## TOPIC: SAMPLING DISTRIBUTION FOR SAMPLE MEAN & CENTRAL LIMIT THEOREM

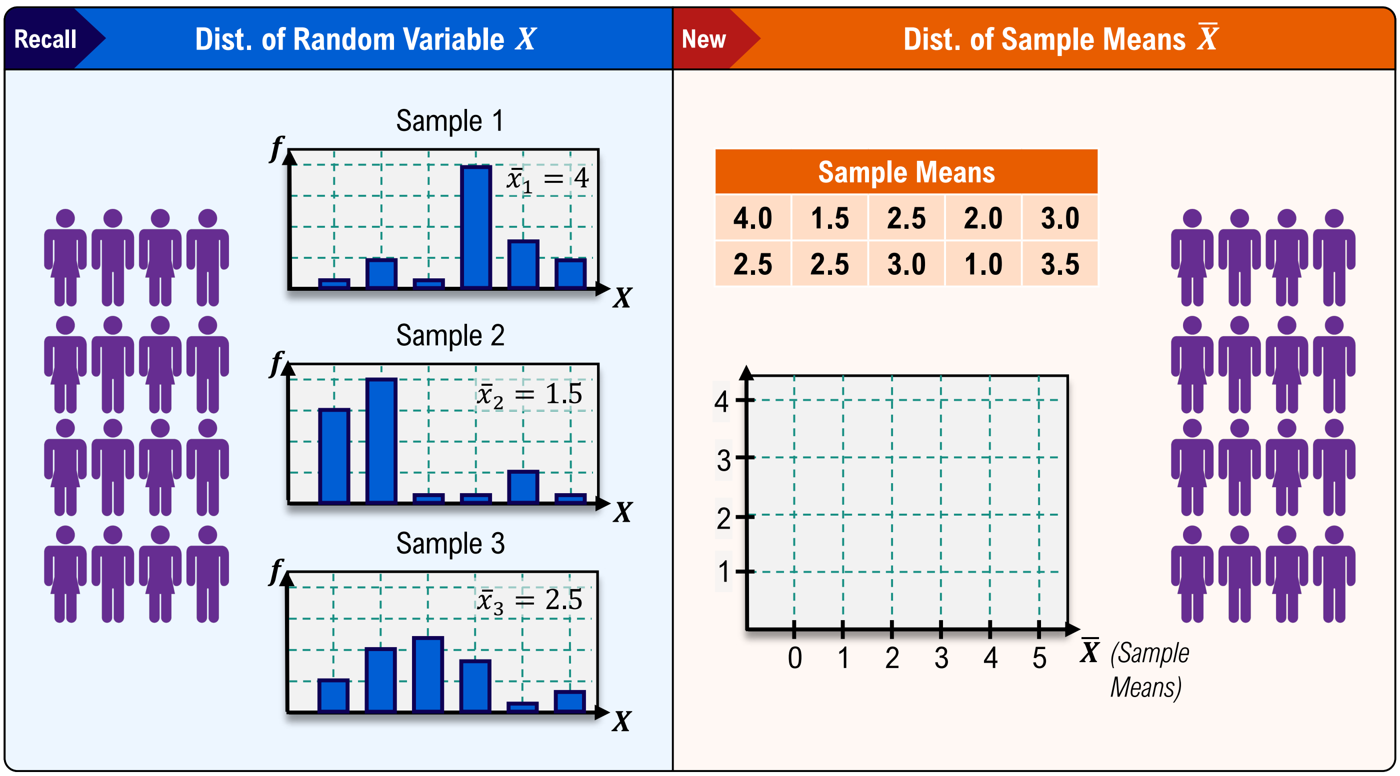
### Mean Sampling Distribution

◆ 1 sample mean can be "off", but many samples of *same* size, $n$, give a consistent sampling distribution of $\bar{X}$.

► The Sampling Distribution of $\bar{X}$ is the _______________ *distribution* of the *sample* mean.

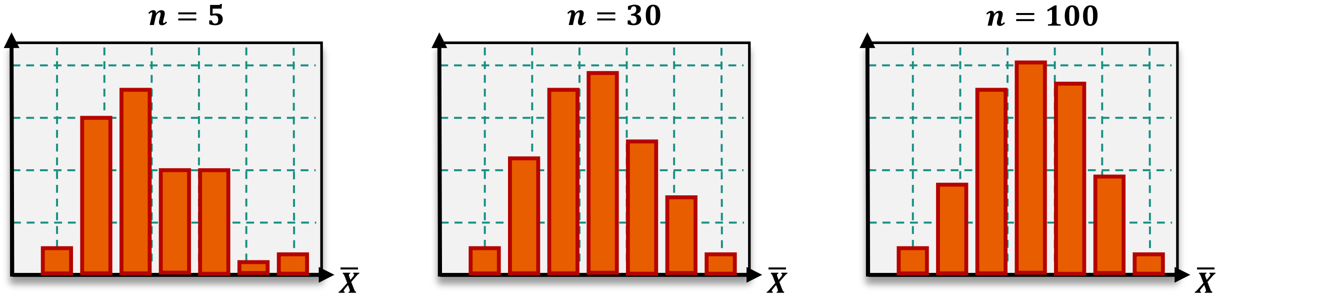
**EXAMPLE**

A pet store is interested in the average number of pets owned by households in America, so they use the following methods to estimate the population mean, $\mu$. First, they take a sample of 30 Americans and use the sample mean as an approximation. Then, they repeat the process to get 10 samples of 30 Americans and use the average of the sample means. Which is a better approximation of the average number of pets in American households?




| Sample Means | | | | |
|---|---|---|---|---|
| 4.0 | 1.5 | 2.5 | 2.0 | 3.0 |
| 2.5 | 2.5 | 3.0 | 1.0 | 3.5 |

◆ The **Central Limit Theorem (CLT)**: For *ANY* rand. var., $X$, as $n\uparrow$, the sampling dist. of $\bar{X}$ becomes more ___________.



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## PRACTICE

For a new advertising campaign, a video game retailer is interested in including information on the average play time of their most popular game. They get 100 random samples of 40 players and obtain their play time to get a sampling distribution. The mean of the sampling distribution is 26.7 hours. In this example, what is the value of $n$?

## PRACTICE

A researcher takes 10 samples of 20 students each to get a sampling distribution of the average number of siblings students at a university have. According to the Central Limit Theorem, what can the researcher do to make their sampling distribution get closer to normal?

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### Central Limit Theorem

◆ Recall: **CLT**: For *ANY* rand. var., $X$, as $n$ (sample size) ↑, the sampling dist. of $\bar{X}$ gets closer to normal.

▸ When $n \geq$ ____ you can assume the sampling dist. of $\bar{X}$ *IS* normal, so you can find $z$-scores & probabilities.

**EXAMPLE**

You run an experiment where you roll a die 30 times, then repeat to get 50 samples. You get the sampling dist. below. Find the prob. of getting a *sample mean* less than 2.5. For a single die roll: $\mu_X = 3.5$ & $\sigma_X = 1.71$.

**New** — **Central Limit Theorem**

**Recall**

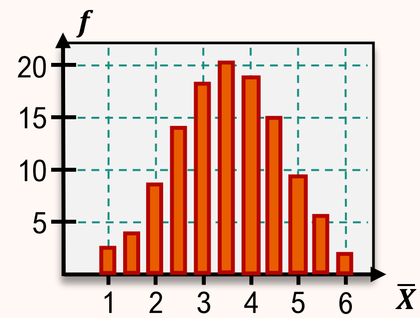
$$z = \frac{x - \mu_X}{\sigma_X}$$

*(z-score)*

$$\mu_{\quad} = \mu_X, \quad \sigma_{\quad} = \frac{\sigma_X}{\sqrt{n}}$$

$$z = \frac{\bar{x} - \quad}{\quad}$$

*(Sampling Dist. for $\bar{X}$)*




*(Mean of 30 Dice Rolls)*

**PRACTICE**

A company's marketing team takes 50 samples of 10 recent clients to create a sampling distribution of sample means for the average amount spent per month on company products. They find that most of the 50 samples are right skewed. Can the Central Limit Theorem be used to determine that the sampling distribution is normal?

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## PRACTICE

If $\mu_X = 3.2$ and $\sigma_X = 0.98$, find the probability of getting a sample mean above 3.5 in a sample of 60 people.

$$z = \frac{\bar{x} - \mu_X}{\frac{\sigma_X}{\sqrt{n}}}$$

*(Sampling Dist. for $\bar{X}$)*

## EXAMPLE

The test audiences who have viewed an upcoming movie release so far gave a new film an average score of 4.2 out of 5 stars with a standard deviation of 0.25 stars. Find the probability that a random test audience of 36 moviegoers will give the film an average rating of 4.3 stars or greater.

$$z = \frac{\bar{x} - \mu_X}{\frac{\sigma_X}{\sqrt{n}}}$$

*(Sampling Dist. for $\bar{X}$)*