$\boxed{13-7}$

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

b) $p = .5$

c) $p = 0, 1$ $\quad \sigma_{\hat{p}} = 0$

$\boxed{13-8}$

* c) 4x

Central Limit Theorem (CLT)

* Describes the sampling distribution of $\hat{p}$:
(graph of all the possible $\hat{p}$)

CLT says the samp. dist. will be:

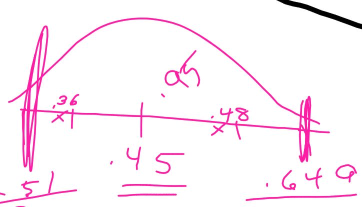
ex: $n = 25$
$p = .45$

- shape: approx. normal if (n is large)
  Conditions: $np \geq 10$ AND $n(1-p) \geq 10$
  $25(.45) \geq 10$ $\quad$ $25(1-.45) \geq 10$
  $11.25 \geq 10$ $\quad$ $13.75 \geq 10$

- center: mean of $\hat{p} = \mu_{\hat{p}} = p$
  $\mu_{\hat{p}} = .45$

- spread: St. dev. of $\hat{p} = \sigma_{\hat{p}} = \sqrt{\dfrac{p(1-p)}{n}}$

$$\sigma_{\hat{p}} = \sqrt{\frac{.45(1-.45)}{25}} = .0995$$



95% of $\hat{p}$'s would be between what?

$.45 \pm 2(.0995)$

$(.251, .649)$

13-3

$n = 124$

a) param. $p = 1/2$

b) CLT applies? $np \geq 10$ AND $n(1-p) \geq 10$

Yes, n is large $\Rightarrow 124(.5) \geq 10$ $124(1-.5) \geq 10$

✓ $62 \geq 10$ ✓ $62 \geq 10$

Shape: approx. normal

Center: mean of $\hat{p} = .5$ $(\mu_{\hat{p}} = p)$

Spread: St. dev. of $\hat{p} = \sqrt{\frac{.5(1-.5)}{124}} = .0449$

c) ✓

d) $\hat{p} = \frac{80}{124} = .645$

e) .645 not on hist.

Yes $\Rightarrow$ very surprising

~~$\hat{p} = .52$~~

f) $z = \frac{.645 - .5}{.0449} = 3.23$

$z = \frac{x - \mu}{\sigma}$

$P(z > 3.23) = 1 - .9994$

$= \boxed{.0006}$

g) Yes, .645 casts doubt on .5 = p, because it was so unlikely

Statistically significant

13-2

Central Limit Theorem (CLT) for $\hat{p}$

$n = 25$
$p = .45$

Describes the sampling distribution:
(graph of all possible $\hat{p}$'s)

(conditions)

* Shape: approx. normal — if $np \geq 10$ AND $n(1-p) \geq 10$

$25(.45) \geq 10$ $\quad 25(1-.45) \geq 10$

$11.25 \geq 10$ $\quad 13.75 \geq 10$

→ * n is large enough

* Center: mean of all $\hat{p} = p$

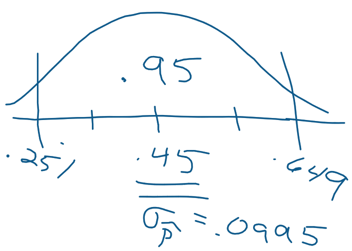
$\mu_{\hat{p}} = p$

$(\mu_{\hat{p}} = .45)$

* Spread: st. dev. of all $\hat{p}$

$= \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$

$= \sqrt{\frac{.45(1-.45)}{25}} = .0995$



95% of $\hat{p}$ should fall between what?

→ ±2 st. dev

$.45 \pm 2(.0995)$

$(.251, .649)$

ex $\hat{p} = .40$

$\sigma_{\hat{p}} = \sqrt{\frac{.4(1-.4)}{25}} = .098$

$.40 \pm 2(.098)$

$(.204, .596)$

95% 'sure'

P is in interval

13-3

a) $124 = n$

(assume) $p = .5$

param

b) Check if CLT applies: $np \geq 10$ AND $n(1-p) \geq 10$

$124(.5) \geq 10$ $124(1-.5) \geq 10$

$62 \geq 10$ $62 \geq 10$

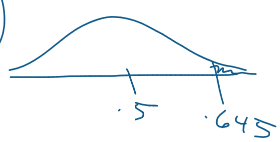
✓ n is large

CLT says the samp. dist. will be:

- approx. normal
- mean of $\hat{p} = .5$
  $\mu_{\hat{p}} = .5$
- st. dev. of $\hat{p} = \sigma_{\hat{p}} = \sqrt{\frac{.5(1-.5)}{124}} = .0449$

d) $\hat{p} = \frac{80}{124} = .645$

e) .645 → very surprising
never happened in 1000 simulations.

f) 

$z = \frac{.645 - .5}{.0449} = 3.23$

$P(z > 3.23) = 1 - .9994 = \boxed{.0006}$

g) yes ⇒ .645 was so unlikely, don't think $p = .5$

Statistically significant

unlikely to happen by chance

estimate p:

$.645 \pm 2(.0449)$

(,)

$X - Y$

c) $\mu_{x-y} = \mu_x - \mu_y$

$= 17.7 - 17.7$

$= 0$

d) $\sigma^2_{x-y} = \sigma^2_x + \sigma^2_y$

Var. Add

$= .81 + .51$

e) $T = 3y + 1$

$\mu_T = 3(17.7) + 1$

$= 55.1$

$\sigma_T = 3(.7141) \cancel{+1}$