③ ## 2-Proportion Test

* when you want to compare two proportions from two different populations.

① · Population 1:
· Population 2:

⑤ $H_0: p_1 = p_2$

$H_a: p_1 \; >, <, \neq \; p_2$

② Parameter (p_1 & p_2)

④ Conditions:

· Random Samp 1 ✓
· $10n_1 < Pop_1$ ✓
· $n_1\hat{p}_1 \geq 10$
$n_1(1-\hat{p}_1) \geq 10$

· Random Samp 2 ✓
· $10n_2 < Pop_2$ ✓
· $n_2\hat{p}_2 \geq 10$
$n_2(1-\hat{p}_2) \geq 10$

⑥ n_1 $\hat{p}_1$
n_2 $\hat{p}_2$

standardized value $= \dfrac{(\text{statistic}) - (\text{parameter})}{\text{SD of stat}}$

<u>Formula:</u>

$$Z = \frac{(\hat{p}_1 - \hat{p}_2) - \overset{0}{\cancel{(p_{o_1} - p_{o_2})}}}{\sqrt{\dfrac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \dfrac{\hat{p}_2(1-\hat{p}_2)}{n_2}}}$$

Formula sheet: ✱

$$\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

$H_0: p_1 = p_2$ ✱

✱ $H_a: p_1 < p_2$

$\hat{p}_1 = \frac{50}{80}$ $\hat{p}_2 = \frac{59}{70}$

p-value ≈ .0014

* Since our p-value is less than 5%
we reject the H_0, which means the
evidence suggests the (p_1) is less
than the (p_2).

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③ 2-Sample T

*① Pop$_1$:

Pop$_2$:

⑤ $H_0 : \mu_1 = \mu_2$

$H_a : \mu_1 \; > \; < \; \neq \; \mu_2$

② Param: (μ_1 & μ_2)

④ Conditions: • Random Samp 1 & Rand. Samp. 2

• $10n_1 <$ Pop 1 & $10n_2 <$ Pop 2

• $n_1 \geq 30$ & $n_2 \geq 30$.

n_1 $\bar{x}_1$ s_1

n_2 $\bar{x}_2$ s_2

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Formula Sheet

$$\sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

Joe Smith recently claimed that the proportion of adult males in the U.S with at least two credit cards is different then the proportion of adult females in the U.S with at least two credit cards. He conducted a survey by randomly selecting 100 males and 90 females. Out of 100 males, 71 had at least two credit cards. Out of 90 females, 72 had at least two credit cards. Conduct an appropriate hypothesis test to see if you believe that the proportion of males is different from the proportion of females?

Pop_M : All adult males in the U.S

Pop_F : All adult females in the U.S

Param: (p_M & p_F) proportion of adults with at least two credit cards.

$H_0: p_M = p_F$

* $H_a: p_M \neq p_F$

Two Proportion Test

- Random $Samp_M$ & Random Samp F
- $10n_M < Pop_M$ & $10n_F < Pop_F$
- $n_M \hat{p}_M \geq 10$ • $n_F \hat{p}_F \geq 10$

  $n_M(1-\hat{p}_M) \geq 10$ $n_F(1-\hat{p}_F) \geq 10$

$n_M = 100$

$n_F = 90$

$\hat{p}_M = \frac{71}{100}$ $\hat{p}_F = \frac{72}{90}$

Samp Diff	Std. Error	Z-Stat	P-value
- 0.09	.06269	-1.43	.1511
$(\hat{p}_M - \hat{p}_F)$	* $\sqrt{\frac{\hat{p}_M(1-\hat{p}_M)}{n_M} + \frac{\hat{p}_F(1-\hat{p}_F)}{n_F}}$		

Formula:

$$Z = \frac{(\hat{p}_M - \hat{p}_F) - 0}{\sqrt{\frac{\hat{p}_M(1-\hat{p}_M)}{n_M} + \frac{\hat{p}_F(1-\hat{p}_F)}{n_F}}} \approx -1.43$$

* Since our p-value is greater than 5% we fail to reject Ho which means we did not have enough evidence to say that the proportion of adult males in the U.S with at least two CC's is different from the proportion of adult females in the US with at least

A student claims that the average G.P.A at Iowa State University is lower than the average G.P.A at Indiana State University. She goes to each college and randomly selects 60 students from each university. The average G.P.A for the 60 students at Iowa State was a 3.14 with a standard deviation of 0.32 and the average G.P.A at Indiana State was a 3.31 with a standard deviation of 0.18. Does the data support the students claim?

Two Sample T

Pop 1: All students at Iowa St. University.

Pop 2: All students at Indiana St. University.

Param: (μ_1 & μ_2) Avg. GPA

Conditions: Random Samp 1 ✓ & Rand. Samp 2 ✓

$10n_1 <$ Pop 1 ✓ & $10n_2 <$ Pop 2 ✓

$n_1 \geq 30$ ✓ $n_2 \geq 30$ ✓

$H_0: \mu_1 = \mu_2$

$H_a: \mu_1 < \mu_2$

$n_1 = 60$

$\bar{x}_1 = 3.14$

$s_1 = .32$

$n_2 = 60$

$\bar{x}_2 = 3.31$

$s_2 = .18$

samp diff	Std. Error	DF	T-Stat
$\boxed{-0.17}$	0.047399	118	-3.587

p-value ≈ .0002

$$Z = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \approx -3.587$$

* Since our p-value is less than 5% we reject the Ho which means the evidence suggests the mean G.P.A at Iowa St. university is lower than the mean G.P.A at Indiana St. University.

If someone believes the average temperature in a specific state is over 76° and they take a sample of 50 days and record the temperatures for that state. The average temperature for the 50 days is 80°. They conduct an appropriate hypothesis test and discover the p-value is equal to 0.04. **Explain in detail** what the p-value is actually saying in the context of this problem.

* There is a 4% chance we would get a sample mean of 80° for 50 days if the actual average temp. in the state is 76°.

p-value = .04

$H_o: \mu = 76°$

$H_a: \mu > 76°$ ←

$n = 50$ $\bar{x} = 80°$

	H_o is TRUE	H_o is False
Reject H_o	Type I ERROR	✓
Fail to Reject H_o	✓	Type II ERROR

* H_o: Do not make a profit
* H_a: We will make a profit

. Shows Ho is true (Do not buy a ticket)

. Reject Ho (Buy Ticket)

(Lose $2)

* Ho: ~~I~~ If you buy a ticket you will lose $2

Ha Win Lotto

* Type I
Reject Ho
when True
Lose $2

Type II
Fail to reject Ho
Don't buy the ticket
but would have won.