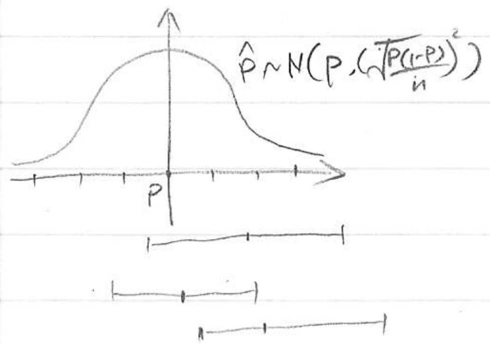
12/06/2016.

- "Inverie Problem" parameter unknow,
  use sample to draw inference about parameter.

- Statisticed Inference.
  ① Point Estimtion : Best guess : $\hat{p}$
  ② Interval Estimtion confidence Interval $CI_{1-\alpha, p} : [\hat{p} \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$



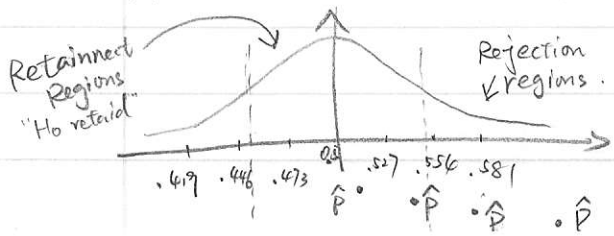
- Inter pretation of a CI
  I. $\frac{\# \text{ of times } \{p \in CI\}}{n} \to 1-\alpha$
  II Before experiment
  $P(p \in CI) = 1-\alpha$.
  III If you believe is subjective prob.
  then under prior information
  You can say $P(p \in CI) = 1-\alpha$

③ Parameter Value Testing.
(Hypers... Testing).

$\alpha \downarrow \Rightarrow 1-\alpha \uparrow \Rightarrow z_{\frac{\alpha}{2}} \uparrow$

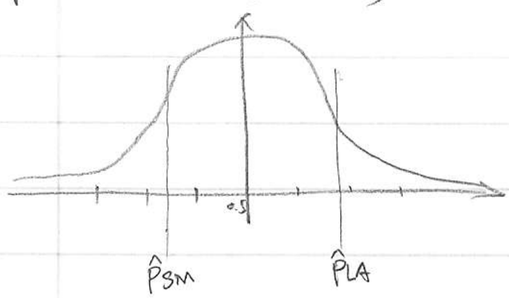
Geder Ratio is Human Births $p := P(\text{male})$
My theory: $p \neq 0.5$ ie. unequal geder ratio Crazy?
△ Default / "Null" Hypothesis denoted:
$H_0 : p = 0.5$
The crazy theory is the altermate Hypothesis H_a: Ha is false : $p \neq 0.5$.

Assume Ho is true. $\hat{p} \sim N(\underset{0.5}{p}, (\underset{0.269}{\sqrt{\frac{p(1-p)}{n}}})^2)$ We take sample of size $n = 345$.



$\hat{p} \sim N(0.5, 0.269^2)$

☆ Let $\alpha := P(\text{too rare})$



$$1-\alpha = P(H_0 \text{ retaind})$$
$$= P(\hat{p} \in [\hat{p}_{small}, \hat{p}_{Large}])$$
$$= P(\hat{p} \in [p \pm \text{margin}])$$
$$= P\left(\hat{p} \in \left[p \pm z_{\frac{\alpha}{2}} \sqrt{\frac{p(1-p)}{n}}\right]\right)$$

- Retainment Regin $= \left[p \pm z_{\frac{\alpha}{2}}\sqrt{\frac{p(1-p)}{n}}\right]$

- Rejection Regin $\left[p \pm z_{\frac{\alpha}{2}}\sqrt{\frac{p(1-p)}{n}}\right]^c$

Calculate $\hat{p}$ (I) if $\hat{p} \in$ Retainment Regin $\Rightarrow$ Retains H_0. We do not have sufficient evidence to reject the null hypothesis

(II) If $\hat{p} \in$ Rejection Region $\Rightarrow$ Reject H_0. Also accepts H_a. We have sufficient evidence to reject the null hypothesis.

ex: $n = 345$, $\alpha = 5\%$

Retainance Region $= \left[0.5 \pm 2\sqrt{\frac{0.5(1-0.5)}{345}}\right] = [0.446, 0.554]$

if 169 bodies were male $\Rightarrow \hat{p} = \frac{169}{345} = 0.48 \in$ Retainance Region

We do not have sufficient evidence to reject human gende ratio equality.

ex: Flip a coin 100 time, you want to know if coin is fair. $p := P(H)$

sce I: 51H Fair? yes.

sce II: 98H Fair? No.

sce III: 61H Fair?

$H_0: p = 0.5$; $H_a: p \neq 0.5$, $\alpha = 5\%$

Ret Region $= \left[p \pm z_{\frac{\alpha}{2}}\sqrt{\frac{p(1-p)}{n}}\right] = \left[0.5 \pm 2\sqrt{\frac{0.5(1-0.5)}{100}}\right]$

$= [0.4, 0.6]$

$\hat{p} = \frac{61}{100} = 0.61$, $\hat{p} \notin$ Retainment region.

ex: Mars (the candy corp.) says the prob of blue M&M's is 20% you think otherwise?

Let's $p :=$ (Blue), $H_0: p = 0.2$, $H_a: p \neq 0.2$

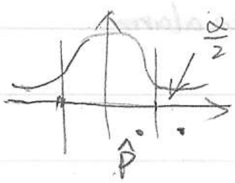
$n = 615$, M&M's $\alpha = 1\%$

Ret Region $= [p \pm z_{\frac{\alpha}{2}}\sqrt{\frac{p(1-p)}{n}}] = [0.2 \pm 2.84\sqrt{\frac{0.2(1-0.2)}{615}}] = [0.1542, 0.2458]$

$\hat{p} = \frac{158}{615} = 0.2569 \Rightarrow \hat{p} \notin$ Ret Region

$\Rightarrow$ Reject H_0. The prob of Blue M&M's is not 20%.

Summary: $\hat{p}$ is draw from $\hat{P} | H_0 \sim N(p, (\sqrt{\frac{p(1-p)}{n}})^2)$



Decision

	Retain H_0	Reject H_0
H_0 true	✓	Type I error
H_0 fales	Type II error	✓

P(Type I error) $= \alpha$

P(Type II error) beyond scope of class.

P(Reject H_a | H_0 false) = Power. (No cover)

$\alpha\uparrow \Rightarrow P(\text{Type I err})\uparrow \Rightarrow P(\text{Type II err})\downarrow$

$\alpha\downarrow \Rightarrow P(\text{Type I err})\downarrow \Rightarrow P(\text{Type II err})\uparrow$

☆ Clinical Trial

H_0: drug does not work.

H_0: drug work.

Decision: release drug to market

Type I error: release a drug than doesn't work

Cost: possible death

Type II error: not releasing a drug that does work.

Cost: people can't be helped.

ex:

Coort case.

H_0 : Innocense

H_a : Guilty

Decision: punishment or Not.

Type I error

punish a innocent person.

Type II error

Let guity person go free.

例: Fire Alarm

H_0: No fire.

H_a: Fire.

Deceion : Set off alarm.

Type I err: false alarm.

Type II err: fire, but no alarm.