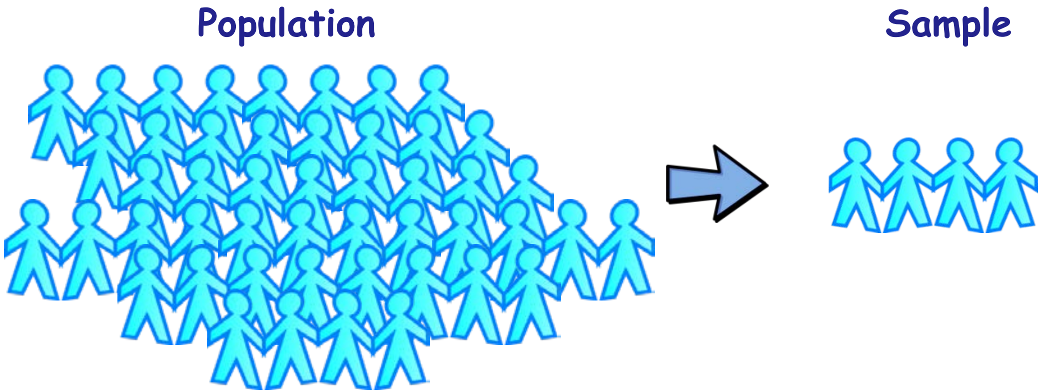
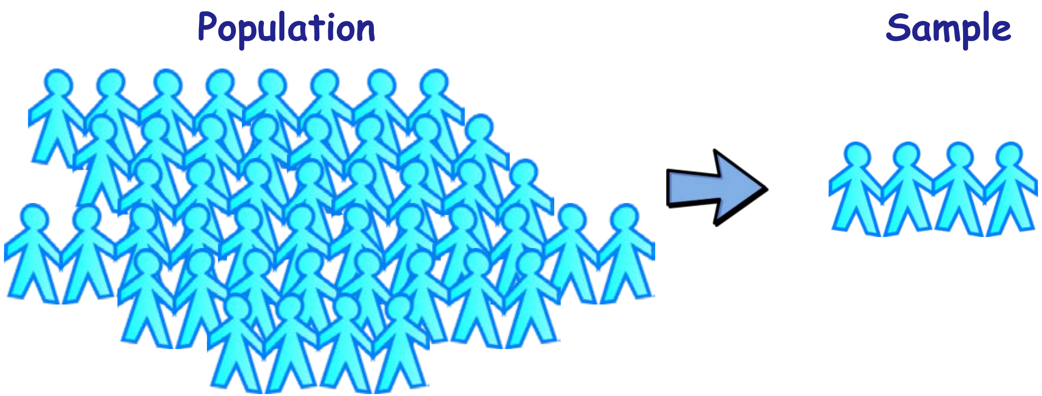
The Central Limit Theorem

The Central Limit Theorem



The Central Limit Theorem



- Populations and Samples are context dependent
- Sample is a subset of the population
- Sample should be representative of the population

The Central Limit Theorem

Population Data

Population Mean: μ

Population Standard Deviation: σ

Sample Data

Sample Mean: $\bar{x}$

Sample Standard Deviation: s

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The Central Limit Theorem

What is the average starting salary of ***all business students*** who graduated last year in New York city?

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Population

all students in New York City who finished their business education last year

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Mean = μ

Std = σ

The Central Limit Theorem

What is the average starting salary of ***all business students*** who graduated last year in New York city?

Population

all students in New York City who finished their business education last year

➡ We wish to find out μ

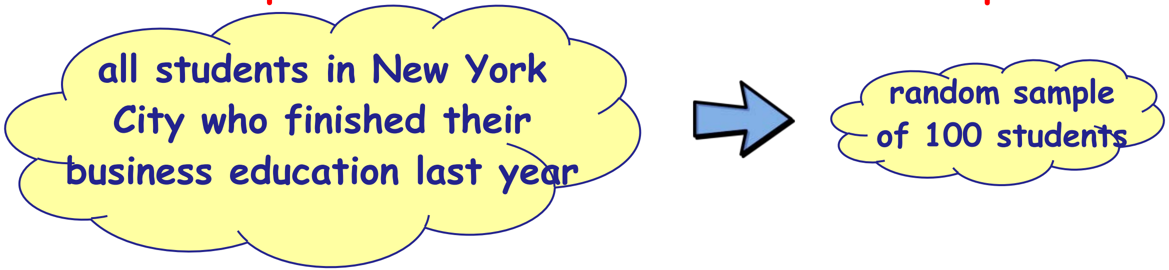
Mean = μ

Std = σ

The Central Limit Theorem

What is the average starting salary of ***all business students*** who graduated last year in New York city?

Population | Sample



Mean = μ
Std = σ

Mean = $\bar{x}$ = 61,400$
Std = s = some number

The Central Limit Theorem

Consider a random sample of ***n*** observations from a population with mean μ and standard deviation σ

The Central Limit Theorem

Consider a random sample of $\boldsymbol{n}$ observations from a population with mean μ and standard deviation σ

Let $\bar{x}$ be the sample mean.

Then the distribution of $\bar{x}$ is approximately Normal with mean = μ and standard deviation = $\frac{\sigma}{\sqrt{n}}$.

That is, $\bar{x}$ ~ Normal $(\mu, \frac{\sigma}{\sqrt{n}})$ and this approximation gets better as sample size increases.

The Central Limit Theorem

What is the average starting salary of ***all business students*** who graduated last year in New York city?

Population

all students in New York City who finished their business education last year

Mean = μ

Std = σ

Sample

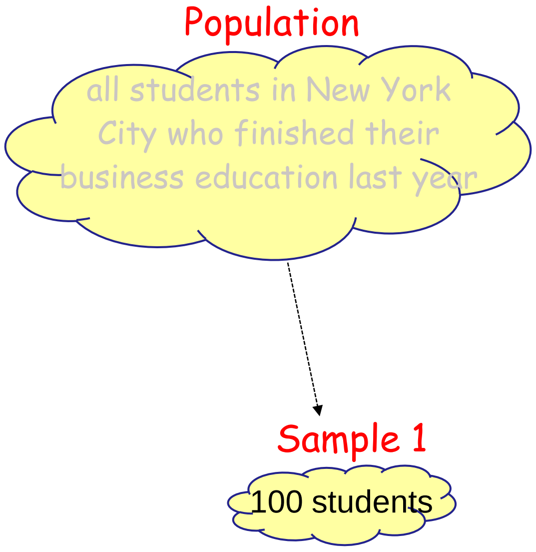
random sample of 100 students

$$\bar{x} \sim \text{Normal}\left(\mu, \frac{\sigma}{\sqrt{100}}\right)$$

Mean = $\bar{x}$ = 61,400$

Std = s = some number

Sample mean has a Normal distribution…



$\bar{x}$ = 61,400$

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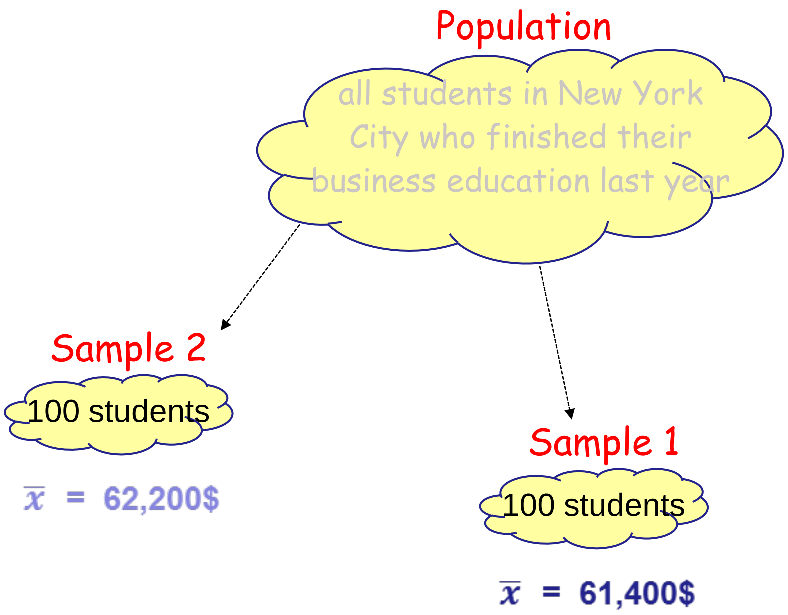

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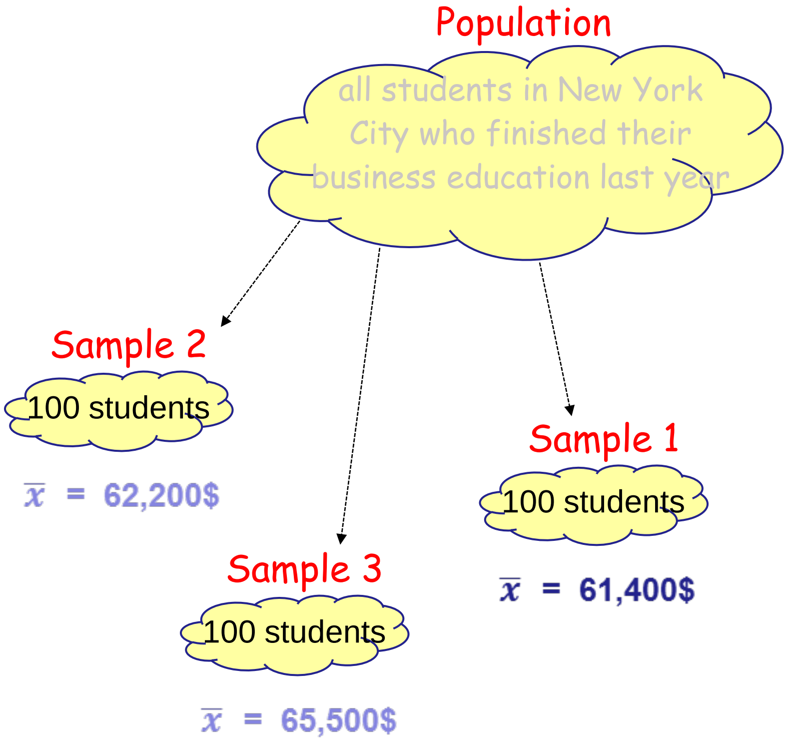

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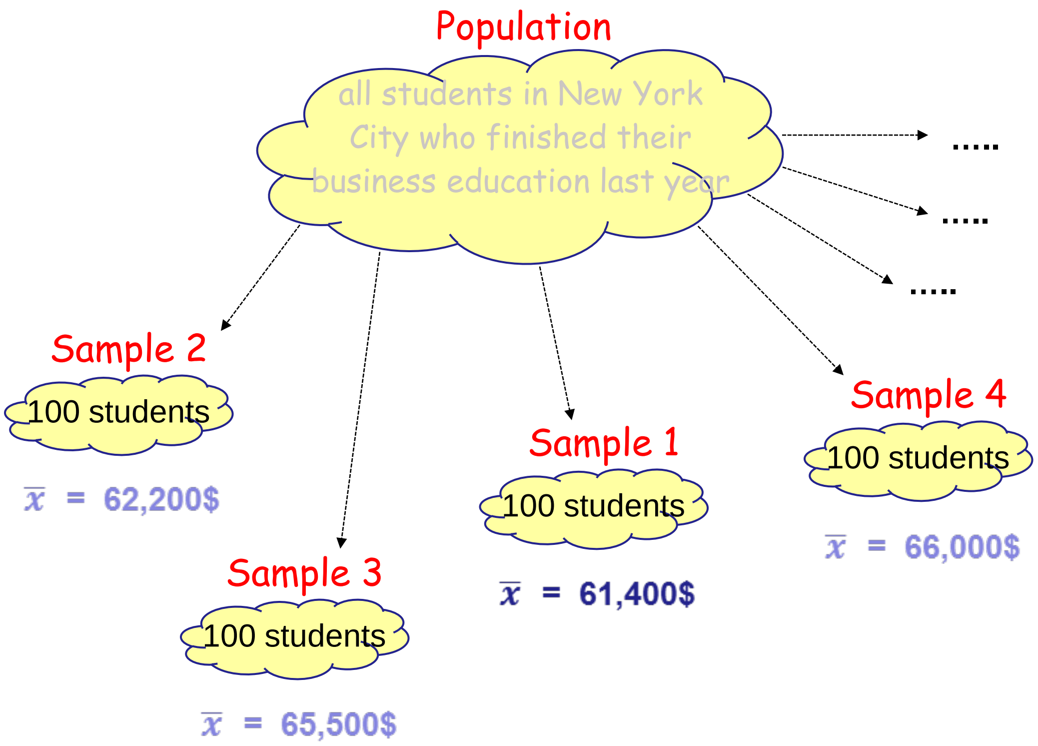

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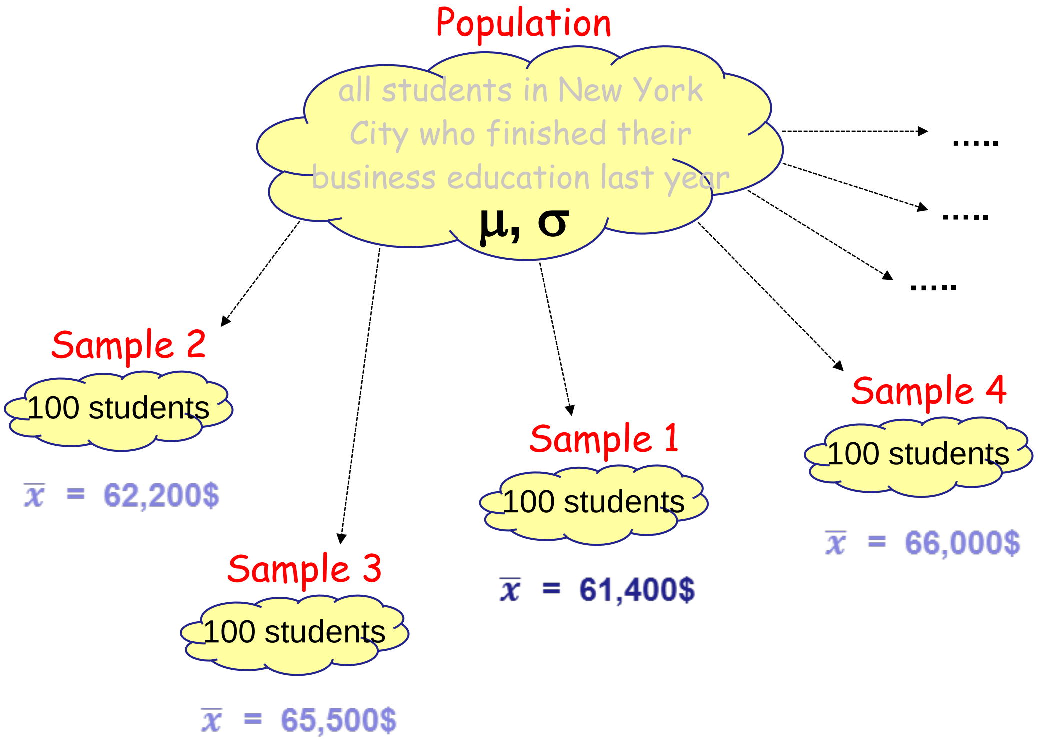
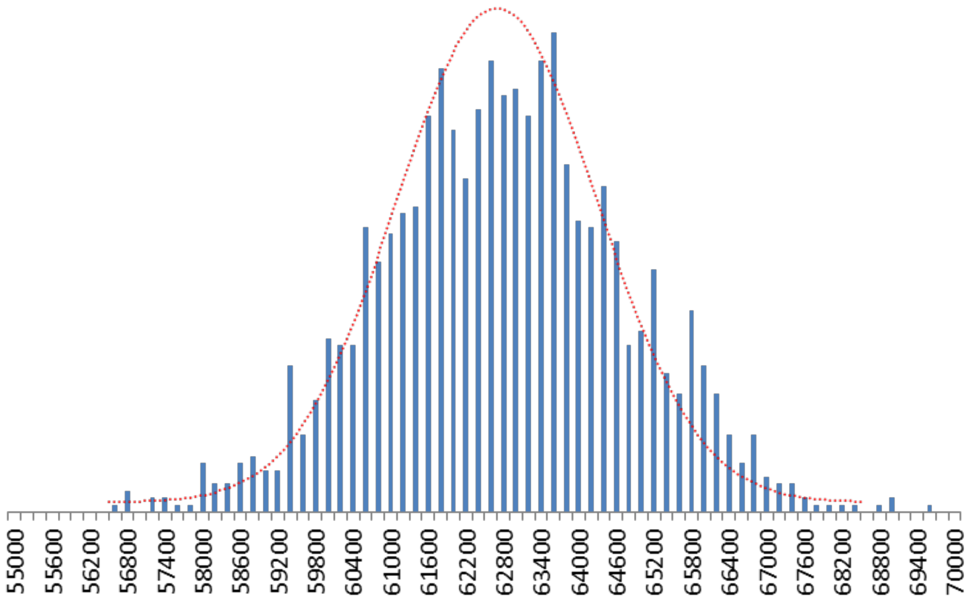


Sample mean has a Normal distribution…



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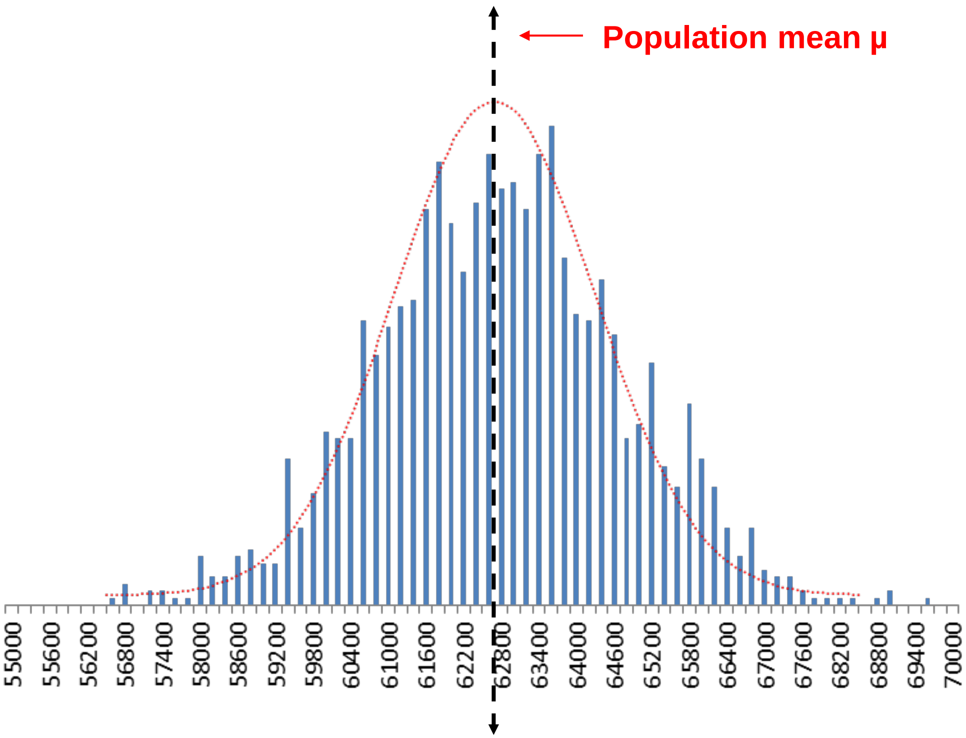
Sample mean has a Normal distribution…



The Central Limit Theorem

Regardless of the nature of population distribution…

… Discrete or Continuous

… Symmetric or Skewed

… Unimodal or multimodal

The mean of a random sample from that population always has a Normal distribution.

The Central Limit Theorem

In Plain Language,

Sample averages are normally distributed irrespective of where the sample came from. Not only are they normally distributed but more importantly they are normally distributed with mean equal to the population mean.