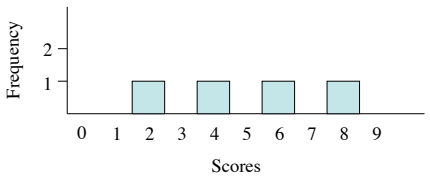
Chapter 7: The Distribution of Sample Means



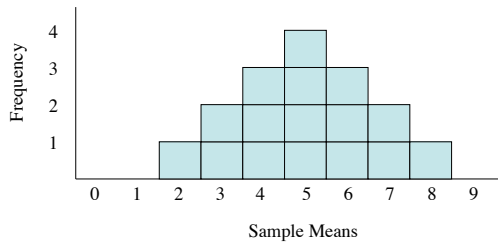
Distribution of Sample Means

- The distribution of sample means is the collection of sample means for all the possible random samples of a particular size n that can be obtained from a population.

Sampling Distribution

- A sampling distribution is a distribution of statistics obtained by selecting all the possible sample of a specific size from a population.

	Scores		Sample Mean
Sample	First	Second	$\bar{X}$
1	2	2	2
2	2	4	3
3	2	6	4
4	2	8	5
5	4	2	3
6	4	4	4
7	4	6	5
8	4	8	6
9	6	2	4
10	6	4	5
11	6	6	6
12	6	8	7
13	8	2	5
14	8	4	6
15	8	6	7
16	8	8	8



Central Limit Theorem

- For any population with mean μ and standard deviation σ, the distribution of sample means for sample n will approach a normal distribution with a mean of μ and a standard deviation $\frac{\sigma}{\sqrt{n}}$ as n approaches infinity.

The distribution of sample means will be almost perfectly normal if either of the following is true:

1. The population from which the samples are selected is a normal distribution.
2. The Number of scores (n) in each sample is relatively large, around 30 or more.

The mean of the distribution of the sample means will be equal to μ (the population mean) and is called the expected value of $\bar{x}$

$$\mu_{\bar{X}} = \mu$$

Mean of all the sample means

Mean of all the scores in the population

The standard deviation of the distribution of sample means is called the :

Standard error of $\overline{X}$

Standard error = $\sigma_{\overline{X}}$

(standard distance between $\overline{X}$ and μ)

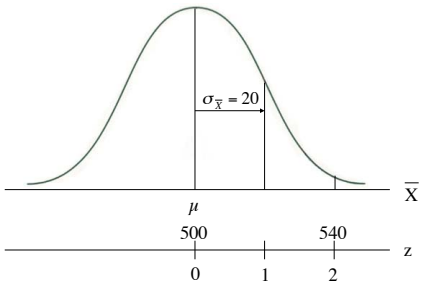
Standard error determined by 2 characteristics:

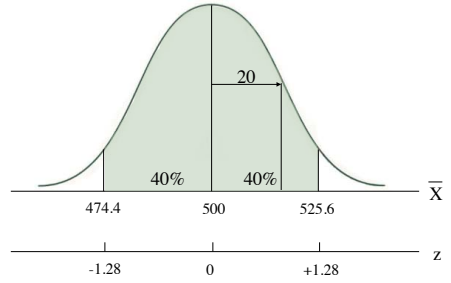
1. Variability of the population from which the sample came
2. The size of the sample

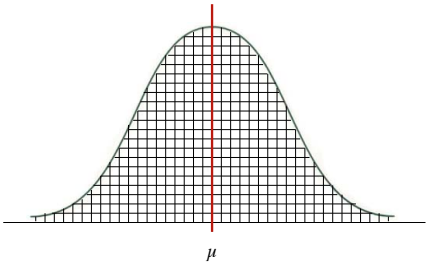
$$\sigma_{\overline{X}} = \sqrt{\frac{\sigma^2}{n}} = \frac{\sigma}{\sqrt{n}}$$

Law of Large Numbers

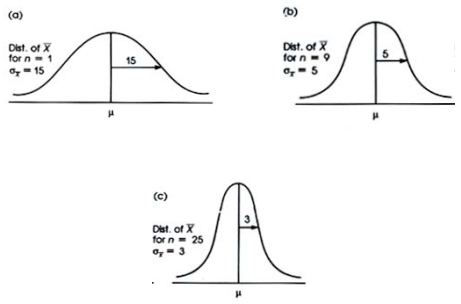
- The larger the sample size (n), the more probable it is that the sample mean will be close to the population mean.


$\sigma_{\bar{X}} = 20$
$\bar{X}$
μ
500
540
z
0
1
2


20
40%
40%
$\bar{X}$
474.4
500
525.6
z
-1.28
0
+1.28

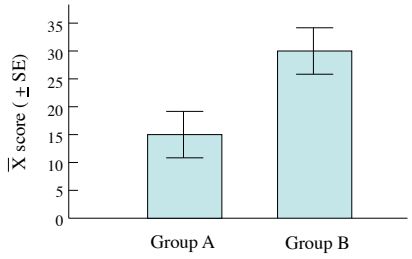

μ

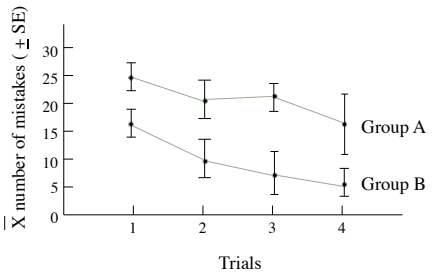
Assume a population with a mean of 50 and a standard deviation of 15

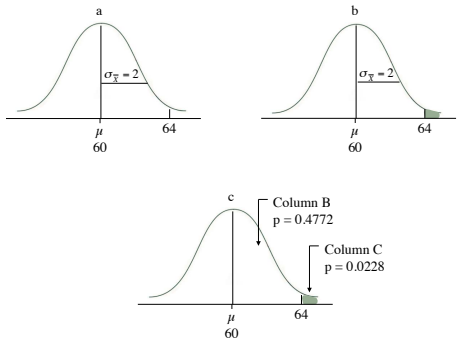


Means presented in a table

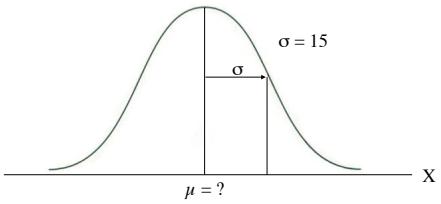
Group	n	Mean	SE
Control	17	32.23	2.31
Experimental	15	45.17	2.78




$\bar{X}$ number of mistakes (± SE)
30
25
20
15
10
5
0
1
2
3
4
Trials
Group A
Group B


a
$\sigma_{\bar{X}} = 2$
μ
60
64
b
$\sigma_{\bar{X}} = 2$
μ
60
64
c
Column B
p = 0.4772
Column C
p = 0.0228
μ
60
64

IQ Scores


σ = 15
σ
X
μ = ?

Given a population of test scores that is normally distributed with $\mu = 60$ and $\sigma = 8$

- I randomly select a test score. What is the probability that the score will be more than 16 points away from the mean?
  - (Hint : What proportion of test scores are > 76 or < 44 ?)