**E**stimation **A**nd **C**onfidence **I**ntervals

**Background**

In quality control processes, especially when dealing with high-value items, destructive sampling is a necessary but costly method to ensure product quality. The test to determine whether an item meets the quality standards destroys the item, leading to the requirement of small sample sizes due to cost constraints.

**Scenario**

A manufacturer of print-heads for personal computers is interested in estimating the **mean** durability of their print-heads in terms of the number of characters printed before failure.

To assess this, the manufacturer conducts a study on a **small sample** of print-heads due to the destructive nature of the testing process.

**Data**

A total of 15 print-heads were **randomly** selected and tested until failure. The durability of each print-head (in millions of characters) was recorded as follows:

1.13, 1.55, 1.43, 0.92, 1.25, 1.36, 1.32, 0.85, 1.07, 1.48, 1.20, 1.33, 1.18, 1.22, 1.29

Sample mean= Sum of heads/ total heads= 18.58/15= 1.2387

Variance = 0.0377

Standard Deviation = Square root of (variance) = √0.0377= 0.1941

**Assignment Tasks**

**a. Build 99% Confidence Interval Using Sample Standard Deviation**

Assuming the sample is representative of the population, construct a 99% confidence interval for the mean number of characters printed before the print-head fails using the sample standard deviation. Explain the steps you take and the rationale behind using the t-distribution for this task.

Answer: From T distribution table, t-score= 2.977

Margin of error = T-score \*Sample mean/ √total prints

= 2.977\*(.1941/√15) = .15

Margin of Error= 0.15

Lower interval = mean-margin of error= 1.2387 -.15= 1.0887

Upper interval= mean+ margin of error= 1.2387 + 0.15 = 1.3887

Result= 99% confidence interval = (1.3887, 1.0887)

**b. Build 99% Confidence Interval Using Known Population Standard Deviation**

If it were known that the population standard deviation is 0.2 million characters, construct a 99% confidence interval for the mean number of characters printed before failure.

Answer:

population standard deviation = 0.2 million

σ = 0.2

n= 15

Z= 2.576

Margin of Error= Z\*( σ/√n) = 2.576(0.2/√15)= 0.1334

Lower interval = mean-margin of error= 1.2387 -0.1334= 1.1053

Upper interval= mean+ margin of error= 1.2387 + 0.1334= 1.3721

Result= 99% confidence interval = (1.3721, 1.1053)