

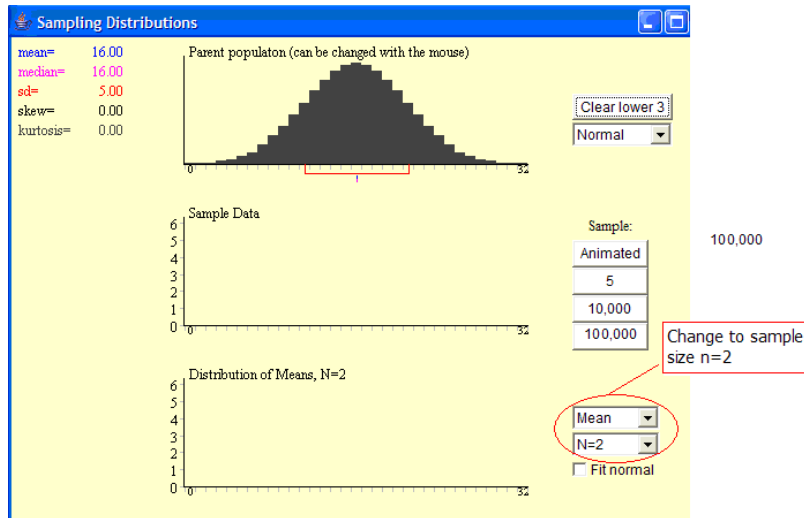
STAT 110: Investigating the Distribution of a Sample Mean

Fall 2017

Consider the applet found at the following website:

http://onlinestatbook.com/stat_sim/sampling_dist/index.html.

1. You should see the following distribution (the applet calls this the Parent population) when you open the applet and click "Begin". How would you describe the center, variability, and shape of this parent Population? You should use the summary statistics to the left of the histogram to help you answer this question.



Center:

Variability:

Shape:

2. Start by changing the sample size to $n=2$ as shown above. Press the "Animated" button once to randomly select two observations from the original population. The applet then calculates their average and then places this mean on the distribution of means. Repeat this process once more. To speed up the sampling procedure, you can click the "Sample: 10,000" button to draw ten-thousand random samples. The resulting graph shows the distribution of the 10,000 sample means, each based on a sample of size $n=2$. How would you describe the center, shape, and variability of this distribution of means?

Center:

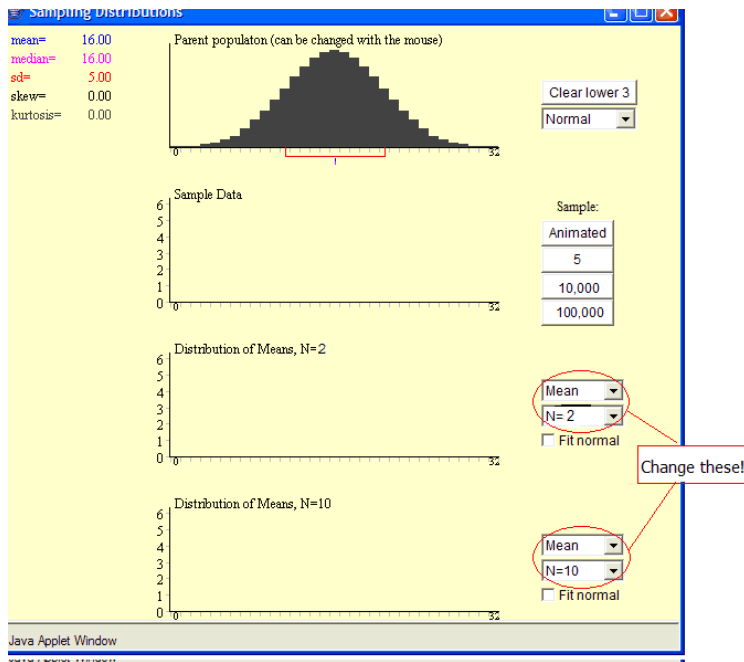
Variability:

Shape:

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3. Now, press the “Clear lower 3” button. Then, change the settings on the applet as noted in the picture below. Then, press “10,000” to simulate drawing ten-thousand samples of size 2 and ten-thousand samples of size 10. Note that the resulting graphs show the distribution of sample means for samples of size $n=2$ and size $n=10$, respectively.

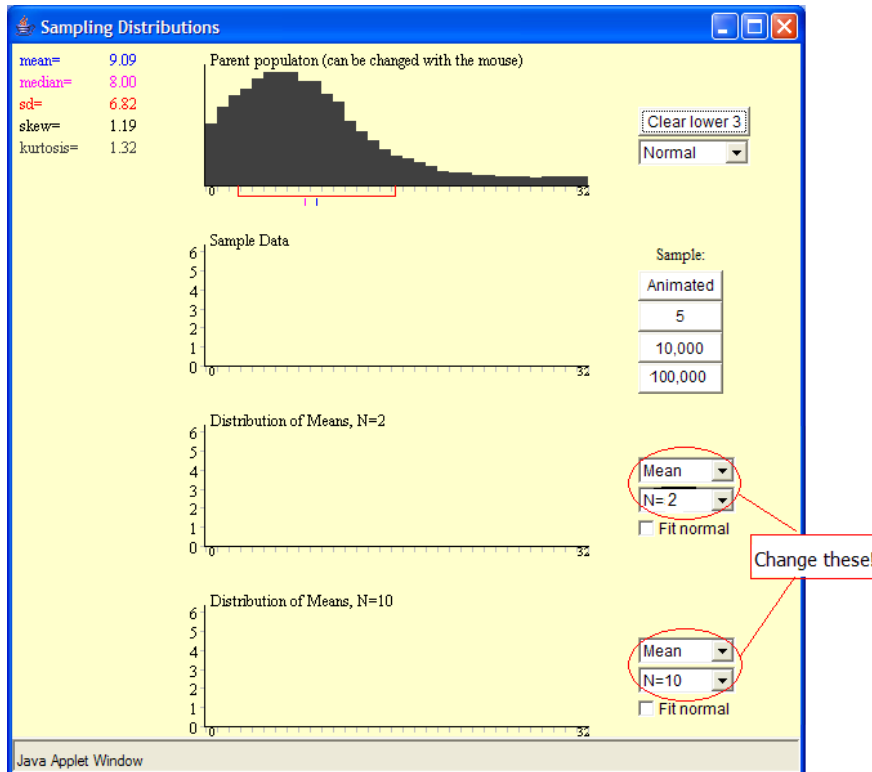


- a. What can you say about the centers of the two distributions of means (for both $n=2$ and $n=10$) as compared to the center of the original Parent population?
- b. How does the variability in the two distributions of means compare to the variability in the original Parent population? What can you say about the variability in the distribution of means as the sample size increases (i.e., as we go from $n=2$ to $n=10$)?
- c. When the original population is normally distributed, what can you say about the shape of the distribution of means, regardless of how small the sample size is?

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4. Again, press the “Clear lower 3” button. Then, change the settings on the applet as noted in the picture below. To change the shape of the Parent population, click on the histogram with the mouse and drag (your cursor will function like a paintbrush). Once you have a Parent population similar to the one shown below, press “10,000” to simulate drawing ten-thousand samples of size 2 and ten-thousand samples of size 10.

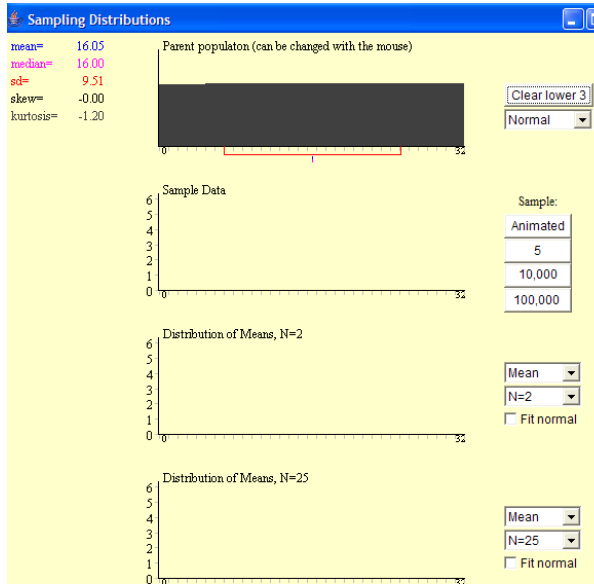


- a. How would you describe the shape of the Parent population?
- b. If the original population is NOT normally distributed, does the distribution of sample means approximately follow the normal distribution for small sample sizes (such as $n=2$)? Explain.
- c. Increase the sample sizes to $n=20$ and $n=25$ and click “10,000”. Now that the sample size is larger, does the distribution of sample means approximately follow the normal distribution? Explain.

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5. Press the “Clear lower 3” button again. Then, change the settings on the applet as noted in the picture below (change the shape of the Parent population, and change the sample sizes to $n=2$ and $n=25$). Then, press “10,000” to simulate drawing ten-thousand samples of size 2 and ten-thousand samples of size 25.



- Is the original Parent population bell-shaped and symmetric?
- When $n=2$, is the distribution of means bell-shaped and symmetric?
- When the sample size increases (say to $n=25$), what happens to the shape of the distribution of means?
- When $n=25$, how does the center of the distribution of means compare to the center of the original Parent population?
- Change the sample sizes to $n=20$ and $n=25$. How does the variability of the distribution of means change as the sample size increases? How does it compare to the variability in the original Parent population?
- Read about the Central Limit Theorem in the notes, and use what you have learned from this applet to state this theorem in your own words.