Estimation and Confidence Intervals

# Background

In quality control processes, especially when dealing with high-value items, destructive sampling is necessary but costly. The 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. A small sample of 15 print-heads is tested to determine the durability, given the destructive nature of the testing.

# Data

Sample data (in millions of characters printed): [1.13, 1.55, 1.43, 0.92, 1.25, 1.36, 1.32, 0.85, 1.07, 1.48, 1.2, 1.33, 1.18, 1.22, 1.29]

# Task 1: Confidence Interval using Sample Standard Deviation

To calculate the 99% confidence interval for the mean number of characters printed before failure, we use the t-distribution since the sample size is small and the population standard deviation is unknown. The t-distribution accounts for the additional uncertainty when estimating the population standard deviation from the sample.

Sample mean: 1.2387

Sample standard deviation: 0.1932

t-value (99% confidence, 14 degrees of freedom): 2.9768

Margin of error: 0.1485

99% Confidence Interval: (1.0901973384384906, 1.3871359948948425)

# Task 2: Confidence Interval using Known Population Standard Deviation

If the population standard deviation is known, we can use the z-distribution to calculate the confidence interval. The z-distribution assumes that the population standard deviation is a fixed, known value.

Population standard deviation: 0.2000

z-value (99% confidence): 2.5758

Margin of error: 0.1330

99% Confidence Interval: (1.1056514133957607, 1.3716819199375725)

# Conclusion

The 99% confidence interval calculated using the sample standard deviation is wider due to the additional uncertainty of estimating the population standard deviation from the sample. When the population standard deviation is known, the z-distribution provides a more precise confidence interval.