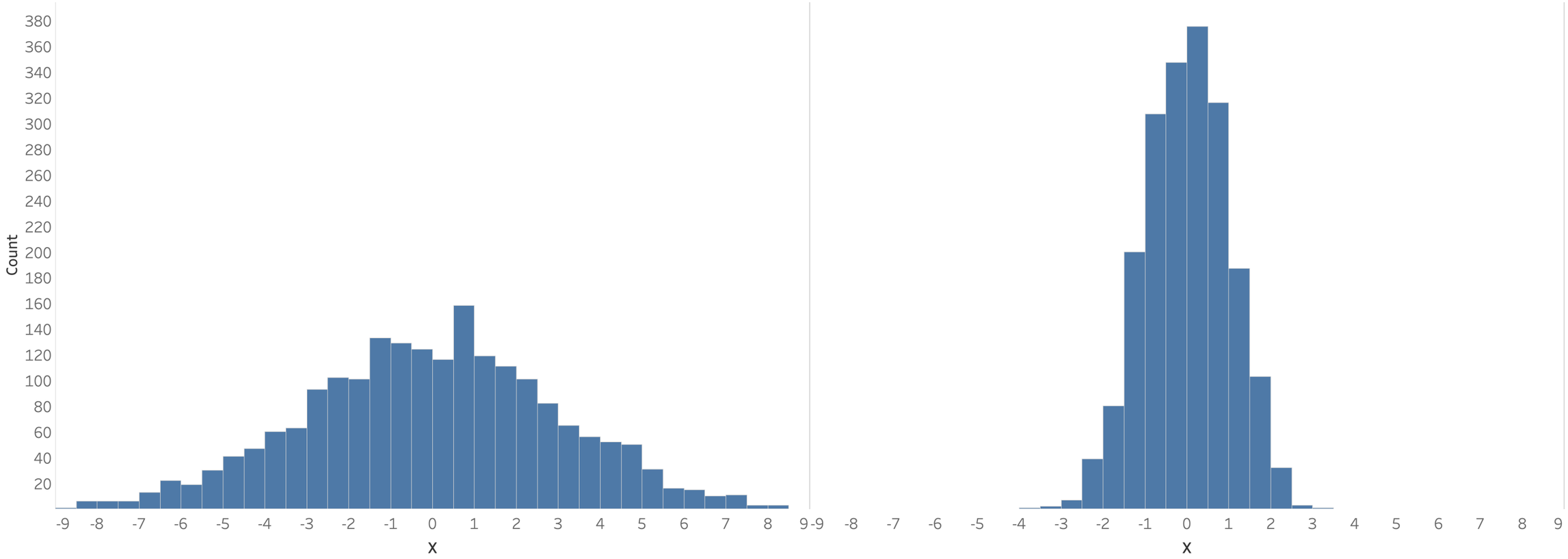
Maarten Van den Broeck
Content Developer at DataCamp

datacamp

Statistics for describing a variable

Statistic	Description
Count	number of observations
Median	midpoint of your observations
Average	mean value of your observations
Min/Max	lowest and highest value
Quartile/IQR	25th and 75th percentile / spread of the 50% of your middlemost observations
Modality/Mode	number of modes / most occurring value
Skewness	(a)symmetry of the distribution
Kurtosis	distribution of extreme values

Measures of spread



- Spread is affected by kurtosis (outliers) and skewness (asymmetry)
- Typically, spread around the mean is only useful for normal distributions

Variance

$x_i - \overline{x}$

$(x_i - \overline{x})^2$

$\sum(x_i - \overline{x})^2$

$\frac{\sum(x_i - \overline{x})^2}{n-1}$

x_i = individual data point, $\overline{x}$ = sample mean

n = number of observations

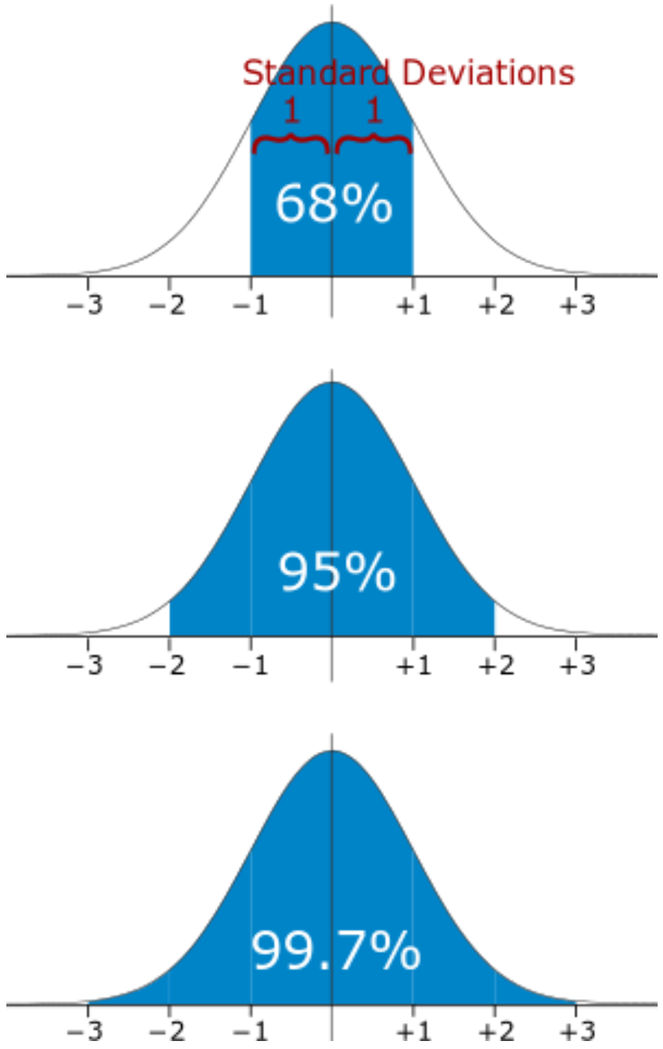
- Variance is the average of the squared differences from the mean
- Higher variance means higher spread of the data
- Unit of variance is squared

[1] Note: you don't need to memorize the formulas. They unveil the black box of Tableau's calculations.

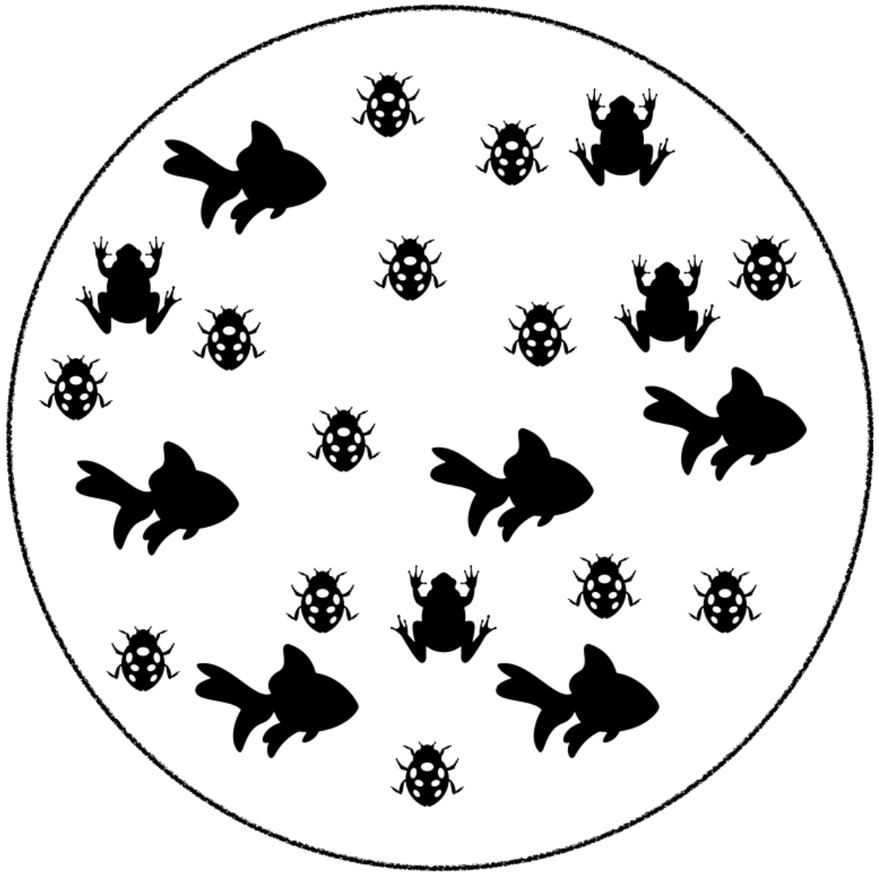
Standard deviation (SD or s)

$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$ or $s = \sqrt{variance}$

- Unit of standard deviation is same as the variable
- How far on average lie the data points from the mean
- 68% of the observations lies within $[-1s, 1s]$ range if data is normally distributed
- Number of standard deviations can be used as a threshold to pinpoint unusual values

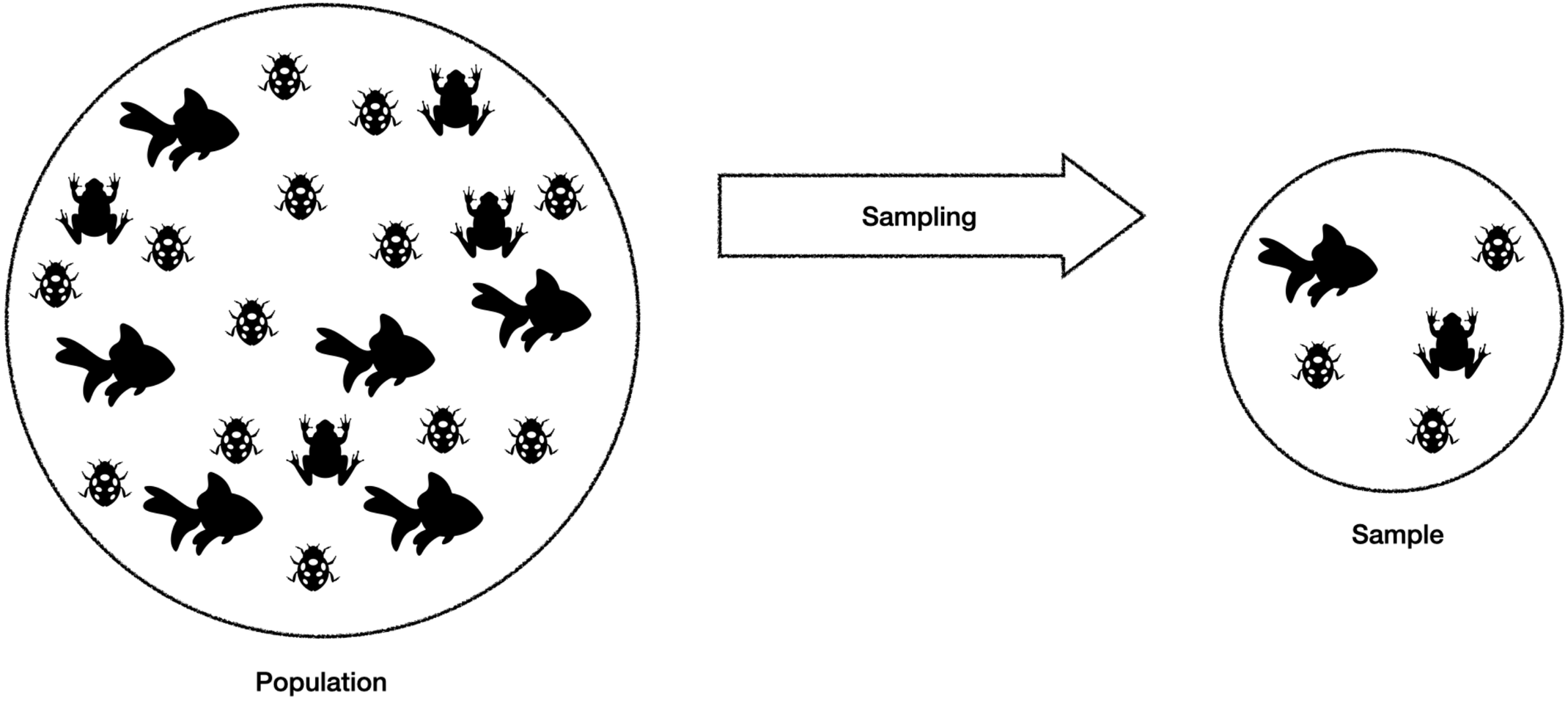


Population vs. sample

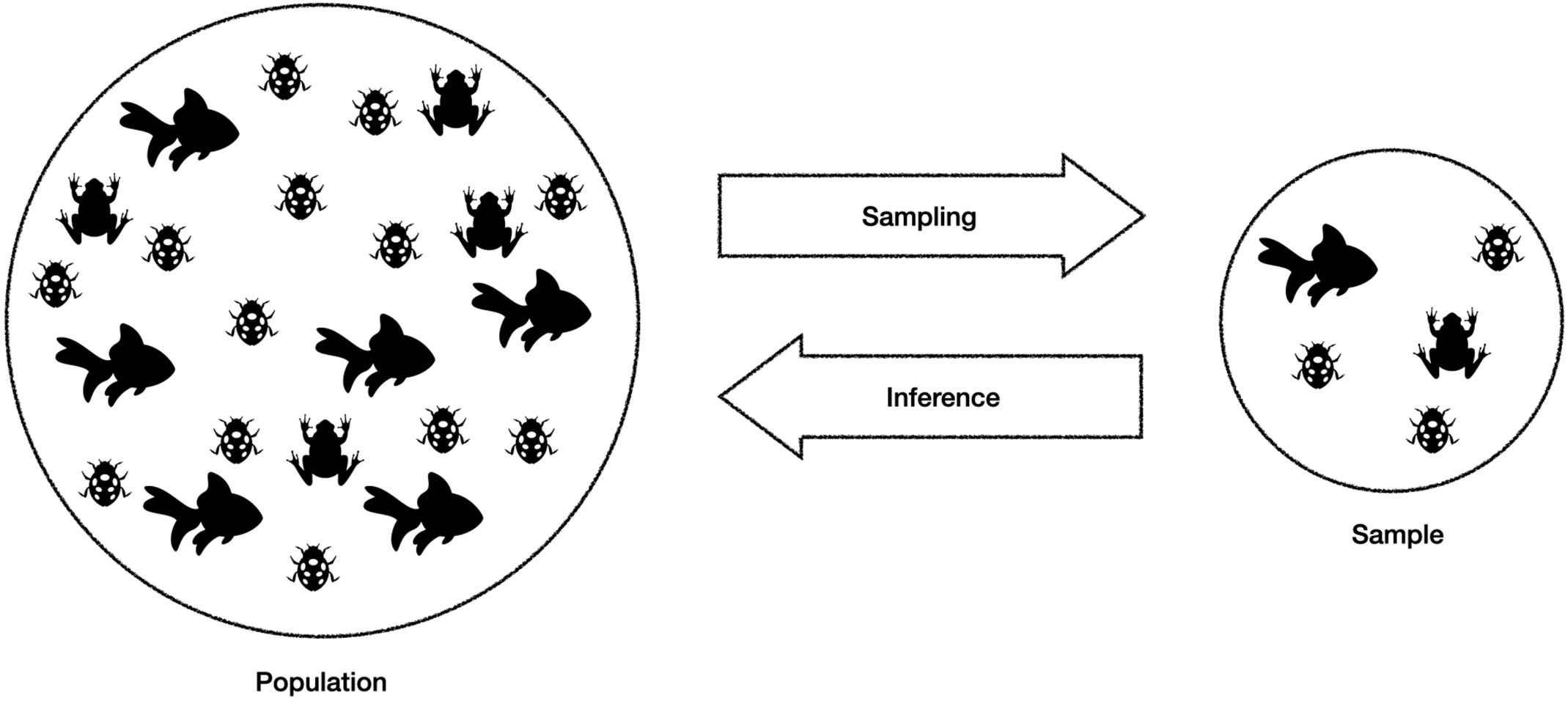


Population

Population vs. sample



Population vs. sample



Calculating spread in sample vs. population

Sample variance s^2

$$s^2 = \frac{\sum(x_i - \overline{x})^2}{n-1}$$

data per country (sample)
generalize for Europe (population)

Sample standard deviation s

$$s = \sqrt{\frac{\sum(x_i - \overline{x})^2}{n-1}}$$

$\overline{x}$ = sample mean

n = sample size

Population variance σ

$$\sigma^2 = \frac{\sum(x_i - \mu)^2}{N}$$

data of your university (population)
no need for generalizing

Population standard deviation σ^2

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

μ = population mean

N = population size

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Calculating spread in sample vs. population

Sample variance s^2

$$s^2 = \frac{\sum(x_i - \overline{x})^2}{\mathbf{n - 1}}$$

data per country (sample)
generalize for Europe (population)

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Let's practice!

STATISTICAL TECHNIQUES IN TABLEAU

Tableau: summary cards and spread

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STATISTICAL TECHNIQUES IN TABLEAU

Standard error and confidence intervals

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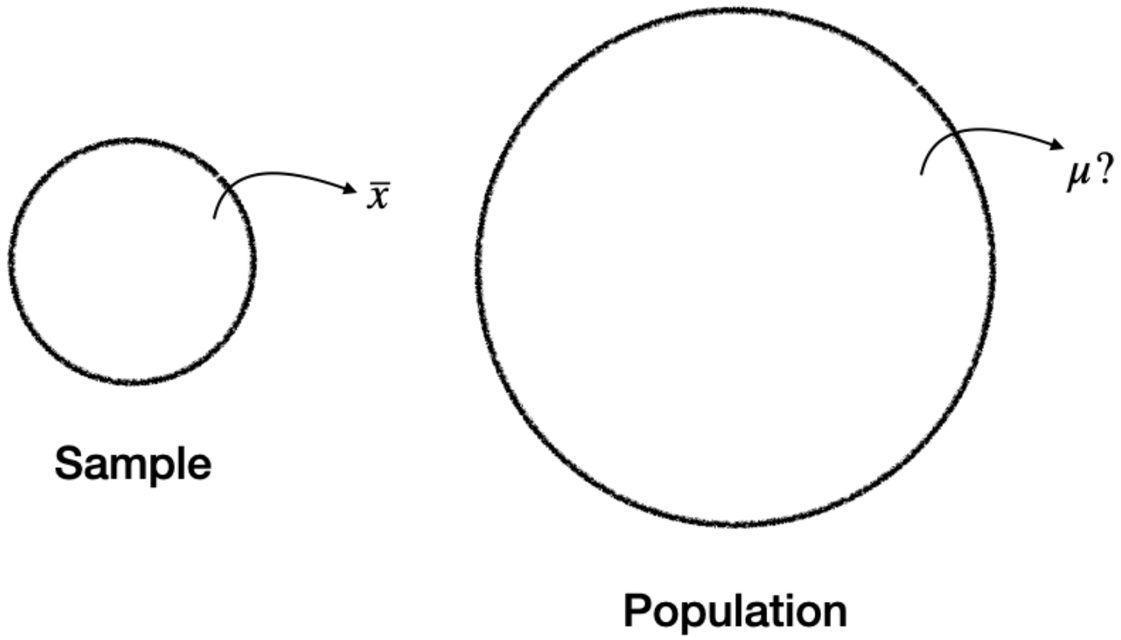
The standard error (SE)

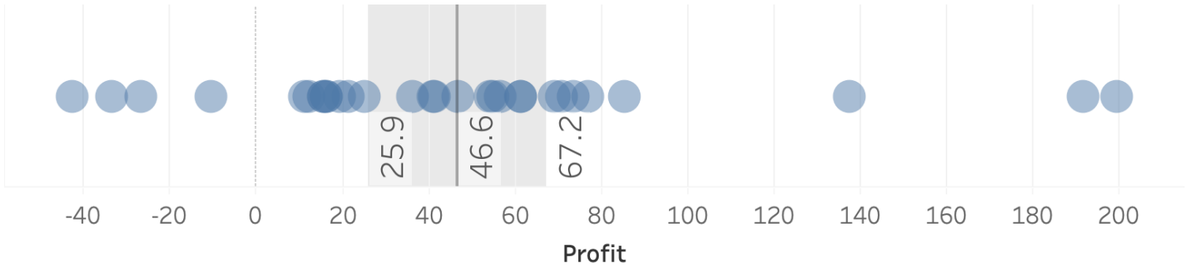


- $SE = \frac{SD}{\sqrt{n}}$ SD = standard deviation
  n = sample size
- Larger sample size means smaller SE

- Standard error of the mean: how much the sample mean and population mean deviate

The confidence interval (CI)

"I'm 95 percent confident that the true population mean lies within the ranges of my confidence interval."



- When taking more samples, 95% of the confidence intervals will contain the true population mean
- Sample $n = 30$
  - Sample mean $\overline{x}$ = `46.6`
  - Lower bound = `25.9`
  - Upper bound = `67.2`
- Population mean = `44.4`
- $CI = \overline{x} \pm level * SE$
- $level = 1.96$ for 95% CI

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STATISTICAL TECHNIQUES IN TABLEAU

Tableau: adding lines and distribution bands

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