
Parameter – numerical summary of the entire population. Example: population mean fuel economy (MPG).

Sample – a few items from the population. Example: 36 vehicles.

Statistic – numerical summary of the sample. Example: sample mean fuel economy (MPG).

95% Confidence Interval

\[
\bar{Y} \pm t^* \left( \frac{s}{\sqrt{n}} \right)
\]

\( t^* \) from a \( t \)-table with 95% confidence and \( n - 1 \) degrees of freedom

95% Confidence Interval

\[
\bar{Y} \pm t^* \left( \frac{s}{\sqrt{n}} \right)
\]

\[
22.0139 \pm 2.030 \left( \frac{2.8473}{\sqrt{36}} \right)
\]

22.0139 ± 0.9633

21.051 mpg to 22.977 mpg
Interpretation – Part 1

- The population mean fuel economy for cars and trucks made in 2004 could be any value between 21.05 mpg and 22.98 mpg.
- This locates the center of the distribution.

Interpretation – Part 2

- We are 95% confident that intervals based on random samples from the population with capture the actual population mean.
- This is confidence in the process.

What is confidence?

www.rossmanchance.com/applets/NewConfsim/Confsim.html
Testing Hypotheses

Do cars and trucks made in 2004 meet the CAFE standard of 24 mpg, on average?

Step 1 - Hypotheses

\[ H_0 : \mu = 24 \text{ mpg} \]
\[ H_A : \mu < 24 \text{ mpg} \]
Stat 301 – Lecture 3

Step 2 – Test Statistic

\[
\begin{align*}
t &= \frac{(\bar{Y} - \mu_0)}{\left(\frac{s}{\sqrt{n}}\right)} = \frac{(22.0139 - 24)}{(2.8473/\sqrt{36})} \\
t &= \frac{-1.9861}{0.47455} = -4.185 \\
P - value < 0.0001
\end{align*}
\]

Step 3 – Decision

- Reject the null hypothesis because the P-value is so small (smaller than 0.05).

Step 4 – Conclusion

- Based on our sample data, the population of cars and trucks in 2004 did not meet the CAFE standard or 24 mpg, on average.
CI versus Testing

Note that our CI is consistent with our test of hypothesis.
CI indicates plausible values are between 21.05 and 22.98 mpg.
24 is not a plausible value!

Statistical Inference

So far we have found plausible values for the population mean value and discovered that 24 is most likely not the value of the population mean.

What about one vehicle?

Individual vehicles will have fuel economies different from the mean.
How can we quantify the variation we might expect to see in an individual vehicle?
95% Prediction Interval

\[ \bar{Y} \pm t^* s \sqrt{1 + \frac{1}{n}} \]

t* from a t - table with 95% confidence and 
95% confidence and 
n – 1 degrees of freedom

95% Prediction Interval

\[ \bar{Y} \pm t^* s \sqrt{1 + \frac{1}{n}} \]

\[ 22.0139 \pm 2.030(2.8473) \sqrt{1 + \frac{1}{36}} \]

22.0139 ± 5.8597

16.15 mpg to 27.87 mpg

Interpretation

I am 95% confident that a vehicle chosen at random from those made in 2004 will have a fuel economy between 16.15 mpg and 27.87 mpg