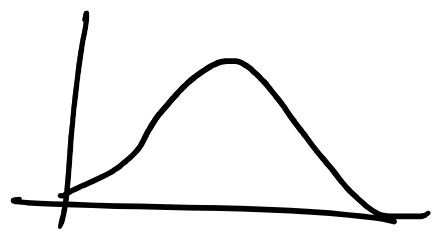
Sampling & Statistical Inference :

-> To analyze MPU (RPi). Every day you will get 50 RPi

-> Mean, S'D, Variance.

-> Sampling Distribution of Mean :



-> Population :

-> Sample :

$$\mu_{\bar{x}} = \mu$$

$$\sigma = \sigma \sqrt{n}$$

-> the size of sample needs to be more than 30.

-> Unit Normal Distribution

$$N(0,1) \qquad z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

-> Case 1 : Standard Deviation is not known.

-> Case 2 : Sample is small size ($n \leq 30$)

-> Student's t-Dist :

$$t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$$ where

$$s^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

-> Interval Estimation :

-> Standard Error :

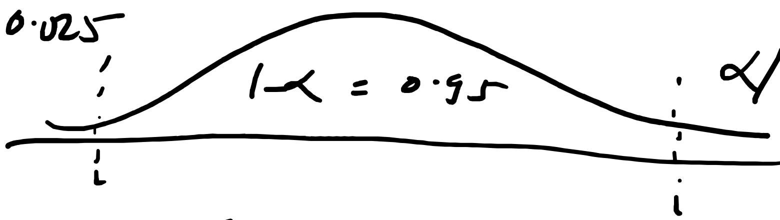
↳ Sample Mean : $\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i = \frac{\sigma}{\sqrt{n}}$

-> Estimating Population Mean μ (σ is known) :

-> Confidence Co-efficient (Arbitrary)

Confidence
||
Prediction

-> $\alpha/2 = 0.025$



$$P\left(-z_{\alpha/2} < z < z_{\alpha/2}\right)$$

→ Conf Levels | Conf Coeff | α | Critical Val

Conf Levels	Conf Coeff	α	Critical Val
80%	0.8	0.2	1.28
90%	0.9	0.1	1.645
95%	0.95	0.05	1.96
98%	0.98	0.02	2.33
99%	0.99	0.01	2.58
99.80%	0.998	0.002	3.08
99.99%	0.999	0.001	3.21

→ Confidence Interval Estimate :

$$\left(\bar{x} - \underbrace{z_{\alpha/2}}_{\text{Confidence Estimate}} \times \underbrace{\frac{\sigma}{\sqrt{n}}}_{\text{standard Error}} \; , \; \bar{x} + z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}} \right)$$

→ A sample of 11 circuits from a large normal population has a mean resistance of 2.20 ohms. We know from past testing population S.D is

We know from past testing population S.D is 0.35 ohms. Determine a 95% confidence interval for the mean resistance of the population

$\rightarrow \left(\bar{x} - z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}, \ \bar{x} + z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}\right)$

$$\left(2.20 - 1.96 \times \frac{0.35}{\sqrt{11}}, \ 2.20 + 1.96 \times \frac{0.35}{\sqrt{11}}\right)$$

$$(1.9932, \ 2.4068)$$

$\rightarrow$ <u>σ is not known:</u> (Values less than 30)

$$\left(\bar{x} - t_{\alpha/2} \times \frac{s_1}{\sqrt{n}}, \ \bar{x} + t_{\alpha/2} \times \frac{s_1}{\sqrt{n}}\right)$$

$\rightarrow$ <u>σ is not known:</u> (Values are more than 30)

$$\left(\bar{x} - z_{\alpha/2} \times \frac{s_1}{\sqrt{n}}, \ \bar{x} + z_{\alpha/2} \times \frac{s_1}{\sqrt{n}}\right)$$

$\rightarrow$ 11 circuits < 30

$s_1 = 0.35$ ohms $\quad \bar{x} = 2.20$ ohms

$$\left(\bar{x} - t_{\alpha/2} \times \frac{s_1}{\sqrt{n-1}},\quad \bar{x} + t_{\alpha/2} \times \frac{s_1}{\sqrt{n-1}}\right)$$

$$\left(2.20 - 2.228 \times \frac{0.35}{\sqrt{10}},\ 2.20 + 2.228 \times \frac{0.35}{\sqrt{10}}\right)$$

→ **Confidence Interval Estimate of μ**

- **σ known**
  - **n small** → **Normal Dist** → $\left(\bar{x} - z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}},\ \bar{x} + z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}\right)$
  - **n large** → **Any Dist** → $\left(\bar{x} - z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}},\ \bar{x} + z_{\alpha/2} \times \frac{\sigma}{\sqrt{n}}\right)$
- **σ unknown**
  - **n small** → **Normal Dist** → $\left(\bar{x} - t_{\alpha/2} \times \frac{s_1}{\sqrt{n}},\ \bar{x} + t_{\alpha/2} \times \frac{s_1}{\sqrt{n}}\right)$
  - **n large** → **Any Dist** → $\left(\bar{x} - z_{\alpha/2} \times \frac{s_1}{\sqrt{n}},\ \bar{x} + z_{\alpha/2} \times \frac{s_1}{\sqrt{n}}\right)$