Loose Change and the Central Limit Theorem

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AMATYC's Southwest Regional Conference
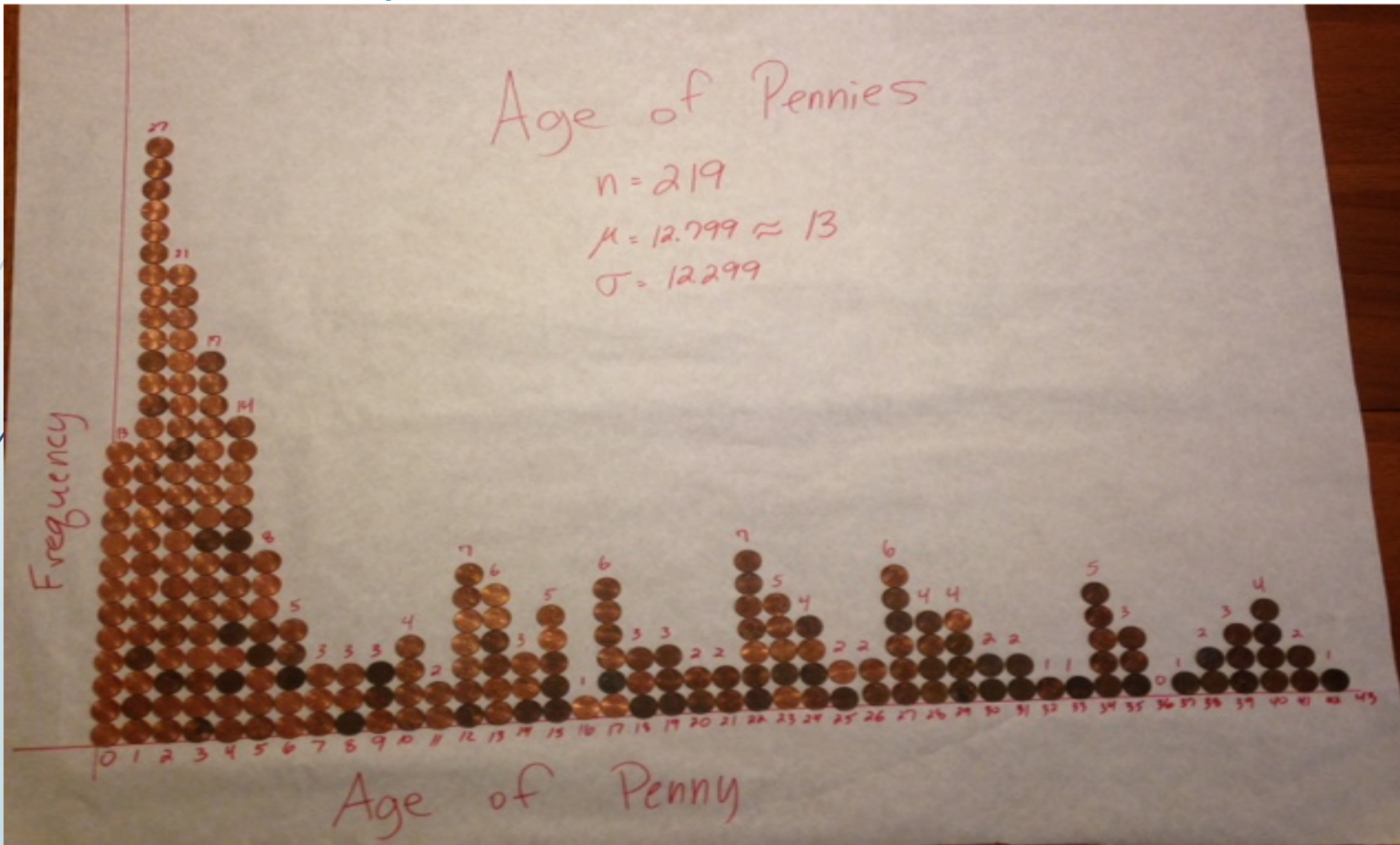
June 7, 2019
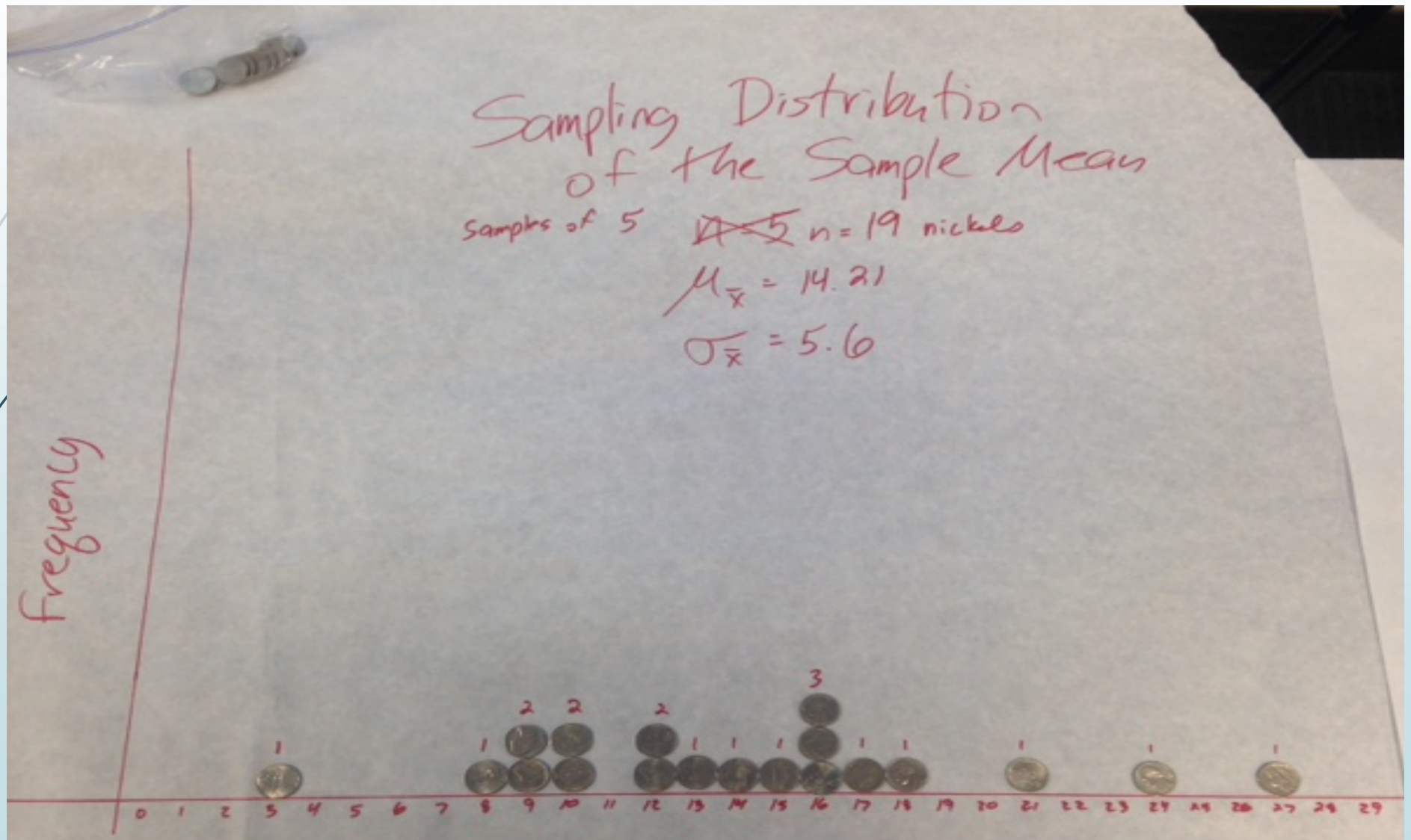
What makes the CLT difficult for students?

- Vocabulary:
  - Sampling Distribution of the Sample Mean
  - Standard Error of the Mean

- Difficult to Picture Conceptually

- Details are hard to remember. What happens to shape? Mean? Standard deviation?

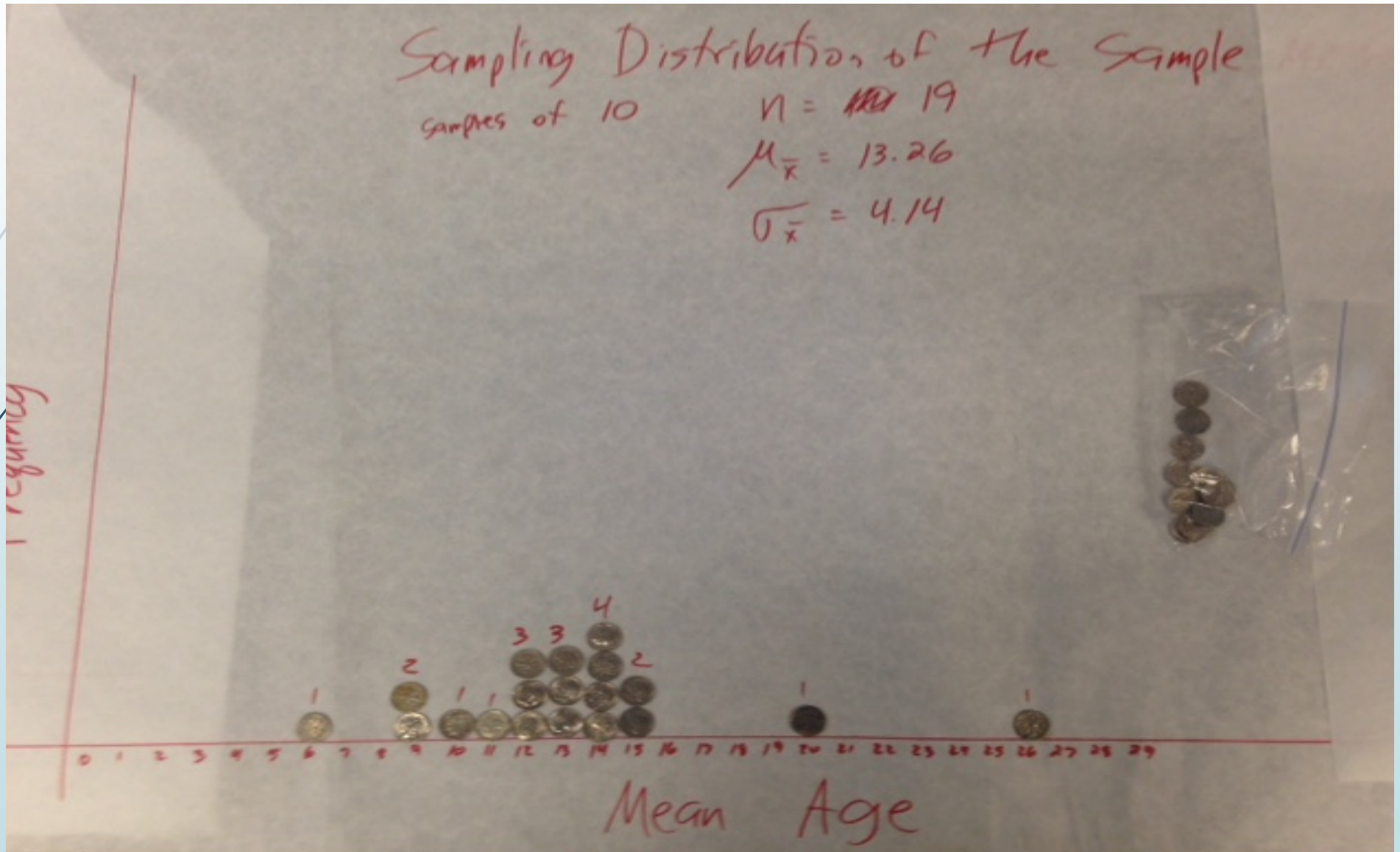- Application problems sound like Normal Distribution Problems
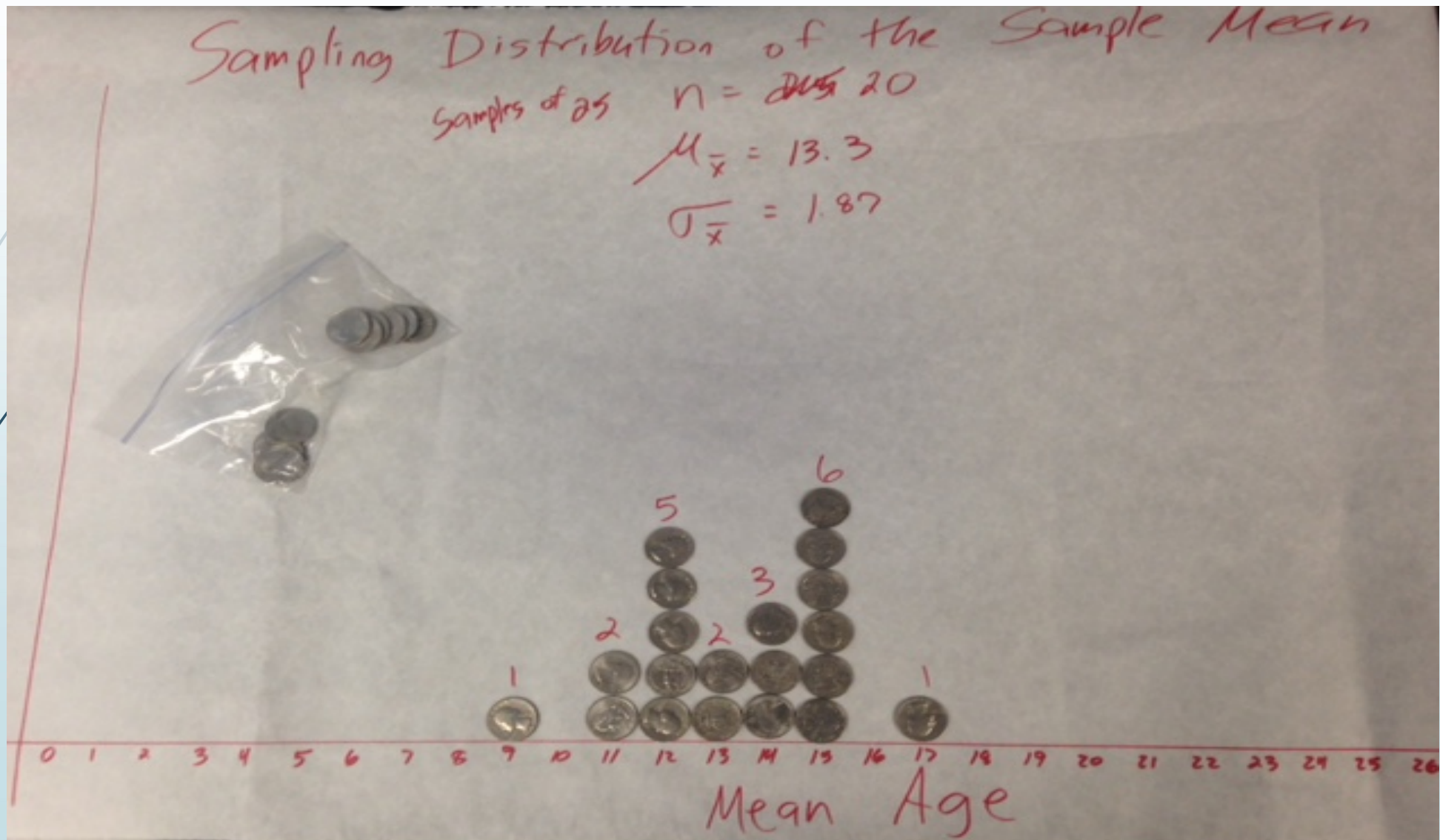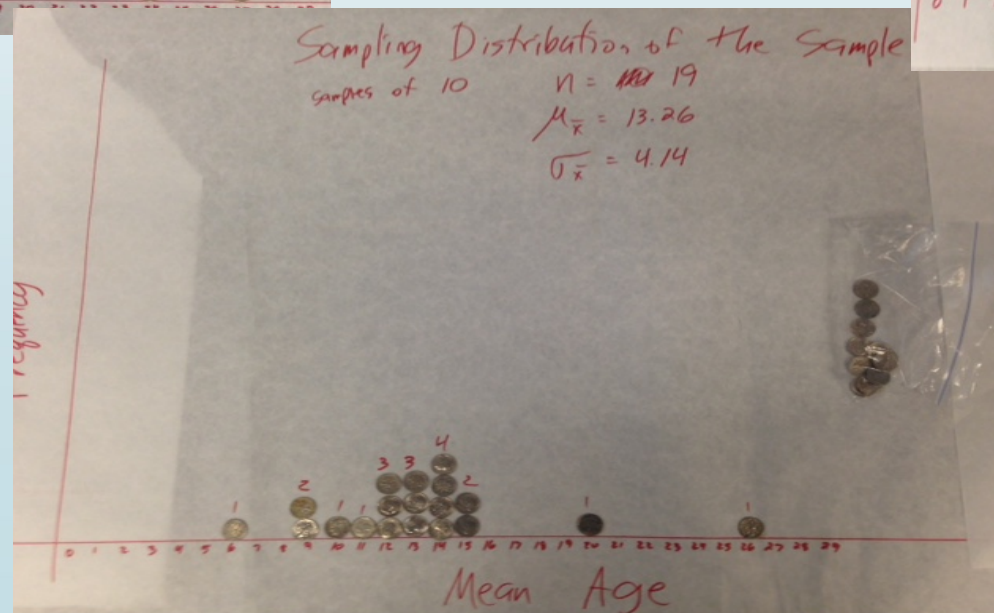
Population Distribution

SDSM with n = 5

SDSM with n = 10

SDSM with n = 25

Notice the change in shape!

Sampling Distribution of the Sample Mean
Samples of 5 $n = 19$ nickels
$\mu_{\bar{x}} = 14.21$
$\sigma_{\bar{x}} = 5.6$

Sampling Distribution of the Sample
Samples of 25 $n = 20$
$\mu_{\bar{x}} = 13.3$
$\sigma_{\bar{x}} = 1.87$

Mean Age

Sampling Distribution of the Sample
Samples of 10 $n = 19$
$\mu_{\bar{x}} = 13.26$
$\sigma_{\bar{x}} = 4.14$

Mean Age
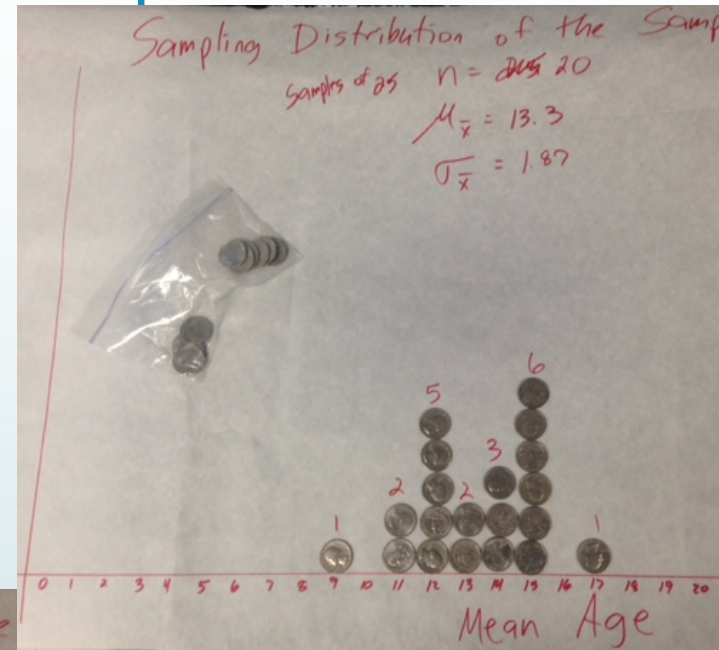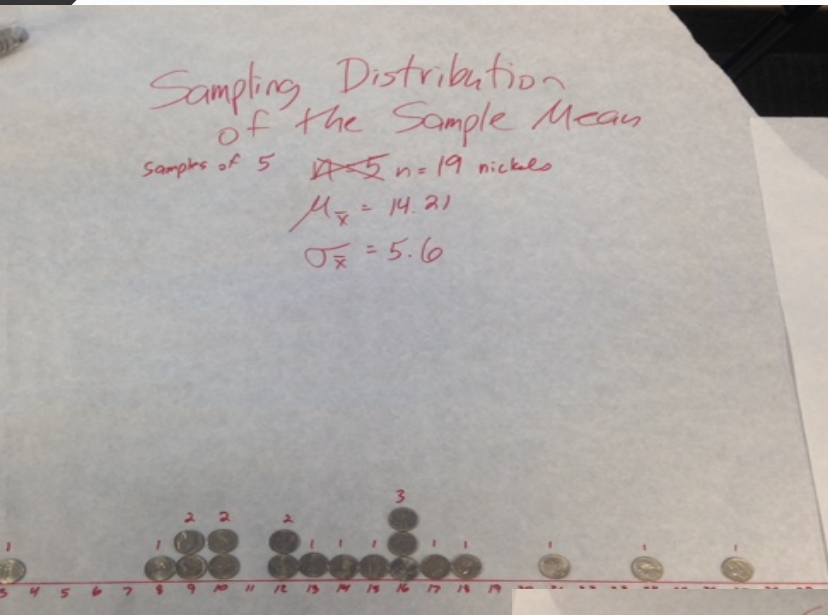
Talking Points for Students

- How does the mean of each s.d.s.m compare to the mean of the population?

- How does the standard deviation of each s.d.s.m. compare to the standard deviation of the population?

- What happened to the shape of the sdsm as the sample size increased?

- What was the shape of the original population? Did that impact the shape of sdsm?

Connections to other topics:

- Opportunity to calc. 1-VAR stats as single list or list/frequency (students can verify the list/frequency saves time)

- College Algebra and/or calculus…coins in circulation is an exponential decay function. Note: approximately 9% of coins fall out of circulation each year

The Problem of Time…

- Value in students collecting their own samples

- Data collection during class prior to the activity

- Volunteers come in outside of class to collect data for everyone

- Students collect data for nickels, but instructor provides data sets for dimes/quarters

- Other ideas?

Sources:

- Project SET (statistics education for teachers) at https://projectsetdotcom.files.wordpress.com/2014/06/act-sv_loop4-cent-and-the-central-limit-theorem.pdf

- Coins minted each year (Wikipedia but still kind of neat) https://en.wikipedia.org/wiki/United_States_Mint_coin_production