Unit 3

Confidence Intervals

$CI = PE \pm MOE$

$CI_p = \text{Sample Proportion} \pm z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

$CI_\mu = \text{Sample Mean} \pm t_{\alpha/2}\frac{s}{\sqrt{n}} \rightarrow z_{\alpha/2}$ { σ is known; $n > 100$

$CI = \text{Sample Stat} \pm \text{Critical Value} * \frac{\text{Stdev}}{\text{Adj } n}$

$\bar{x} = 10\,cm$ $MOE = 2\,cm$ 95% CI

$CI = \bar{x} \pm MOE = 10\,cm \pm 2\,cm = (8\,cm, 12\,cm)$

$CI_a = \bar{x} \pm MOE_{90\%}$ (smallest)

$CI_b = \bar{x} \pm MOE_{95\%}$

$CI_c = \bar{x} \pm MOE_{99\%}$ (largest)

$CI_d = \bar{x} \pm MOE_{100\%} = (-\infty, \infty)$ (uninformative)

As $n \rightarrow \infty$ what happens to our CI? $\alpha = 0.05$

$CI \rightarrow (L, U) \rightarrow (\mu, \mu)$

Hypothesis Testing

$H_0 \rightarrow$ "Established Knowledge"

$H_a \rightarrow$ "Some objection to the null"

Take scientific statements and test them with math & data

① Stage your Hypotheses

② Locate our α → Probability of Type I Error

$\alpha = (0.01, 0.05, 0.10)$ = "Certainty in our results"

Type 1 Error	Type 2 Error
Reject H_0 when H_0 is true	Fail to reject H_0 when H_0 was false

$H_0: \bar{X} = 30$ *

$H_a: \bar{X} \neq 30$

Reject H_0

Truth: $\bar{X} = 30$

Truth: $\bar{X} = 52$

③ Calculate the Test Statistic

$$t^* = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$ * Assumed Null

$$t^* = \frac{\bar{d} - d_0}{s_d/\sqrt{n}}$$ * Dependent Diff in Means

$$t^* = \frac{(\bar{x}_1 + \bar{x}_2) - (\mu_{0_1} - \mu_{0_2})}{\sqrt{\frac{s_1^2}{n} + \frac{s_2^2}{n}}} = \frac{s_1}{\sqrt{n}} + \frac{s_2}{\sqrt{n}}$$ * Independent Diff in Means

$$z^* = \frac{\hat{p} - p_0}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}}$$

Anything can use z^* if $n > 100$

④ Test the Hypothesis

P-value → Probability that our result is due to chance

Crit-value → Hypothetically what is a reasonable test stat to assume random chance

Z^* is overly complex

t^* very simple

P-value

$t^* + df$

$df = n - 1$

① Go to t-table
② Look up df
③ Find value(s) close to t^*
④ Probability at the top of column = P-value

Critical Value

① Go to t-table
② Find df
③ Find α
④ The intersect is the crit value

⑤ Decision Rule

$P > \alpha$ Fail

$P < \alpha$ Reject

$t^* \rightarrow t_{\alpha/2}$ based in test direction

* Conclude from Rejection