Stat 401 B – Lecture 3

Population – all items of interest.
Example: All vehicles made In 2004.

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

Parameter – numerical summary of the entire **population**.

Example: **population mean** fuel economy (MPG).

Statistic – numerical summary of the **sample**.

Example: **sample mean** fuel economy (MPG).

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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

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95% Confidence Interval

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

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

$$22.0139 \pm 0.9633$$

21.051 mpg to 22.977 mpg

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Interpretation – Part 1

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

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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.

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What is confidence?

http://statweb.calpoly.edu/chance/applets/ConfSim/ConfSim.html

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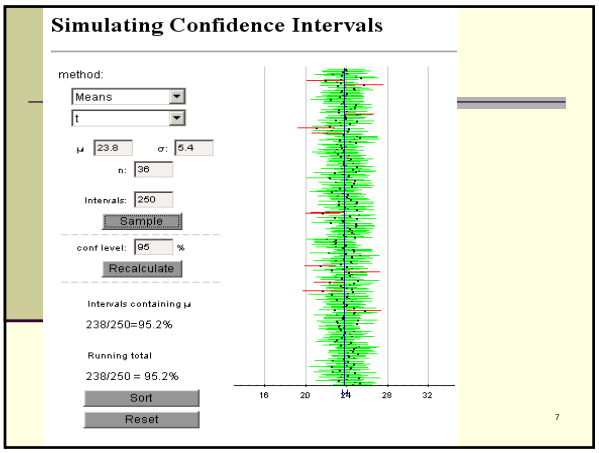

Testing Hypotheses

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

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Step 1 - Hypotheses

$$H_0 : \mu = 24 \text{ mpg}$$

$$H_A : \mu < 24 \text{ mpg}$$

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Step 2 – Test Statistic

$$t = \frac{\left(\bar{Y} - \mu_0\right)}{\left(\frac{s}{\sqrt{n}}\right)} = \frac{\left(22.0139 - 24\right)}{\left(\frac{2.8473}{\sqrt{36}}\right)}$$

$$t = \frac{-1.9861}{0.47455} = -4.185$$

$$\text{P-value} < 0.0001$$

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Step 3 - Decision

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

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Step 4 – Conclusion

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

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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!

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Statistical Inference

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

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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?

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95% Prediction Interval

$$\bar{Y} \pm t^* s\sqrt{\left(1+\frac{1}{n}\right)}$$

t^* from a t - table with

95% confidence and

$n-1$ degrees of freedom

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95% Prediction Interval

$$\bar{Y} \pm t^* s\sqrt{\left(1+\frac{1}{n}\right)}$$

$$22.0139 \pm 2.030(2.8473)\sqrt{\left(1+\frac{1}{36}\right)}$$

$$22.0139 \pm 5.8597$$

16.15 mpg to 27.87 mpg

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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

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