HW p.588 Section 9.2

(21) Problem: What is the probability that SRS's of sizes 300, 1200, and 4800 are within ±.03 of the true parameter, p = .4?

n = 300 $\mu_{\hat{p}} = p = .4$

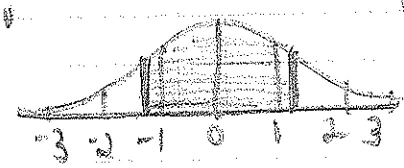
• pop ≥ 10(300)
all adults ≥ 3000 ✓ Condition met to use standard deviation formula.

• np ≥ 10 n(1−p) ≥ 10 Condition met to use Normal distribution.
(300)(.4) ≥ 10 300(.6) ≥ 10
120 ≥ 10 ✓ 180 ≥ 10 ✓

$\sigma_{\hat{p}} = \sqrt{\frac{(.4)(.6)}{300}} = .0283$

$P(.37 \le \hat{p} \le .43) = P\left(\frac{.37-.4}{.0283} \le z \le \frac{.43-.4}{.0283}\right) = P(-1.06 \le z \le 1.06)$
$= .7108$

The probability that an SRS of size n = 300 adults has 37% to 43% who say they attend church regularly is 71.08%.



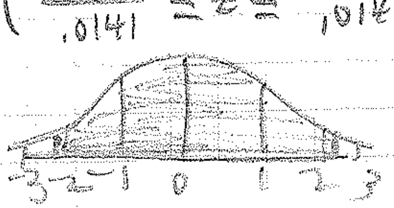
n = 1200 $\mu_{\hat{p}} = p = .4$

• all adults ≥ 10(1200)
all adults ≥ 12,000 ✓ Condition met to use standard deviation formula.

• np ≥ 10 n(1−p) ≥ 10 Condition met to use Normal distribution.
1200(.4) ≥ 10 1200(.6) ≥ 10
480 ≥ 10 ✓ 720 ≥ 10 ✓

$P(.37 \le \hat{p} \le .43) = P\left(\frac{.37-.4}{.0141} \le z \le \frac{.43-.4}{.0141}\right) = P(-2.128 \le z \le 2.128)$
$= .9668$

$\sigma_{\hat{p}} = \sqrt{\frac{(.4)(.6)}{1200}} = .0141$



The probability that an SRS of adults of size $n = 300$ has 37% to 43% say they attend church regularly is 96.68%.

$n = 4800 \quad \mu_{\hat{p}} = p = .4$

- all adults $\geq 10(4800)$ — Condition met to use standard deviation formula
  all adults $\geq 48{,}000$ ✓

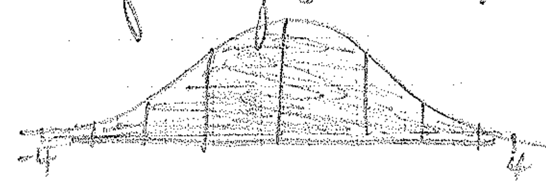
- $np \geq 10 \quad n(1-p) \geq 10$ — Conditions met to use Normal distribution.
  $4800(.4) \geq 10 \quad 4800(.6) \geq 10$
  $1920 \geq 10$ ✓ $\quad 2880 \geq 10$ ✓

$\sigma_{\hat{p}} = \sqrt{\dfrac{(.4)(.6)}{4800}} = .0071$

$$P(.37 \leq \hat{p} \leq .43) = P\left(\frac{.37-.40}{.0071} \leq z \leq \frac{.43-.4}{.0071}\right) = P(-4.235 \leq z \leq 4.235)$$

$$= .9999 \approx \underline{1}$$

The probability that an SRS of adults of size $n = 4800$ has 37% to 43% say they attend church regularly is 99.99%



Larger sample sizes give more accurate results. The sample proportions are more likely to be close to the true population proportion.

(25) p = proportion of all adults who jog $\quad p = .15$
$n = 1540$ adults

a) $\mu_{\hat{p}} = p = .15 \qquad \sigma_{\hat{p}} = \sqrt{\dfrac{(.15)(.85)}{1540}} = .0091$

b) pop ≥ 10(sample) — Condition met to use standard deviation formula.
all adults $\geq 10(1540)$ ✓

c) $np \geq 10$ $\quad$ $n(1-p) \geq 10$ $\quad$ Condition met to use Normal distribution.

$1540(.15) \geq 10$ $\quad$ $1540(.85) \geq 10$

$231 \geq 10$ ✓ $\quad$ $1309 \geq 10$ ✓

d) $P(.13 \leq \hat{p} \leq .17) = P\left(\frac{.13-.15}{.0091} \leq z \leq \frac{.17-.15}{.0091}\right)$

$= P(-2.198 \leq z \leq 2.198) = .9721$

The probability that between 13% and 17% of a SRS of n = 1540 adults jog is 97.21%

e) $\sigma_{\hat{p}} = \frac{1}{3}\sqrt{\frac{(.15)(.85)}{1540}} = \sqrt{\frac{(.15)(.85)}{9(1540)}}$

To reduce the standard deviation to 1/3 of our value for n = 1540, we would need a sample size of n = 6160 adults.

(2b) $p = .15$ $\quad$ $n = 200$ adults

$\mu_{\hat{p}} = p = .15$ $\quad$ $\sigma_{\hat{p}} = \sqrt{\frac{(.15)(.85)}{200}} = .02525$

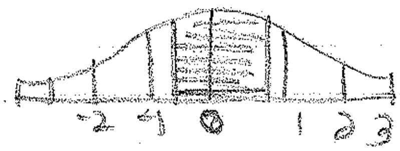
Conditions: • all adults $\geq 10(200)$ ✓ may use standard deviation formula

• $200(.15) \geq 10$ ✓ $\quad$ $200(.85) \geq 10$ ✓ may use Normal distribution

$30 \geq 10$ $\quad$ $170 \geq 10$

$P(.13 \leq \hat{p} \leq .17) = P\left(\frac{.13-.15}{.02525} \leq z \leq \frac{.17-.15}{.02525}\right) = P(-0.791 \leq z \leq 0.791)$

$= .5711$



The probability that between 13% and 15% of adults in a SRS of size n = 200 say they jog is 57.11%

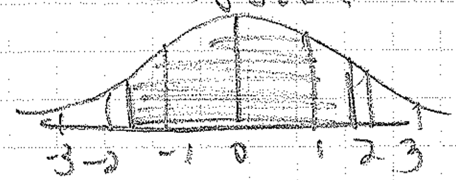
$p = .15$ $\quad$ $n = 800$ adults $\quad$ $\mu_{\hat{p}} = p = .15$ $\quad$ $\sigma_{\hat{p}} = \sqrt{\frac{(.15)(.85)}{800}} = .0126$

Conditions: [show them here]

$P(.13 \le \hat{p} \le .15) = P\left(\frac{.13-.15}{.0126} \le z \le \frac{.17-.15}{.0126}\right) = P(-1.587 \le z \le 1.587)$

$= .8882$

Sentence Here

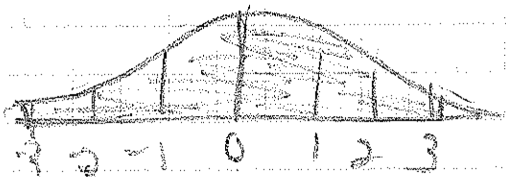


$p = .15$ $\quad n = 3200$ adults $\quad \sigma_{\hat{p}} = \sqrt{\frac{(.15)(.85)}{3200}} = .00631$

Conditions: [Show them here]

$P(.13 \le \hat{p} \le .17) = P\left(\frac{.13-.15}{.00631} \le z \le \frac{.17-.15}{.00631}\right)$

$= P(-3.169 \le z \le 3.169) = .9984$



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Larger sample sizes give more accurate results. Sample distributions of the sample proportions are more likely close to the true population parameter, p.

(27)

a) $\hat{p} = .62 \quad p = .67$

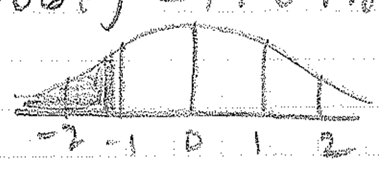
b) What is the probability that at most 67% of a SRS of n = 100 adults attending this college will support a crackdown on underage drinking?

Conditions: all adults attending this college $\ge 10(100)$ ✓ May use SD

$(100)(.67) \ge 10$ ✓ $\quad (100)(.33) \ge 10$ ✓ May use Normal Dist

$P(\hat{p} < .62) = P\left(z \le \frac{.62-.67}{.047}\right) = P(z \le -1.064) = 14.37\%$

Sentence Here



(28) a) $\mu_{\hat{p}} = p = .52$ $\qquad \sigma_{\hat{p}} = \sqrt{\frac{(.52)(.48)}{500}} = .0223$

$n = 500$

b) What is the probability that at least half, $\hat{p} = .5$, of the phone calls dialed are unlisted?

__Conditions__: All residents in LA with phones $\geq 10(500)$ ✓ May use SD

$(500)(.52) \geq 10$ $\qquad 500(.48) \geq 10$ $\qquad$ May use Norm Dist

$260 \geq 10$ $\qquad 240 \geq 10$

$$P(\hat{p} \geq .5) = P\left(z \geq \frac{.5 - .52}{.0223}\right) = P(z \geq -.8969) = .8133$$

Draw Here $\qquad$ __Sentence Here__

p. 590

(29) $p = .75 \quad n = 100$

- Condition met for stand. deviation?

  pop ≥ 10 (sample) ✓ $\qquad \sigma_{\hat{p}} = \sqrt{\frac{(.75)(.25)}{100}} = .0433$

  all questions ≥ 1000 ✓

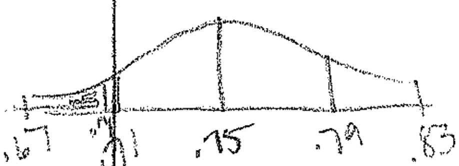
- Condition met for Normal Approximation?

$np \geq 10 \qquad n(1-p) \geq 10$

$100(.75) \geq 10 \qquad 100(.25) \geq 10$

$75 \geq 10$ ✓ $\qquad 25 \geq 10$ ✓

$P(\hat{p} \leq .7) = P\left(z \leq \frac{.7 - .75}{.0433}\right) = P(z \leq -1.15) = .1251 = \boxed{12.51\%}$



Sentence Here

b) $n = 250 \quad p = .75 \qquad \sigma_{\hat{p}} = \sqrt{\frac{(.75)(.25)}{250}} = .0274$

$P(\hat{p} \leq .7) = P\left(z \leq \frac{.7 - .75}{.0274}\right) = P(z \leq -1.825) = \boxed{.034 = 3.4\%}$

Sentence + Draw

c) $\sigma_{\hat{p}} = \frac{1}{4}\sqrt{\frac{(.75)(.25)}{100}} = \sqrt{\frac{(.75)(.25)}{16(100)}}$ $\boxed{\text{1600 test questions}}$

d) Yes, it applies to all values of p.

30
a) pop = 3000 $p = .3$ $n = 15$ $\hat{p} = 3/15 = 20\%$

- Condition met for standard deviation?

  pop $\geq$ 10(sample)

  $3000 \geq 10(15)$

  $3000 \geq 150$ ✓ Yes

- Condition met for Normal Approximation?

  $np \geq 10$ $n(1-p) \geq 10$

  $15(.3) \geq 10$

  $4.5 \geq 10$ X $\boxed{No}$

b) pop = 316 $n = 50$ $p = .4$ $\hat{p} = 15/50 = .3$

- Condition met for standard deviation? No

  pop $\geq$ 10(sample)

  $316 \geq 10(50)$

  $316 \geq 500$ X $\boxed{No}$

  Therefore can't use Norm Dist !!

c) Binomial distribution

1) Hisp / Not Hisp

2) $n = 15$

3) Independent

4) $p = .3$

X = # of Hisp on executive committee

$P(X \leq 3) = {}_{15}C_0 (.3)^0(.7)^{15} + {}_{15}C_1 (.3)^1(.7)^{14} + \dots {}_{15}C_3 (.3)^3(.7)^{12}$

Draw + Sentence !!

$\boxed{.2968}$