(107) ① $H_0: \mu \geq 22$

$H_a: \mu < 22$

② $\alpha = .05$

③ $\bar{x} = 20$ $\quad t = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}}$ $\quad d.f. = n-1$

$s = 4$

$n = 32$ $\quad = \dfrac{20 - 22}{4/\sqrt{32}}$ $\quad d.f. = 32 - 1$

$= -2.828$ $\quad d.f. = 31$

④ p-value: $\quad$ may ignore the negative because of symmetry

$2.744 < 2.828 < 3.022$

$\Downarrow$

$.005 > \text{p-value} > .0025$ $\quad$ Double? NO

⑤ Decision

$\underset{\alpha}{\overset{\|}{.05}} > .005 > \text{p-value} > .0025$

$\Rightarrow$ p-value $< \alpha$

$\Rightarrow$ $\boxed{\text{Reject } H_0}$

(109) ① $H_0: \mu \le 22$

$H_a: \mu > 22$

② $\alpha: .05$

③ Data:

$\bar{x} = 24$

$s = 4$

$n = 15$

↳ MUST ASSUME THE PARENT DISTRIBUTION'S APPROX. NORMAL.

TEST STATISTIC

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \qquad d.f. = n-1$$

$$= \frac{24 - 22}{4/\sqrt{15}} \qquad d.f. = 15-1$$

$$= 1.936 \qquad d.f. = 14$$

④. p-value: $1.753 < 1.936 < 2.131$

$\Downarrow \qquad \Downarrow$

$.05 > \text{p-value} > .025$ Double? NO.

⑤ Decision:

$.05 > \text{p-value} > .025$

$\shortparallel$

α

$\Rightarrow$ p-value $< \alpha$

$\Rightarrow \boxed{\text{Reject } H_0}$

(11) ① $H_0: \mu = 22$
$H_a: \mu \neq 22$

② $\alpha = .05$

③ Data

$\bar{x} = 20$
$s = 4$
$n = 24$
↳ must assume the distribution is approx normal.

test statistic

$t = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}}$ d.f. $= n-1$

$= \dfrac{20 - 22}{4/\sqrt{24}}$ d.f. $= 24-1$

$= -2.449$ d.f. $= 23$

Ignore

④ p-value:

$2.177 < 2.449 < 2.500$

$\Downarrow \quad \Downarrow \quad \Downarrow$

$.02 > \text{p-value} > .01$

$.04 > \text{p-value} > .02$

Double? yes!

⑤ Decision:

$.05 > .04 > \text{p-value} > .02$
$\| $
α

so p-value $< \alpha$

$\Rightarrow$ $\boxed{\text{Reject } H_0}$

(113). (1) $H_0: \mu = 4.55$

$H_a: \mu \neq 4.55$ "Differs from" amount in 2005

(2) $\alpha = .10$

(3). Data:

$\bar{x} = 4.76$

$s = 2.297$

$n = 20$

Test statistic

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \quad d.f. = n-1$$

$$= \frac{4.76 - 4.55}{2.297/\sqrt{20}} \quad d.f. = 20-1$$

$$= 0.409 \quad d.f. = 19$$

(4) p-value

$0.409 < 0.688$

$\Downarrow$

p-value $> .25$ DOUBLE? YES

$\Rightarrow$ p-value $> .50$

(5) Decision:

p-value $> .50 > .10$ ($= \alpha$)

$\Rightarrow$ p-value $> \alpha$

$\Rightarrow$ $\boxed{\text{Fail to Reject } H_0}$

---

(114) (a) $\alpha = .05$

(1) $H_0: \mu \leq 180$

$H_a: \mu > 180$ "what the golfer wanted"

(2) $\alpha = .05$

(3) Data

$n = 6$

$\bar{x} = 182.7$

$s = 2.7$

Test statistic:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \quad d.f. = n-1$$

$$= \frac{182.7 - 180}{2.7/\sqrt{6}} \quad d.f. = 6-1$$

$$= 2.449 \quad d.f. = 5$$

(4) p-value

$2.015 < 2.449 < 2.571$

$.05 > \text{p-value} > .025$

Double? NO

(5) Decision:

$.05 > \text{p-value} > .025$

($.05 = \alpha$)

so p-value $< \alpha$

$\Rightarrow$ $\boxed{\text{Reject } H_0}$

#116 ① $H_0: \mu = 1736$

$H_a: \mu \neq 1736$

"differed from national mean"

② $\alpha = .05$

③ Data:

$\bar{x} = 1922.76$

$s = 350.90$

$n = 25$

Test statistic

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \quad d.f. = n-1$$

$$= \frac{(1922.76 - 1736)}{350.90/\sqrt{25}} \quad d.f. = 25-1$$

$$= 2.661 \quad d.f. = 24$$

④ p-value

$$2.492 < 2.661 < 2.797$$

$$.01 > \text{p-value} > .005$$

Double? yes

$$\Rightarrow .02 > \text{p-value} > .01$$

⑤ Decision

$$\underset{\alpha}{\overset{\shortparallel}{.05}} > .02 > \text{p-value} > .01$$

$$\Rightarrow \text{p-value} < \alpha$$

$$\Rightarrow \boxed{\text{Reject } H_0}$$

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#(39) (a). (1) $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 \neq \mu_2$

(2) $\alpha = .05$

(3) Data

$\bar{x}_1 = 10$ $\bar{x}_2 = 12$
$s_1 = 2.1$ $s_2 = 2.3$
$n_1 = 15$ $n_2 = 15$

Test Statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\left(\frac{s_1^2(n_1-1) + s_2^2(n_2-1)}{n_1+n_2-2}\right)\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

$d.f. = n_1+n_2-2$

$$= \frac{(10-12)}{\sqrt{\left(\frac{(2.1)^2(15-1)+(2.3)^2(15-1)}{(15+15-2)}\right)\left(\frac{1}{15}+\frac{1}{15}\right)}}$$

But only for the t score NOT the z score!
↓
may ignore

$= -2.487$ $d.f. = 15+15-2 = 28$

you should find something APPROXIMATELY equal to this value

(4) p-value:

$2.467 < 2.486 < 2.763$
⇓ ⇓ ⇓
$.01 > \text{p-value} > .005$
⇓
$.02 > \text{p-value} > .01$

Double? Yes

(5) Decision

$.05 > .02 > \text{p-value} > .01$
α (= .05)

so p-value < α
$\Rightarrow$ $\boxed{\text{Reject } H_0}$

(41) ① $H_0: \mu_1 \le \mu_2$

$H_a: \mu_1 > \mu_2$ "RIGHT TAILED" I will not use this terminology

② $\alpha = .05$

③ Data:

$\bar{x}_1 = 20$ $\bar{x}_2 = 18$

$s_1 = 4$ $s_2 = 5$

$n_1 = 10$ $n_2 = 15$

Test Statistic

$$t = \frac{(20-18)}{\sqrt{\left(\frac{(4)^2(10-1)+(5)^2(15-1)}{(10+15-2)}\right)\left(\frac{1}{10}+\frac{1}{15}\right)}}$$

$d.f._1 = n_1+n_2-2$
$= 10+15-2$
$= 23$

$t = 1.057 \quad d.f. = 23$

④ p-value:

$$0.858 < 1.057 < 1.060$$

$$\Downarrow \qquad \Downarrow \qquad \Downarrow$$

$$.20 > \text{p-value} > .15$$

Double? NO

⑤ Decision:

$$.20 > \text{p-value} > .15 > .05 = \alpha$$

$\frac{5}{2}0$

p-value $> \alpha$

$\Rightarrow$ $\boxed{\text{Fail to Reject } H_0}$

Fraud $\downarrow$ Firearms $\downarrow$

pg 3hree

#45

① $H_0: \mu_1 \geq \mu_2$

$H_a: \mu_1 < \mu_2$

② $\alpha = .05$

③. Data:

$\bar{x}_1 = 10.12$ $\bar{x}_2 = 18.78$

$s_1 = 4.9$ $s_2 = 4.64$

$n_1 = 10$ $n_2 = 10$

$$t = \frac{(10.12 - 18.78)}{\sqrt{\left(\frac{(4.9)^2(10-1)+(4.64)^2(10-1)}{10+10-2}\right)\left(\frac{1}{10}+\frac{1}{10}\right)}}$$

$d.f._1 = n_1+n_2-2$
$= 10+10-2$
$= 18$

$= \ominus 4.058$ $d.f._1 = 18$

may ignore

④ p-value

$3.922 < 4.058$

$\Downarrow$

$.0005 >$ p-value

Double? No

⑤. Decision:

$.05 > .0005 >$ p-value

α

$\hookrightarrow$ p-value $< \alpha$

$\Rightarrow$ $\boxed{\text{Reject } H_0}$

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#83

① $H_0: p = .7$

$H_a: p \neq .7$

② $\alpha = .05$

③ Data:

$x = 16$

$n = 20$

$\Rightarrow \hat{p} = \frac{x}{n} = \frac{16}{20} = .80$

So TEST STATISTIC

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$$= \frac{(.80 - .70)}{\sqrt{\frac{(.7)(.3)}{20}}}$$

$$= 0.98$$

$q_0 = 1 - p_0$

$= 1 - .7$

$= .3$

④ p-value

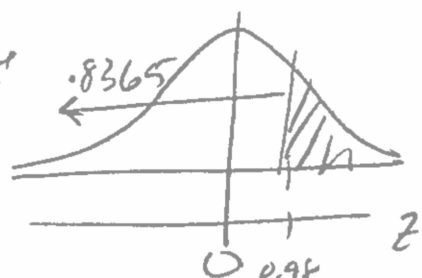

TABLE Value

.8365

So p-value: $1 - .8365 =$

$= .1635$ DOUBLE? YES!

$\Rightarrow$ p-value $= .3270$

⑤ Decision

$.3270 > .05$

$\Rightarrow$ p-value $> \alpha \Rightarrow$ Fail to Reject H_0

pg two

85 b. 1 $H_0: p \le .50$

$H_a: p > .50$ "MAJORITY" means "more than 50%"

2. $\alpha = .05$

3. Data:

$n = 1008$

$x = 534$

$\Rightarrow \hat{p} = .530$

Test Statistic

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$q_0 = 1 - p_0$
$= 1 - .5$
$= .5$

$$= \frac{(.530 - .50)}{\sqrt{\frac{(.5)(.5)}{1008}}}$$

$$= 1.90$$

4 p-value

1.90 → TABLE VALUE .9713

$1 - .9713 = .0287$

Double? NO

p-value = .0287

5 Decision $.0287 < .05$

$\Rightarrow$ p-value $< \alpha$

$\Rightarrow$ $\boxed{\text{Reject } H_0}$

Pg 3 hnge

#86 (b)

① $H_0: p \le .50$
$H_a: p > .50$ "majority"

② $\alpha = .05$

③ Data

$x = 394$
$n = 758$
$\hat{p} = \frac{x}{n} = \frac{394}{758}$
$= .520$

Test statistic

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

$q_0 = 1 - p_0$
$= 1 - .5$
$= .5$

$$= \frac{(.52 - .50)}{\sqrt{\frac{(.5)(.5)}{758}}}$$

$= 1.10$

④ p-value

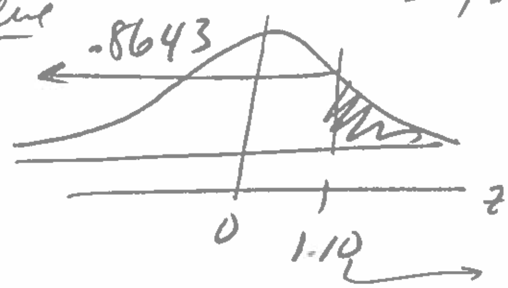

TABLE VALUE
.8643

$1 - .8643 = .1357$

Double? NO

so p-value = .1357

⑤ Decision

$.1357 > .05$

$\Rightarrow$ p-value $> \alpha \Rightarrow$ $\boxed{\text{Fail to Reject } H_0}$