An inventor has developed a new, energy-efficient lawn mower engine. He claims that the engine will run continuously for more than 5 hours (300 minutes) on a single gallon of regular gasoline. (The leading brand lawnmower engine runs for 300 minutes on 1 gallon of gasoline.)

From his stock of engines, the inventor selects a simple random sample of 50 $\to N$ engines for testing. The engines run for an average of 305 $\to \bar{x}$ minutes. The true standard deviation σ is known and is equal to 30 $\to \sigma$ minutes, and the run times of the engines are normally distributed.

Test hypothesis that the mean run time is more than 300 $\to \mu$ minutes. Use a 0.05 $= \alpha = 5\%$ level of significance.

$\bar{X} = 305$

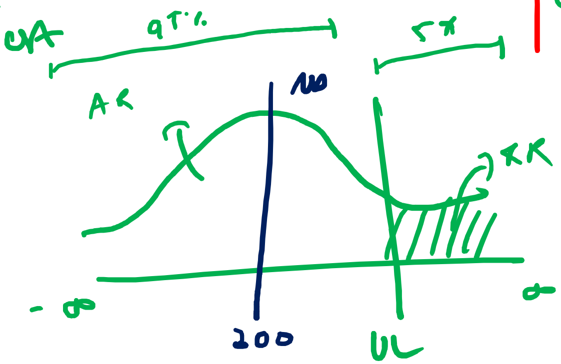
$\boxed{CI = \mu \pm Z_\alpha \frac{\sigma}{\sqrt{n}}}$

Already Accepted

✓ $H_0 \Rightarrow \mu \leq 300$

✗ $H_A \Rightarrow \mu > 300$

→ Right Tail Test



$AR = [-\infty, 307]$ ✓

$RR = [307, +\infty]$

$\boxed{UL = \mu + Z_\alpha \frac{\sigma}{\sqrt{N}}}$

$\Rightarrow 300 + \frac{1.65 \times 30}{\sqrt{50}} \Rightarrow 300 + \frac{49.5}{7.071} = 300 + 7 = 307$

Failed to reject H_0, Rejected H_A

A Telecom service provider claims that individual customers pay on an average 400 Rs. per month with standard deviation of 25 Rs. A random sample of 50 customers bills during a given month is taken with a mean of 250 and standard deviation of 15. What to say with respect to the claim made by the service provider?

μ σ_μ $\bar{x}$ $\sigma_{\bar{x}}$

$H_A \neq$

σ_μ ✓

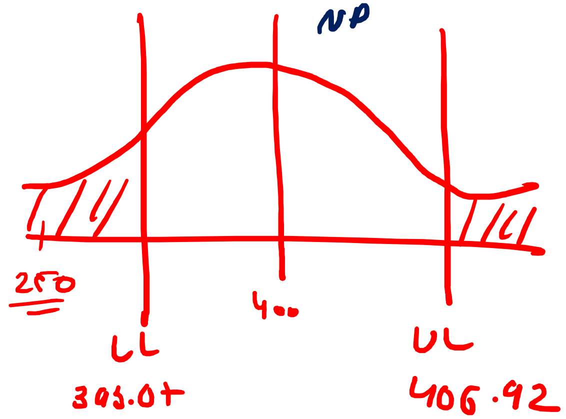
$\sigma_{\bar{x}}$

× $H_0 \Rightarrow \mu = 400$ $\Rightarrow$ 2 Tail Test

✓ $H_A \Rightarrow \mu \neq 400$

$$LL = \mu - Z_\alpha \frac{\sigma}{\sqrt{n}} = 400 - \frac{1.96 * 25}{\sqrt{50}} = 393.07$$

$$UL = \mu + Z_\alpha \frac{\sigma}{\sqrt{n}} = 400 + \frac{1.96 * 25}{\sqrt{50}} \Rightarrow 406.92$$



$\alpha = 5\%$

$Z_{\alpha\,(2T)} = 1.96$

$\sigma = 25$

$\bar{x} = 250$

$n = 50$

H_0 Rejected, H_A is Accepted

→ HT → ND → CI method

↓

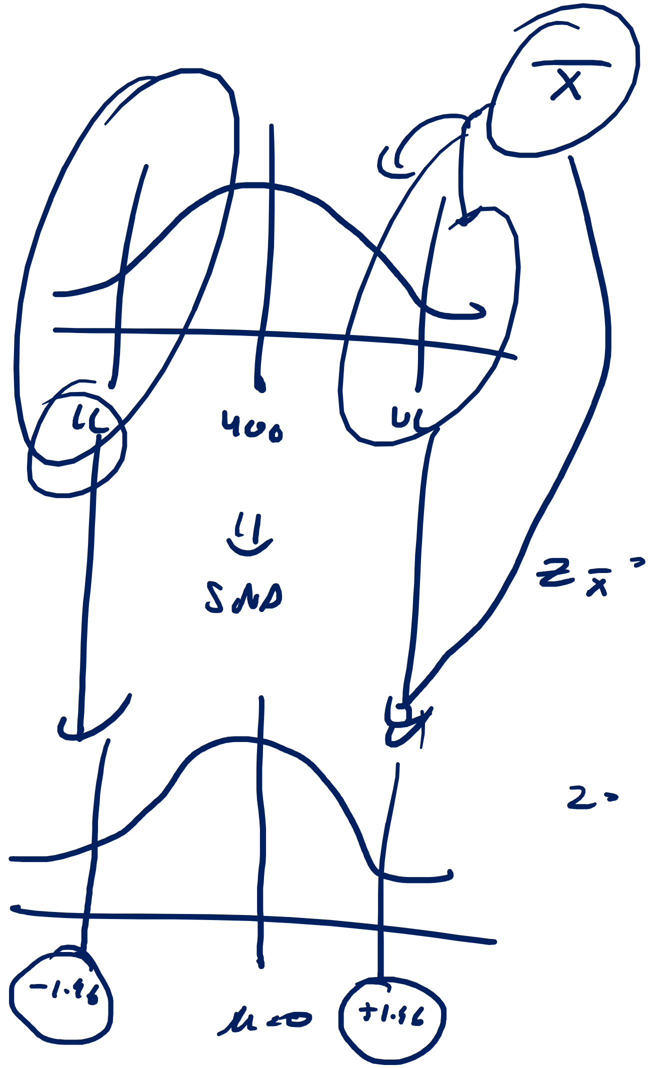
SND → Z-score method

$$\mu \pm Z_\alpha \frac{\sigma}{\sqrt{n}}$$

$$Z = \frac{X - \mu}{\sigma/\sqrt{n}}$$

$$\Rightarrow \frac{\left(\cancel{\mu} \pm Z_\alpha \frac{\sigma}{\sqrt{n}}\right) - \cancel{\mu}}{\cancel{\sigma/\sqrt{n}}}$$

$$\sigma = 1$$



$$Z_{\bar{x}} = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

$Z = 1.69$

An inventor has developed a new, energy-efficient lawn mower engine. He claims that the engine will run continuously for more than 5 hours (300 minutes) on a single gallon of regular gasoline. (The leading brand lawnmower engine runs for 300 minutes on 1 gallon of gasoline.)

From his stock of engines, the inventor selects a simple random sample of 50 engines for testing. The engines run for an average of 305 minutes. The true standard deviation σ is known and is equal to 30 minutes, and the run times of the engines are normally distributed.

Test hypothesis that the mean run time is more than 300 minutes. Use a 0.05 level of significance.

→ $\alpha = 5\%$.

$$CI = \mu \pm z_\alpha \frac{\sigma}{\sqrt{N}}$$

$$\left.\begin{aligned} H_0 &\Rightarrow \mu \le 300 \\ H_A &\Rightarrow \mu > 300 \end{aligned}\right\} \rightarrow \text{Right Tail Test}$$

SND

$$z_x = \frac{x - \mu}{\sigma/\sqrt{N}}$$

$\bar{x} = 305$

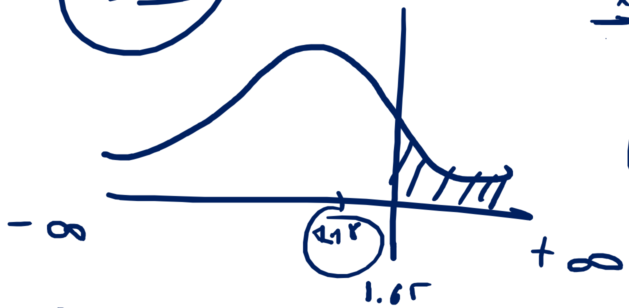
$\mu = 300$

$\sigma = 30$

$N = 50$

$$z_{\bar{x}} = \frac{\bar{x} - \mu}{\sigma/\sqrt{N}}$$

$$\Rightarrow \frac{305 - 300}{30/\sqrt{50}} = 1.18$$



$$\frac{(\cancel{\mu} \pm z_\alpha \cancel{\sigma/\sqrt{N}}) - \cancel{\mu}}{\cancel{\sigma/\sqrt{N}}}$$

A researcher has agreed upon a data on a daily return of portfolio of call option over a recent 250 days period.

The mean daily return has been 0.1% and the standard deviation of daily return portfolio is 0.25%.

The researchers believe that mean daily portfolio return is not 0.

Construct a hypothesis test of researcher's belief at 95% Confidence Interval.

$1-\alpha \rightarrow$ significance

$\mu \quad \bar{X} \quad \bar{X}_1, \quad \bar{X}_2$

Imp

ML

Z - Test

ANOVA → Python

Z - Score method

$\times\ H_0 \Rightarrow \mu = 0 \Rightarrow$ 2 T Test

$\checkmark\ H_A \Rightarrow \mu \neq 0$

H_0 is Rejected, H_A is Accepted

5% sig

95% conf

$$\boxed{Z_{\bar{x}} = \frac{\bar{X} - \mu}{\sigma / \sqrt{N}}}$$

$\mu = 0$

$\bar{X} = 0.001$

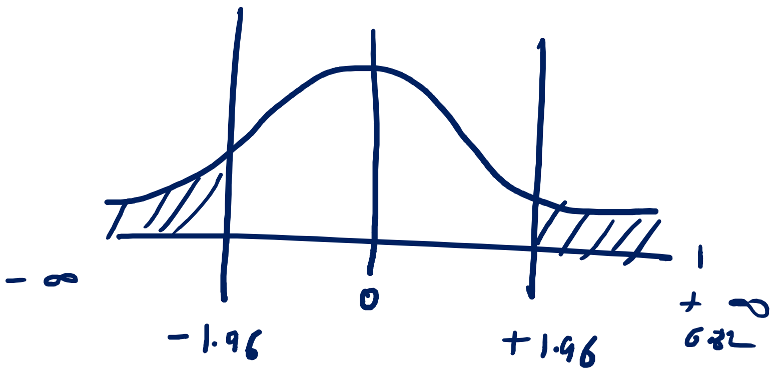
$\sigma = 0.0025$

$\alpha = 5\%$

$Z_{\alpha/2} = \pm 1.96$

$N = 250$

SND



$$Z_{\bar{x}} = \frac{0.001 - 0}{0.0025/\sqrt{250}}$$

$$\Rightarrow \frac{\cancel{0.001}}{\cancel{0.0025}} * \sqrt{250}$$

0.4

$\Rightarrow 0.4 * 15.811$

$\Rightarrow 6.32$