

Name: _____

AP Statistics Handout: Lesson 8.1

Topics: review sampling distribution for \bar{x} , 95% confidence interval for \bar{x} , four step process

Lesson 8.1 Guided Notes

YouTube Creator



Mr. Beast
2020: **\$24 Million**

Insta Influencer



Kendall Jenner
2019: **\$16 Million**

“TikToker”



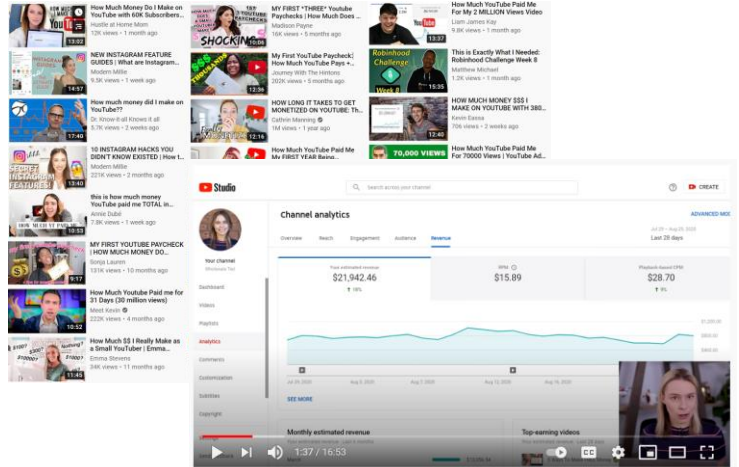
Josh Richards
2020: **\$1.5 Million**

Source: Forbes

Today’s Key Analysis: Do social media creators, on average, make a livable wage?

The Data: YouTubers

- Searched “How much I make on YouTube” and found hundreds of videos in which YouTubers show off how much they make on the platform. We randomly sampled 35 of these videos.
- From the figures shown in each video, we estimated their yearly salary.
- Since these videos show their private channel revenue pages, we know the data is reliable.



Review: Sampling Distribution for \bar{x}

The Population Mean vs. The Sample Mean

μ = _____ mean

- Parameter
- Ex: mean salary _____

\bar{x} = _____ mean

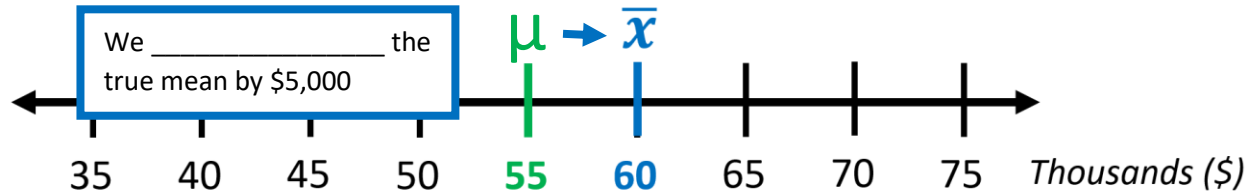
- Statistic used to estimate μ
- Ex: mean salary _____



Imagine a world where...

1. The true mean yearly salary among YouTubers is \$55,000
2. The true standard deviation of salaries is \$29,500

In most scenarios, **we don't know the true mean (μ)!** So, we collect a sample and estimate using the sample mean (\bar{x}). Imagine we randomly selected 35 YouTubers. Among them, the average yearly earnings were $\bar{x} = \$60,000$.



Is a \$5,000 overestimate a typical estimation error? To explore that, we need the **sampling distribution for a mean**:

Under certain conditions: $\bar{x} \sim \text{Normal}(\mu_{\bar{x}} = \mu, \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}})$

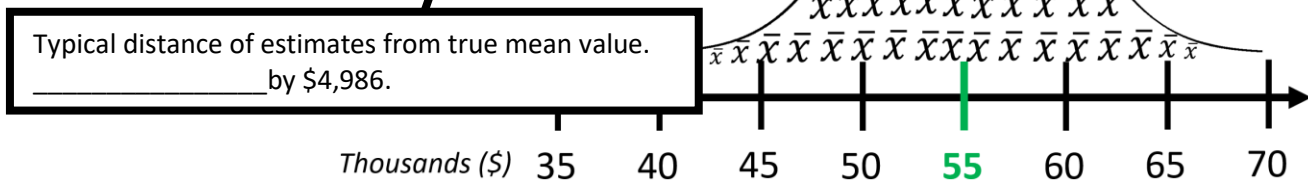
Calculations:

$$\bar{x} \sim \text{Normal}(\mu_{\bar{x}} = \mu, \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}})$$

$$\bar{x} \sim \text{Normal}(\mu_{\bar{x}} = 55000, \sigma_{\bar{x}} = \frac{29500}{\sqrt{35}})$$

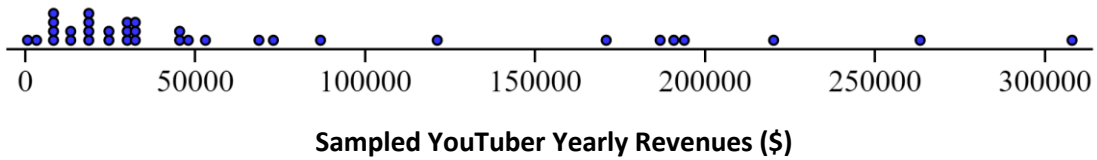
$$\bar{x} \sim \text{Normal}(\mu_{\bar{x}} = 55000, \sigma_{\bar{x}} = 4986)$$

Means from repeated random samples of 35 YouTubers (in a world where $\mu = \$55,000$).



1) Was our estimate's error amount (\$5,000) pretty typical? Justify using the sampling distribution above.

The t-distribution and interval for \bar{x}



2) Label the U.S. individual poverty line, the U.S. mean wage, the sample mean, and the sample standard deviation on the dotplot above.

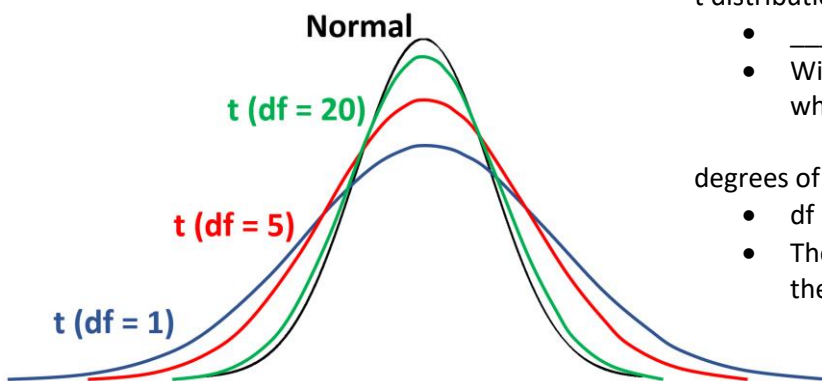
3) Do you believe it's likely that the true mean YouTuber salary is exactly the same as the mean salary among our random sample? Why or why not?

First Attempt to Create the Confidence Interval

$$\bar{x} \sim \text{Normal}\left(\mu_{\bar{x}} = \mu, \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}\right)$$

4) Why can't we simply use the normal distribution to calculate our confidence interval?

The t-distribution to the Rescue!



t distribution

- _____ than normal curve
- Width captures _____ when using S_x to estimate σ

degrees of freedom (df) = _____

- df measures how _____ S_x estimates σ
- The higher n, the more precisely we estimate σ , and the more our t-curve _____!



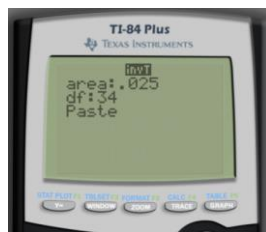
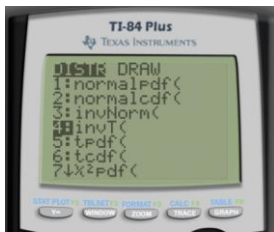
t critical values

t^* : the _____ of the t-interval

- Tells you how many _____ you're including in your interval.
- Determines the _____.

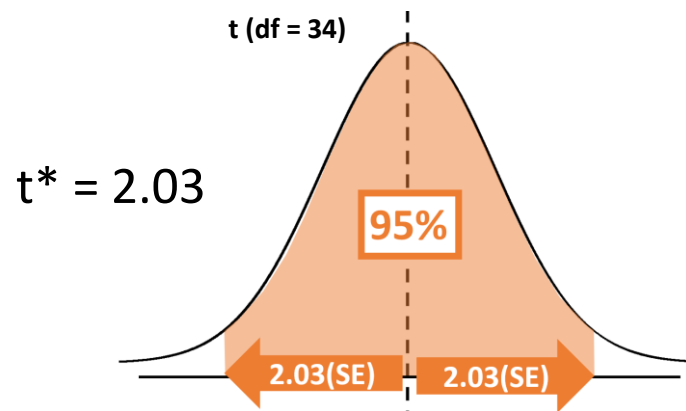
5) For a z-interval (based on a normal curve), we use a critical value (z^*) of 1.96 to capture 95% confidence. For a t-interval (based on a t-distribution) to capture 95% confidence, will the critical value (t^*) need to be higher or lower than 1.96? Explain.

Calculator steps to find t^*



2nd → VARS → 4: InvT

-Area: percent below interval (2.5% = 0.025)
-df: $n - 1$ ($35 - 1 = 34$)



Confidence Interval for a Mean

6) Using the formula, calculate and interpret the confidence interval for the mean YouTube salary:

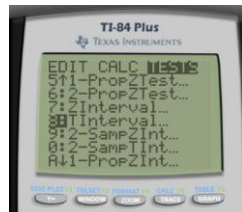
Formula:

- point estimate \pm margin of error
- $\bar{x} \pm t^*(SE_{\bar{x}})$

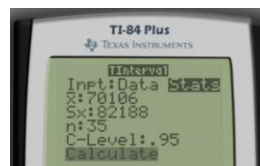
The Four Steps Process

a) **Construct and interpret** a 95% confidence interval for the true mean salary of all YouTubers.

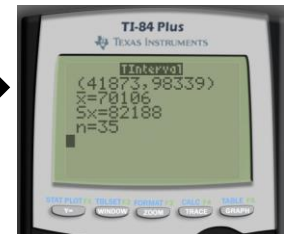
For “DO” phase: Calculator steps



STAT → TESTS →
8: Interval



→Stats
 \bar{x} : sample mean
 S_x : sample stdev
 n: sample size
Calculate



Output

Lesson 8.1 Discussion

We can directly estimate¹ the true mean income of YouTubers from Ad Revenue:

$$\begin{array}{rcl} \text{Creator Share of 2019 YouTube Ad Revenue} & / & \text{\# of Creators} \\ \$8,331,950,000 & & 18,000,000 \\ \hline & & \text{Average Yearly Pay Per Creator} \\ & & \mathbf{\$463} \end{array}$$

Confidence interval we estimated: **\$41,877 to \$98,339**

Discussion Question: Why was our confidence interval so far off?

Lesson 8.1 Practice

Teachers: We recommend providing additional practice exercises from your AP Stats textbook or from prior AP Stats exams. The following textbook sections and AP exam questions are aligned to this lesson.

- [The Practice of Statistics \(AP Edition\)](#), 4th-6th editions section 8.3
 - 6th edition update (CED-aligned): section 10.1
- [Stats: Modeling the World \(AP Edition\)](#), 4th/5th editions: ch 22, 3rd edition: ch 23
- [Statistics: Learning from Data \(AP Edition\)](#), 2nd edition: section 12.2
- [Advanced High School Statistics](#), section 7.1
- [AP Exam Free Response Questions \(FRQs\)](#): 2013 Q1 (part b)

¹ Sources: Alphabet 4th quarter earnings release: https://abc.xyz/investor/static/pdf/2019Q4_alphabet_earnings_release.pdf?cache=05bd9fe, "How YouTube Ad Revenue Works," *Investopedia*, June 4, 2020: <https://www.investopedia.com/articles/personal-finance/032615/how-youtube-ad-revenue-works.asp#:~:text=Enabling%20ads%20on%20your%20YouTube,get%20the%20remaining%2055%20percent,> "How Many YouTube Channels Are There?", *Tubics*, <https://www.tubics.com/blog/number-of-youtube-channels>, *SocialBlade*, data accessed 2019

