

Solutions

① $H_0: \mu_1 - \mu_2 = 0$ $H_a: \mu_1 - \mu_2 \neq 0$

② $H_0: p = 0.045$ $H_a: p > 0.045$

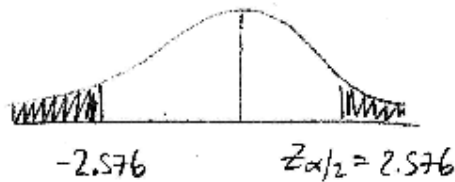
③ 1) $H_0: \mu = 70$ $H_a: \mu \neq 70$

two-tailed

2) Assumptions: $n \geq 30$ ✓

3)
$$z = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$
$$= \frac{69.1 - 70}{(3.5/\sqrt{49})}$$
$$= -1.8$$

4) Rejection Region
 $\alpha = 0.01$



two-tailed

5) Don't reject H_0
 $\mu = 70$

6) $p = P(|z| > 1.8)$
 $= 2(0.5 - 0.4641)$
 $= 0.0718$



④ 1) $H_0: \mu_1 - \mu_2 = 0$ $H_a: \mu_1 - \mu_2 \neq 0$
two-tailed

2) Assumptions: $n_1 \geq 30$ and $n_2 \geq 30$ ✓

3)
$$z = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$
$$= \frac{59 - 60 - 0}{\sqrt{\frac{2^2}{40} + \frac{2^2}{40}}}$$
$$\approx -2.24$$

To find D_0 , look at H_0 :

$H_0: \mu_1 - \mu_2 = 0$

$D_0 = 0$

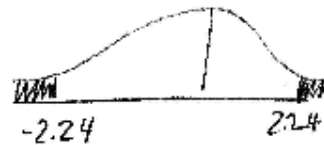
4) Rejection Region
 $\alpha = 0.05$

two-tailed



5) Reject H_0
 $\mu_1 - \mu_2 \neq 0$ or $\mu_1 \neq \mu_2$

6) $p = P(|z| > 2.24)$
 $= 2(0.5 - 0.4875)$
 $= 0.025$

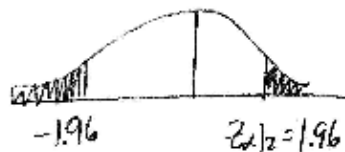


⑤ 1) $H_0: p = 0.006$ $H_a: p \neq 0.006$
two-tailed

2) Assumptions: $np_0 = 1200(0.006) > 5 \checkmark$
 $nq_0 = 1200(0.994) > 5 \checkmark$
 $q_0 = 1 - p_0$

3) $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$ $\hat{p} = \frac{6}{1200}$
 $= \frac{\frac{6}{1200} - 0.006}{\sqrt{\frac{0.006(0.994)}{1200}}}$
 ≈ -0.45

4) Rejection Region two-tailed
 $\alpha = 0.05$



5) Don't reject H_0 .
 $p = 0.006$

6) $p = P(|z| > 0.45)$
 $= 2(0.5 - 0.1736)$
 $= 0.6528$



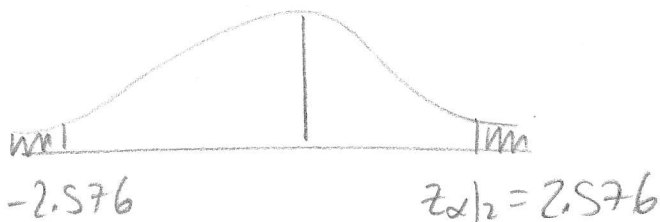
⑥ 1) $H_0: p_1 - p_2 = 0$ $H_a: p_1 - p_2 \neq 0$
two-tailed

2) $n_1 \hat{p}_1 > 5$, $n_1 \hat{q}_1 > 5$, $n_2 \hat{p}_2 > 5$, $n_2 \hat{q}_2 > 5$
 $\hat{q}_1 = 1 - \hat{p}_1 = 0.948$ $\hat{q}_2 = 1 - \hat{p}_2 = 0.977$

3) $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$
 $= \frac{0.052 - 0.023}{\sqrt{\left(\frac{75(1925)}{2000^2}\right)\left(\frac{1}{1000} + \frac{1}{1000}\right)}}$
 ≈ 3.41

$x_1 = n_1 \hat{p}_1 = 52$
 $x_2 = n_2 \hat{p}_2 = 23$
 $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2} = \frac{75}{2000}$
 $\hat{q} = 1 - \hat{p} = \frac{1925}{2000}$

4) Rejection Region
 $\alpha = 0.01$ two-tailed



5) Reject H_0
 $p_1 - p_2 \neq 0$ or $p_1 \neq p_2$

6) $p = P(|z| > 3.41)$
 $= 2(0.5 - 0.4997)$
 $= 0.0006$



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1) $H_0: \mu = 355$

$H_a: \mu < 355$
left-tailed

2) $n \geq 30$ ✓

3) $z = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$
 $= \frac{354.4 - 355}{1.9/\sqrt{32}}$
 ≈ -1.79

4) Rejection Region
 $\alpha = 0.02$



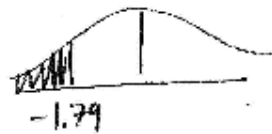
left-tailed

$-z_{\alpha} = -2.054$

5) Don't reject H_0
 $\mu = 355$

6) $p = P(z < -1.79)$
 $= 0.5 - 0.4633$
 $= 0.0367$

left-tailed

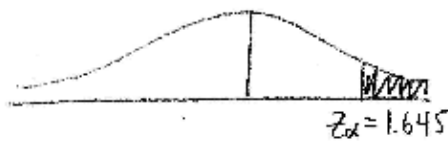


⑧ 1) $H_0: p = 0.004$ $H_a: p > 0.004$
right-tailed

2) $np_0 = 1800(0.004) > 5$ ✓
 $q_0 = 1 - p_0 = 0.996$
 $nq_0 = 1800(0.996) > 5$ ✓

3) $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$ $\hat{p} = \frac{17}{1800}$
 $= \frac{\frac{17}{1800} - 0.004}{\sqrt{\frac{0.004(0.996)}{1800}}}$
 ≈ 3.66

4) Rejection region right-tailed
 $\alpha = 0.05$



5) Reject H_0
 $p > 0.004$

6) $p = P(z > 3.66)$
 $z = 3.66$ is off the z-table
 ≈ 0

⑨ 1) $H_0: \mu_1 - \mu_2 = 0$

$H_a: \mu_1 - \mu_2 > 0$
right-tailed

2) $n_1 \geq 30$ and $n_2 \geq 30$ ✓

3) $z = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

To find D_0 , look at H_0 :

$H_0: \mu_1 - \mu_2 = 0$

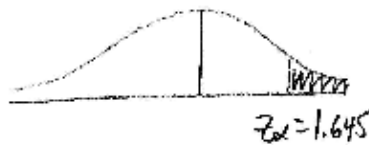
D_0 ↗

$= \frac{38.7 - 36.0 - 0}{\sqrt{\left(\frac{5.1^2}{45} + \frac{4.8^2}{42}\right)}}$

≈ 2.54

4) Rejection Region
 $\alpha = 0.05$

right-tailed



5) Reject H_0
 $\mu_1 - \mu_2 > 0$ or $\mu_1 > \mu_2$

6) $p = P(z > 2.54)$
 $= 0.5 - 0.4945$
 $= 0.0055$



10) 1) $H_0: p_1 - p_2 = 0$ $H_a: p_1 - p_2 < 0$
left-tailed

2) $\hat{p}_1 = \frac{7}{350}$ $\hat{q}_1 = 1 - \hat{p}_1 = \frac{343}{350}$

$\hat{p}_2 = \frac{19}{800}$ $\hat{q}_2 = 1 - \hat{p}_2 = \frac{781}{800}$

$n_1 \hat{p}_1, n_1 \hat{q}_1, n_2 \hat{p}_2, n_2 \hat{q}_2$ all > 5 ✓

3) $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$ $\hat{p} = \frac{7+19}{350+800} = \frac{26}{1150}$
 $\hat{q} = 1 - \hat{p} = \frac{1124}{1150}$
 $= \frac{\frac{7}{350} - \frac{19}{800}}{\sqrt{\frac{26(1124)}{1150^2} \left(\frac{1}{350} + \frac{1}{800}\right)}}$

≈ -0.39

4) Rejection region $\alpha = 0.01$ left-tailed



$-z_\alpha = -2.326$

5) Don't reject $H_0: p_1 - p_2 = 0$ or $p_1 = p_2$

6) $p = P(z < -0.39)$
 $= 0.5 - 0.1517$
 $= 0.3483$

