7.4 & 7.5 Sampling Distributions and the Central Limit Theorem

Parameters, Statistics, and inferences

A statistic is a numerical measure describing a sample.

Notation of Statistics and Parameters

Measure	Statistic	Parameter
Mean	$\overline{x}$ (x-bar)	μ (mu)
Variance	s^2	σ^2 (sigma squared)
Standard Deviation	s	σ (sigma)
Proportion	$\hat{p}$ (p-hat)	p

Inferences

is the logical process of reaching a conclusion based on evidence, reasoning, and established facts,

Ex: if there is smoke, there will be fire. we are not 100% sure.

Types of Inferences

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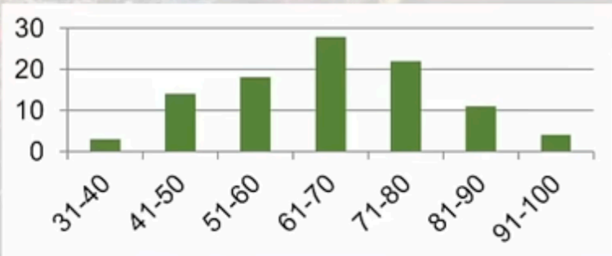
1. Estimation: we estimate the value of a population *parameter* using a *sample*
2. Testing: we do a test to help us make a *decision* about a population parameter
3. Regression: we make *predictions or forecasts* about a statistic

Requires understanding sampling distributions and the Central Limit Theorem

Frequency vs. Sampling Distribution

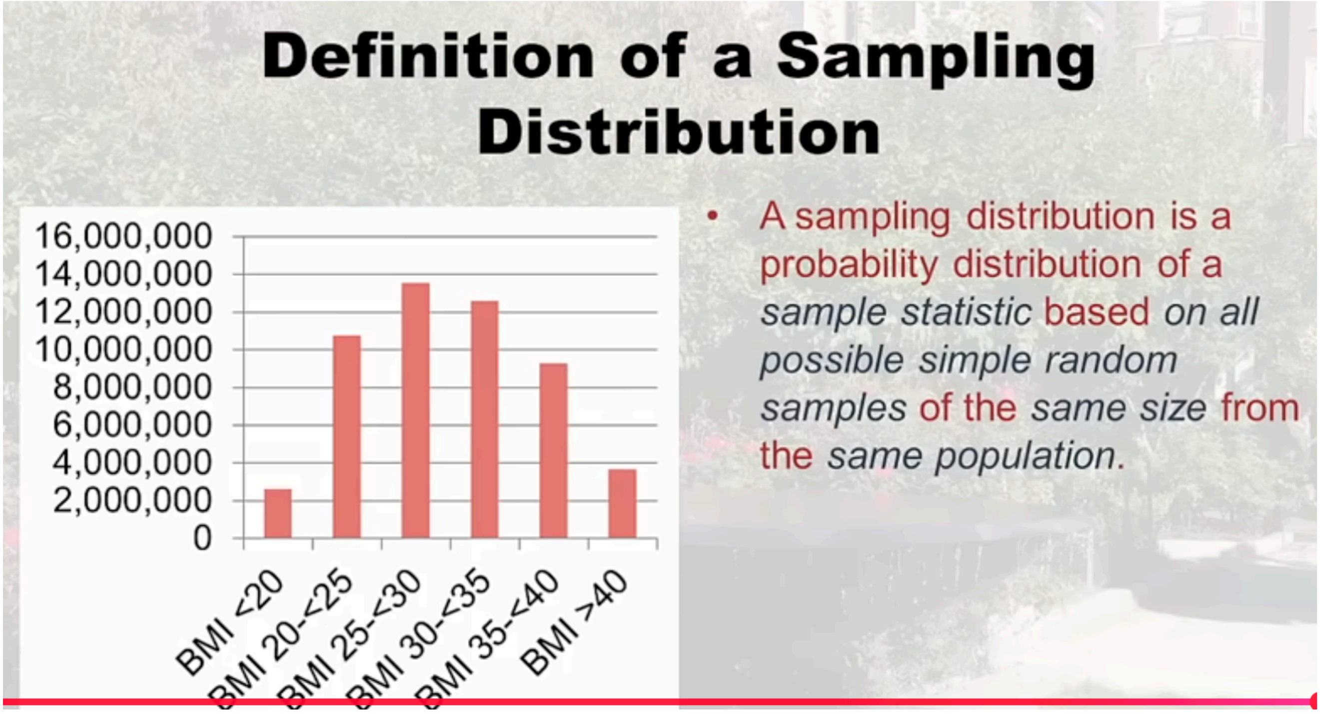
Frequency Distribution

1. Make a histogram of a quantitative variable.
2. Draw the shape and name the distribution.

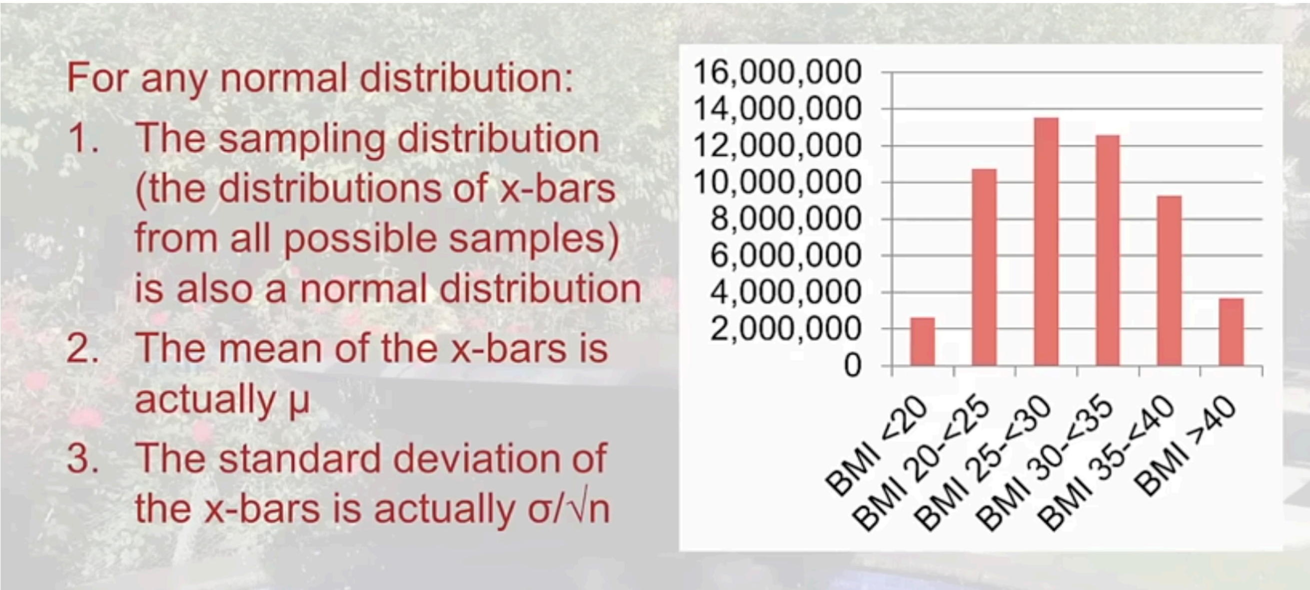


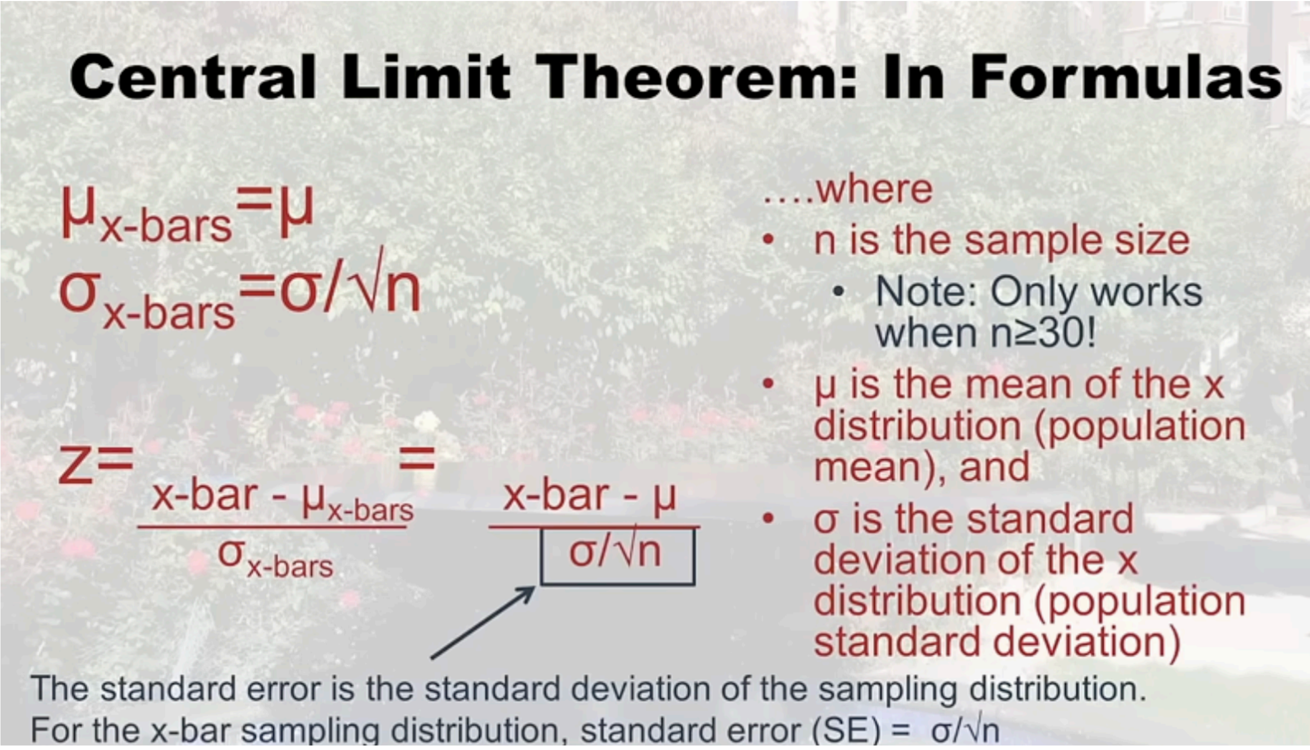
Sampling Distribution

1. Start with a population.
2. Decide on an n.
3. Take as many samples of n as possible from the population.
4. Make an x-bar for each sample.
5. Make a histogram of all the x-bars.

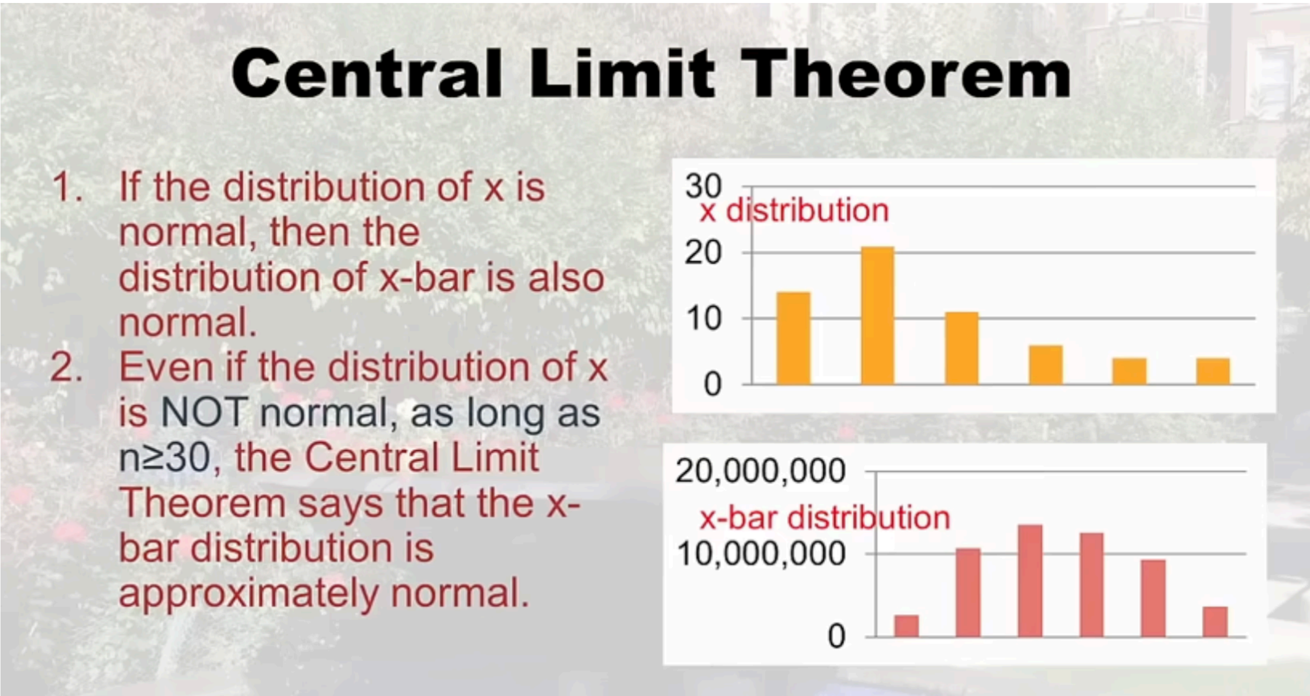


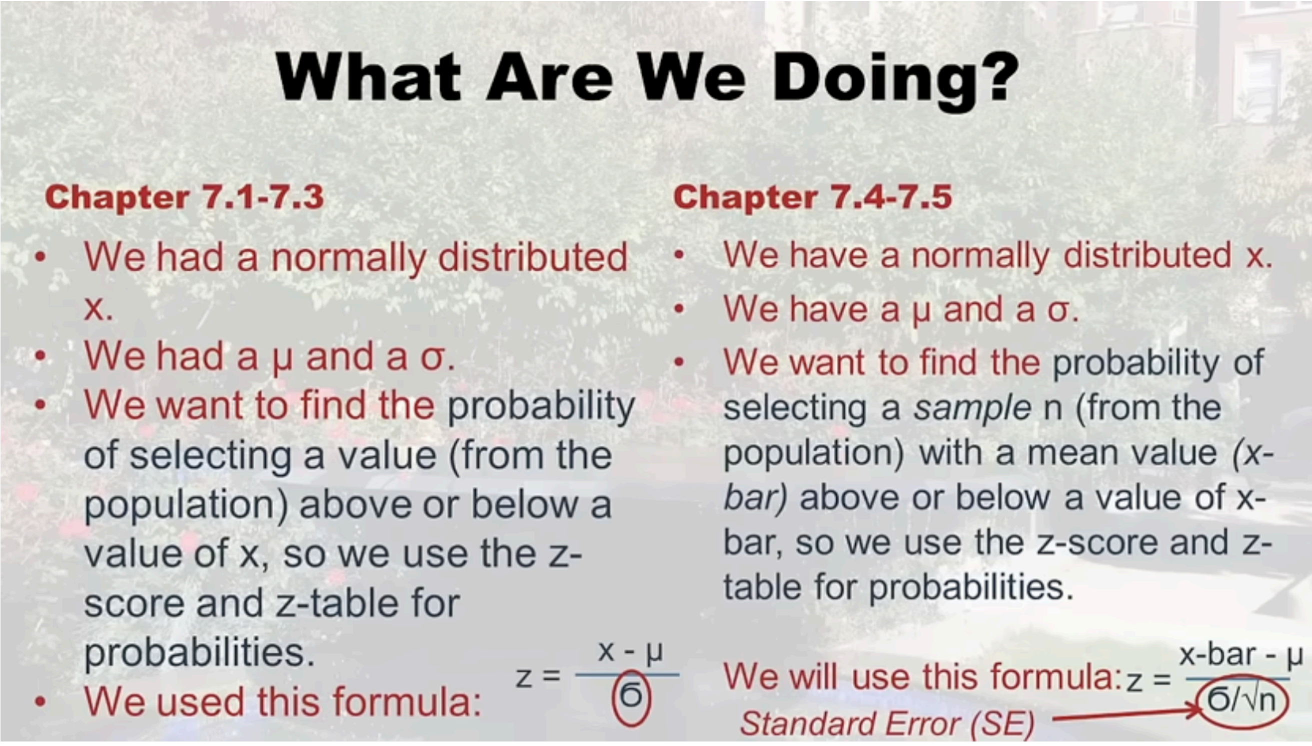
Central Limit Theorem





Standard Error is the standard deviation of the sampling distribution.





What μ (mu) is

- **μ = population mean**
- It's the **true average** of *everyone* in the population
- Fixed number (but usually **unknown**)

  👉 Example:

  Average height of **all** students in a university = **μ**

What (x-bar) is

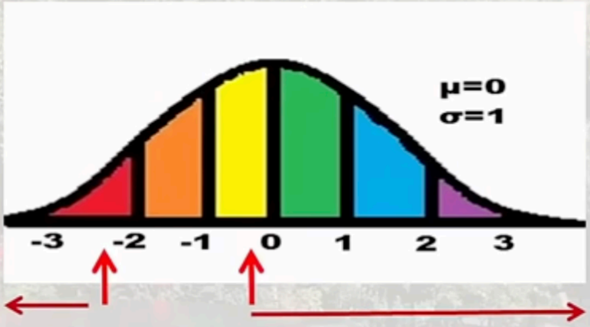
- **x̄\bar{x}x̄ = sample mean**
- Calculated from a **sample**, not everyone
- **Changes** from sample to sample (random)

  👉 Example:

  Average height of **30 students you randomly pick** = **x̄\bar{x}x̄**

Remember the Students?

- Assume the 100-student class is a population.
- Now I have to pick an n
  - Let's pick 36.
- *Question:* What is the probability of me selecting a sample of 36 students with an x-bar between 60 and 65?



z1 = (60-65.5)/2.4 = -2.28
p1 = 0.0113
z2 = (65-65.5)/2.4 = -0.21
p2 = 0.5832

1 – 0.0113 – 0.5832 = 0.4055