Abnormal Distribution

- Hypothesis Testing
  - ↳ Type I & Type II error
  - ↳ Z test
  - ↳ one tail & two tail hypothesis
- Confidence interval
- Margin of error
- Confidence level
- α - significance / β - confidence
- ↳ α & β depends on hypothesis testing
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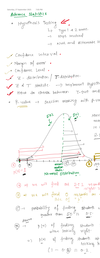
- T-test → passes normality with p-value



α → we will find the 95% values in the Z-score distribution

β → probability of finding people who stand taller than 2m is 2.5%

α → 100 - β finding people who stand taller than 2m is 97.5%

↳ 100 - β finding people who stand taller than 2m is 97.5%

$(1 - \alpha) \cdot 100 = 95\%$

Z distribution

$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$

Sample mean / population mean

Standard deviation / population

Population / sample size

- α → $\frac{\alpha}{2}$ (2-tail test)
- α → α (1-tail test)

$P(-z < z < z) = 1 - \alpha$

$z = 1 - \frac{\alpha}{2}$ (2-tail test)

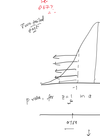
$z = 1 - \alpha$ (1-tail test)

p-value for $z = 1.96$ → 2 tail tailed test.

$\frac{0.975}{0.025}$ = $\frac{0.975}{0.025}$

$0.975 - 0.025 = 0.95$

T-distribution



As we increase no. of observation t-distribution approaches SND (z-dist).

If n > 30 so we find z-statistic.

If n < 30 so we find t-statistic.

$T_{score} = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$

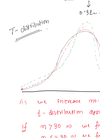
$\bar{x}$ → sample mean
s → sample standard deviation
μ → population mean
n → sample size

P value from T-score, another parameter if is required.

df [degree of freedom] = n - 1

- Confidence level:
  How sure you want to be in your estimate (sample) parameter.

  Typically, 90%, 95%, 99%



$\frac{1 - 0.95}{2} = 0.025$

$1 - \frac{0.05}{2} = 0.975$

$z = 1.96$

Margin of Error = Critical value × (standard error)

for significance level 0.05 → 0.95 (95% [T-test])

CI → find critical z (critical value)

↳ range of values in which we can be.

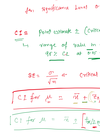
95% CI at 95% SL.

$SE = \frac{\sigma}{\sqrt{n}}$ → critical z = $\frac{z}{\sqrt{n}}$ (z-value / $\sqrt{n}$)

$\boxed{CI \text{ for } \mu = \bar{x} \pm \left(z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}\right)}$

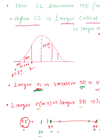
$\boxed{CI \text{ for } \mu = \bar{x} \pm \left(\frac{z_{\alpha/2} \times \sigma}{\sqrt{n}}\right)}$

- Total CL determines MoE (find CL value)
- Higher CL → larger (critical value) → larger MoE and wider CL.



MoE = $z \times \frac{\sigma}{\sqrt{n}}$

- Larger n, so smaller SE → precision MoE → narrow CI
- Larger σ(σ↑) → larger SE → larger MoE → wider CI.



$\frac{\sigma}{\sqrt{n}} = \frac{\sigma}{\sqrt{100}} = \frac{\sigma}{10}$

$\frac{\sigma}{\sqrt{n}} = \frac{\sigma}{\sqrt{400}} = \frac{\sigma}{20}$

- Goal → $\frac{\sigma}{\sqrt{n}} \to 0$ → $\sigma \to 0$, $n \to \infty$

so, we can see the energy for this relationship, which doesn't $\frac{\sigma}{\sqrt{n}} \to 0$ energy.

$95\% \text{ CI} = (\bar{x} - 0.2, \bar{x} + 0.2)$

$P(\bar{x} - 0.2 \le \mu \le \bar{x} + 0.2) = 0.95$

$P(\mu - 0.2 \le \bar{x} \le \mu + 0.2) = 0.95$

$\bar{x} \in [\mu - 0.2, \mu + 0.2]