Hypothesis test for p

$H_0: p = p_0$	$H_0: p \le p_0$	$H_0: p \ge p_0$
$H_1: p \ne p_0$	$H_1: p > p_0$	$H_1: p < p_0$

Use the z-table

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

Example: In a sample of 100 voters, 55 favor a ballot measure. At the 5% level of significance, can we conclude that more than 50% of all voters favor the measure?

1

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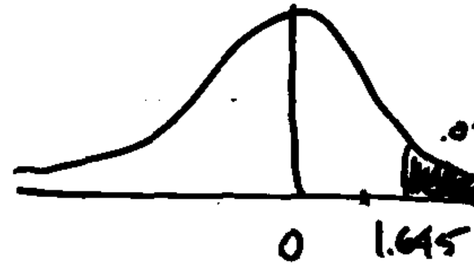
$H_0: p \le .5$

$H_1: p > .5$

2



$n = 100$

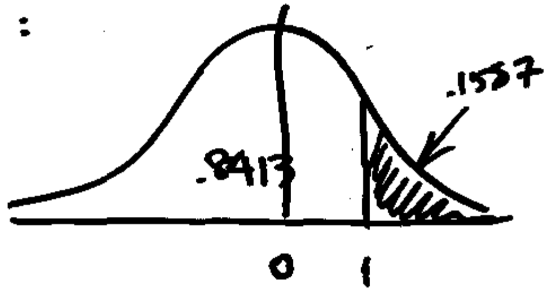
$\hat{p} = \frac{55}{100} = .55$

$$z = \frac{.55 - .5}{\sqrt{\frac{(.5)(.5)}{100}}} = 1$$

Accept H_0. We were unable to show that more than 50% of voters favor the measure.

(3)

p-value:



pvalue = .1587

Comparing 2 population means

$H_0: \mu_1 - \mu_2 = d_0$
$H_1: \mu_1 - \mu_2 \neq d_0$ | etc.

$$\text{Test stat} = z = \frac{\bar{x}_1 - \bar{x}_2 - d_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

OR

(4)

$$t = \frac{\bar{x}_1 - \bar{x}_2 - d_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

df = same as for C.I.s

Comparing 2 proportions

$H_0: p_1 - p_2 = d_0$
$H_1: p_1 - p_2 \neq d_0$ | etc.

(The d_0 is almost always 0)

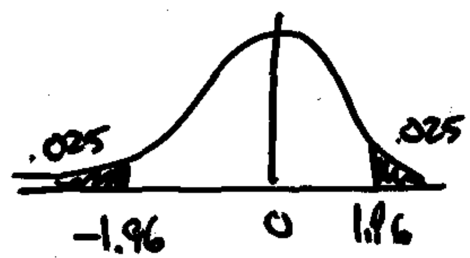
$$\text{Test stat} = z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}},$$

where $\hat{p} = \dfrac{n_1 \hat{p}_1 + n_2 \hat{p}_2}{n_1 + n_2}$

Example: See if the defect rates for 2 manufacturing processes are different. Use $\alpha = .05$

$H_0: p_1 - p_2 = 0$

$H_1: p_1 - p_2 \neq 0$



Collect the data:

$n_1 = 80 \qquad n_2 = 60$

$x_1 = 5 \qquad x_2 = 6$

$\hat{p}_1 = \frac{5}{80} = .0625 \qquad \hat{p}_2 = \frac{6}{60} = .1$

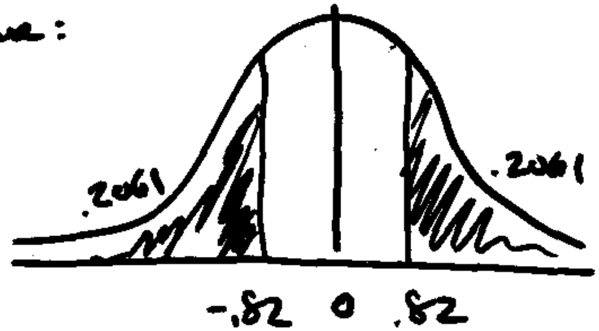
$$\hat{p} = \frac{80\left(\frac{5}{80}\right) + 60\left(\frac{6}{60}\right)}{80 + 60}$$

$$= \frac{5+6}{80+60} = \frac{11}{140} = .0786$$

$$Z = \frac{.0625 - .1}{\sqrt{(.0786)(.9214)\left(\frac{1}{80} + \frac{1}{60}\right)}} = -.82$$

Accept H_0. We failed to detect a difference between the 2 defect rates.

p-value:



pvalue = .4122

Matched pairs

$$\left.\begin{array}{l} H_0: \mu_d = d_0 \\ H_1: \mu_d \neq d_0 \end{array}\right| \text{ etc}$$

$$\text{Test stat} = t = \frac{\bar{d} - d_0}{s_d/\sqrt{n}}$$

Example: 200 matched pairs of supermarkets.

In the "A" half of each pair, a new product is introduced, but not in the "B" half.

A	B
173	168
211	214
200	190
⋮	⋮

$\Big\}$ 200 data points.

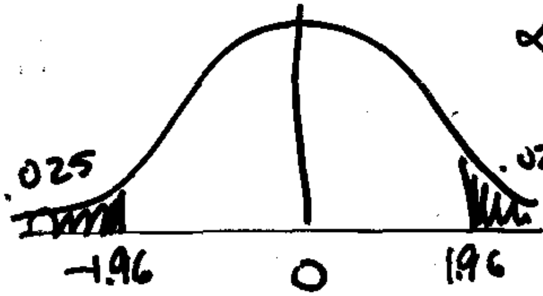
Test for a change in either direction.

$H_0: \mu_d = 0$

$H_1: \mu_d \neq 0$

(9)

$\alpha = .05$



df = 199

Say $\bar{d} = -20$ and $s_d = 2$

$$t = \frac{-20 - 0}{2/\sqrt{200}} = -141$$

Reject H_0. Sales were significantly lower at the "A" stores.

pvalue ≈ 0

(10)

HW #5 p. 357 10.24
10.46
10.57

p. 366 10.56
10.66

due Tuesday, May 4

Midterm is also May 4