# Sampling

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# Example

- Consider a population consisting of the values 3, 5, 9, 11 and 14. For his data set, we have $\mu = 8.4$ and $\sigma = 4.4497$. Suppose we want to take samples of size 2 from this population. Find all possible pairs and find the mean for each sample.

| *Pair* | 3,5 | 3,9 | 3,11 | 3,14 | 5,9 | 5,11 | 5,14 | 9,11 | 9,14 | 11,14 |
|---|---|---|---|---|---|---|---|---|---|---|
| *x* | 4 | 6 | 7 | 8.5 | 7 | 8 | 9.5 | 10 | 11.5 | 12.5 |

- What is the mean of all the possible values of x for these samples of size two and what is the standard deviation?
- Mean = 8.4
- Std = 2.569

# Example

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| *Pair* | 3,5,9 | 3,5,11 | 3,5,14 | 3,9,11 | 3,9,14 | 3,11,14 | 5,9,11 | 5,9,14 | 5,11,14 | 9,11,14 |
|---|---|---|---|---|---|---|---|---|---|---|
| $x$ | 5.67 | 6.33 | 7.33 | 7.67 | 8.67 | 9.33 | 8.33 | 9.33 | 10 | 11.33 |

- What is the mean of all the possible values of x for these samples of size two and what is the standard deviation?
- Mean = 8.4
- Std = 1.713

- Suppose that x is the mean of a simple random sample of size n drawn from a large population. If the population mean is μ and the population standard deviation is σ, then the mean of the sampling distribution of x is μ = μ  and the standard deviation of the sampling distribution is σ = σ / sqrt(N)
- If our original population has a normal distribution, the sample mean' s distribution is N (μ, σ / sqrt(N))
- An **unbiased statistic** is a statistic used to estimate a parameter in such a way that mean of its sampling distribution is equal to the true value of the parameter being estimated. We consider the above values to be unbiased estimates of our distribution.

- The **Central Limit Theorem** states that if we draw a simple random sample of size n from any population with mean μ. and standard deviation σ, when n is large the sampling distribution of the sample mean is close to the normal distribution N(μ, σ / sqrt(N)).
- Determining whether n is large enough for the central limit theorem. to apply depends on the original population distribution.
- The more the population distribution's shape is from being normal, the larger the needed sample size will be.
- A rule of thumb is that n > 30 will be large enough.

- The mean TOEFL score of international students at a certain university is normally distributed with a mean of 490 and a standard deviation of 80· Suppose groups of 30 students are studied. Find the mean and the standard deviation for the distribution of sample means.
- Mean = 490
- Std = 80 / Sqrt(30)

- A waiter estimates that his average tip per table is \$20 with a standard deviation of \$4. If we take samples of 9 tables at a time, calculate the following probabilities when the tip per table is normally distributed.
  - What is the probability that the average tip for one table is less than \$21?
    - $P(X<21) = 0.7734$
  - What is the probability that the average tip for one table is more
    - $P(X>21) = 0.2266$
  - What is the probability that the average tip for one table is between \$19 and \$21? than \$21?
    - $P(19<X<21) = 0.5468$