unbiased estimator

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

consistent estimator

$\sigma_{\bar{x}}$ decreases as n increases

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$ true if

$$\frac{n}{N} \le .05$$

$\boxed{7.4}$ $\underline{\bar{x}}$ the mean of a sample

The shape of the Sampling Distribution of $\bar{x}$

Two cases

(1) The population from which the sample is taken is normally distributed.

with $\mu_{\bar{x}} = \mu$ and $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

assuming

$\frac{n}{N} \le .05$

then the distribution of $\bar{x}$ is normally distributed regardless of the sample size.

#7.32
pg. 311

$\mu = 6.7$ min
$\sigma = 2.1$ min

$n = 16$

$\mu_{\bar{x}} = 6.7$

$\sigma_{\bar{x}} = \frac{2.1}{\sqrt{16}} \approx 0.525$

It is normally distributed

② The population is not normally distributed

Central Limit Theorem -

For a large sample size, the sampling distribution of $\bar{x}$ is approximately normal, irrespective of the shape of the population distribution.

$\mu_{\bar{x}} = \mu$ and $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ if $\frac{n}{N} \leq .05$

and the sample size is considered large if $n \geq 30$ ☆

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Title: Apr 5-9:24 AM (4 of 14)

#7.36

$\mu = 133$ lbs $\quad \sigma = 24$ lbs

skewed right

$n = 45$ persons

$\mu_{\bar{x}} = 133 \quad \sigma_{\bar{x}} = \frac{24}{\sqrt{45}} \approx 3.578$

The shape is <u>approximately</u> normal.

$\boxed{7.5}$ Applications

pg 312 $\quad p(\mu - \sigma_{\bar{x}} \le \mu \le \mu + \sigma_{\bar{x}}) \approx$

$= \text{normalcdf}(-1, 1, 0, 1)$

$\approx .682689$

$\approx .6827$

EX 7-5 pg 313

weights of packages of cookies (normally distributed)

$\mu = 32 \text{ oz.} \quad \sigma = .3 \text{ oz}$

Find $P(31.8 < \mu_{\bar{x}} < 31.9)$ if $n = 20$

$\mu_{\bar{x}} = 32 \text{ oz}$ $\qquad \dfrac{.3}{\sqrt{20}}$

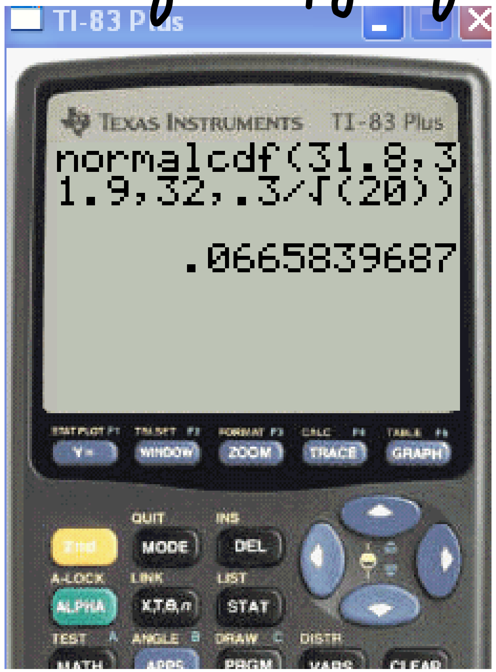
$\sigma_{\bar{x}} = \dfrac{.3}{\sqrt{20}}$

$P(31.8 < \mu_{\bar{x}} < 31.9) = \text{normalcdf}(31.8, 31.9, 32, .3/\sqrt{20})$

$\approx .065839$

$\approx .0666$

from pg before



7-6 Avg of \$7868 on credit cards in 2004 $\sigma = 2160$ $n = 81$

Shape of the distribution is unknown

a) within \$440 of pop mean.

$7868 - 440 = 7428$

$7868 + 440 = 8308$

$P(7428 < \mu_{\bar{x}} < 8308)$

$= \text{normalcdf}(7428, 8308, 7868, 2160/\sqrt{81})$

$\approx .9332$

Shape - approximately normal.

b) $P(-\infty < \bar{x} < 7548)$

$7868 - 320$
$= 7548$

$= \text{normalcdf}(-E99, 7548, 7868, 2160/\sqrt{81})$

$\approx .0912$

$\bar{x}$

one

$\boxed{7.6}$ Population and Sample Proportions.

Pop proportion $=$ $\frac{\text{\# with the desired characteristic}}{\text{total \# in population}}$

$$p = \frac{X}{N}$$

the sample proportion $=$ $\frac{\text{\# with trait}}{\text{total in sample}}$

$$\hat{p} = \frac{x}{n}$$

"p hat"

#7.60 population of 1000, 640 posses a certain characteristic

In a sample of 40, 24 posses that characteristic

Find p and $\hat{p}$

$$p = \frac{X}{N} = \frac{640}{1000} = .64$$

$$\hat{p} = \frac{24}{40} = .60$$

The sampling error is

$$\hat{p} - p$$

$$.60 - .64 = -.04$$

The mean of the sample proportion, $\hat{p}$ is equal to the population proportion, p.

unbiased estimators

$$\mu_{\hat{p}} = p$$

The standard deviation

$$\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}}$$

$q = 1 - p$

where p is the population proportion.

$$\frac{n}{N} \leq .05$$

$$\sqrt{\frac{N-n}{N-1}}$$

consistent estimator

$\sigma_{\hat{p}}$ gets smaller as n gets larger.

(Central Limit Theorem for Proportions)

The sample distribution of $\hat{p}$ is approximately normal for sufficiently large sample size

$np > 5$ and $nq > 5$

EX 7-9 50% of Americans are satisfied [with] their jobs

(assume this is true for the current population of Americans)

Let $\hat{p}$ be the proportion of Americans in a r.s. of 1000 who are satisfied.

Find the mean, standard deviation and describe the shape

$\mu_{\hat{p}} = .5$

$n = 1000$

$np = 1000(.5) = 500$

$nq = 500$

$\sigma_{\hat{p}} = \sqrt{\frac{(.5)(.5)}{1000}} \approx .0158$

shape is approx normal

What if $p = .65$ $q = .35$