**Teaching the Central Limit Theorem**

*+3 Bonus on an Exam*

**Summary:** Teach the central limit theorem to one ISQ staff member (not a relative) who does not know/remember statistics. That person will take notes, answer questions, and rate your teaching. You will focus on big ideas and NOT on formulas (such as ). You should be able to teach it without looking at any notes.

**Starting:** Pick a staff member from Mr. Malan’s list to whom you can teach the CLT (in English). Two students cannot teach the same person. Give him/her a notes page and a pen/pencil. ***You should never hold the pen/pencil.*** Go to: <http://onlinestatbook.com/stat_sim/sampling_dist/index.html> and click “Begin” on the upper left side.

**Teaching:**

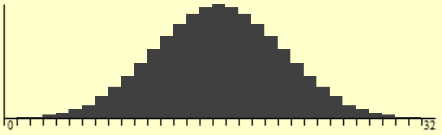
Start by covering the following basics:

The underlined words here match with the blanks on the “student’s” notes page

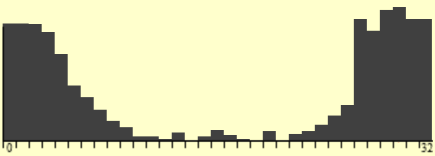
* What a normal distribution is.
* What it means for it to be tall in the middle and short on the sides.
* Give an example of data that might be normally distributed. (The applet you will use automatically uses . Give an example of real data that might follow this distribution.
* Describe how to draw a normal curve.

Intro to Sampling Distribution:

* Show an animated example of taking a random sample of 2 values and how this creates an average.
* Then again. And again. And again. Take **Lots** of time here. Discuss what’s happening. Why are certain section producing more sample values? These are deep ideas. Your student will need time to process them.
* The resulting distribution of averages from samples forms a sampling distribution.



A) When the original distribution is normal:

* Use the normal curve that is provided on the website.
* Start with . Animate a few times, then try the “5” button, the “10,000” button, and eventually the “100,000” button. Ask your student what they observe about the shape, center and spread.
* Repeat with , and .

B) When the original distribution is not normal:

* Redraw the original curve to be ugly (I strongly suggest bimodal).
* Start with . Animate a few times, then jump to the “10,000” button. Ask your student what they observe about the shape, center and spread.
* Repeat with , and .

Final Reflections

* Your “student” will now have to turn their observations into the Central Limit Theorem. They must describe the Shape, Center, and Spread of sampling distributions.
* After they write their conclusions, you will then state the entire Central Limit Theorem it in plain words.

**Other Details:**

You should be able to teach the full lesson **from memory** and **without help**.

I will follow up with your “student” afterward, discussing your understanding, clarity, and professionalism.

**Notes for “Student”** Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In statistics, we often study data that  
  
follow a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ distribution.

Draw one here:

Our original data might not be normal, but \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from \_\_\_\_\_\_\_\_\_\_\_\_\_\_ might have a normal distribution.

*(Now, your teacher will give an animated demonstration of what a sampling distribution is.)*

**Pause to Read Instructions:** For each of the eight following scenarios (i, ii, iii, etc.), describe the:

* Shape: How close is the sampling distribution to being normal? “Not at all”/“sort of”/“meh”//“perfect,” etc.
* Center: How does the mean of the sampling distribution compare to the mean of the original distribution?
* Spread: Without any calculations, describe in simple terms how the spread-out-ness of the sampling distribution compares to the spread-out-ness of the original distribution. (“Same,” “a little more spread,” “a little less spread,” “way more spread out,” etc.

A) If the original distribution is \_\_\_\_\_\_\_\_\_\_\_\_\_­­­\_\_\_\_\_\_\_:

1. Very small sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

1. Small sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

1. Medium sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

1. Large sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

B) If the original distribution is \_\_\_\_\_\_\_\_\_\_ ­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:

1. Very small sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

1. Small sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

1. Medium sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
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1. Large sample size

|  |  |  |
| --- | --- | --- |
| Shape: Describe how “normal” the sampling distribution looks. | Center: Describe how the mean of the sampling distribution compares to the mean of the original distribution? | Spread: Describe how the spread of the sampling distribution compares to the spread of the original distribution? |
|  |  |  |

The Central Limit Theorem describes the ***shape***, ***center***, and ***spread*** of sampling distributions. Can you deduce what it says about each?

**Shape**: How can the sampling distribution be approximately normal? (2 ways)

**Center**: How does the center of the sampling distribution compare to the center of the original distribution? (1 word)

**Spread**: How does the spread of the sampling distribution compare to the spread of the original distribution?   
(1 sentence)

*(Your teacher will now give you a clear statement of the Central Limit Theorem.)*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ taught me the Central Limit Theorem.

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Your Score:**

Here is (approximately) the email that I will write to your “student” after you teach the lesson:

Dear Statistically Enlightened Faculty ☺,

Thank you so much for your participation in this lesson! The AP Statistics student who taught you the Central Limit Theorem is trying to earn a bonus of up to 3 points on his/her upcoming exam. Here are the possible points:

A) His/Her own understanding of the CLT 0 0.5 1 1.5

B) Clarity, pace, and communication in teaching 0 0.5 1

C) Professionalism (email, scheduling, focus, etc.) 0 0.5

Will you please rate the student on the above criteria and then email me the breakdown?   
 Example: A) 1.5 B) 0.5 C) 0.5 = 2.5/3

Thanks!

Steven

**Picking a Volunteer:**

In the next 5 minutes:

* Claim a volunteer. Pay attention to what times work for them.
* Send them a formal email (**NOW**) to arrange a time. CC Mr. Malan on the email.

|  |  |  |
| --- | --- | --- |
| Volunteer to be Taught | Claimed by: | Approximate time that they said ***could*** work for them.  **But you must still email them right now!** |
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Example of the worst email ever: Discuss as a class: How could the previous email be improved?

Dear Mr. Bailes,

I would like

hi. when can i come