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Eco 602 – Frequentist Concepts Assignment

10/15/2021

Q1. What is the probability of observing a count of exactly 3 successes in a binomial distribution with parameters n = 4 and p = 0.75? Include your answer and the R code

dbinom(x = 3,size = 4,prob = 0.75)

= 0.421875 = 42%

Q2. What is the probability of observing a count of 3 successes or fewer in a binomial distribution with parameters n = 4 and p = 0.75?

pbinom(q = 3, size = 4, prob = 0.75)

= 0.6835937 = 68%

Q3. What is the probability of observing more than 3 successes in a binomial distribution with parameters n = 5 and p = 0.75? *Cannot use lower.tail = FALSE

#q3 - more than 3 successes (4 or more)

1 - pbinom(q = 3, size = 5, prob = 0.75)

= 0.6328125 = 63%

#check prob more than 3

dbinom(x = 4,size = 5,prob = 0.75) +

dbinom(x = 5,size = 5,prob = 0.75)

= 0.6328125 = 63%

Q4. What is the probability of observing a value of less than 1.2 from a normally distributed population with mean = 2 and standard deviation = 2? Include your answer and the R code

pnorm(q = 1.2, mean = 2, sd = 2)

= 0.3445783 = 34%

Q5. What is the probability of observing a value of greater than 1.2 from a normally distributed population with mean = 2 and standard deviation = 2?

1 - pnorm(q = 1.2, mean = 2, sd = 2)

= 0.6554217 = 65%

Q6. What is the probability of observing a value between 1.2 and 3.2 from a normally distributed population with mean = 2 and standard deviation = 2?

#q6 - prob between 1.2 and 3.2

#prob of greater than 1.2

val1 = 1 - pnorm(q = 1.2, mean = 2, sd = 2)

#prob of greater than 3.2

val2 = 1 - pnorm(q = 3.2, mean = 2, sd = 2)

#subtract from each other

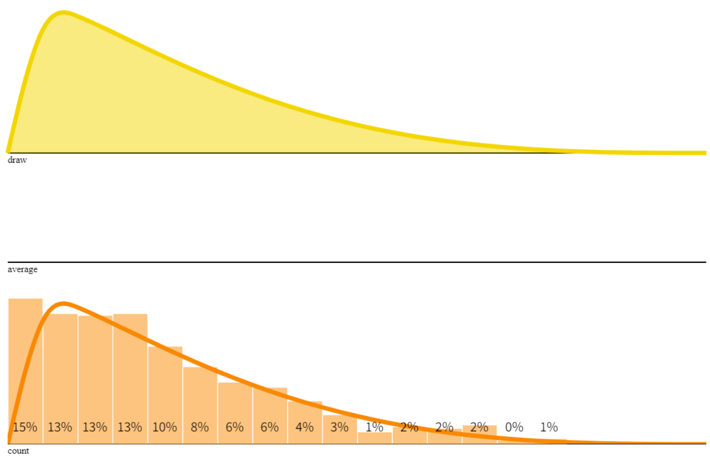
totalP = val1 - val2

totalP

= 0.3811686 = 38%

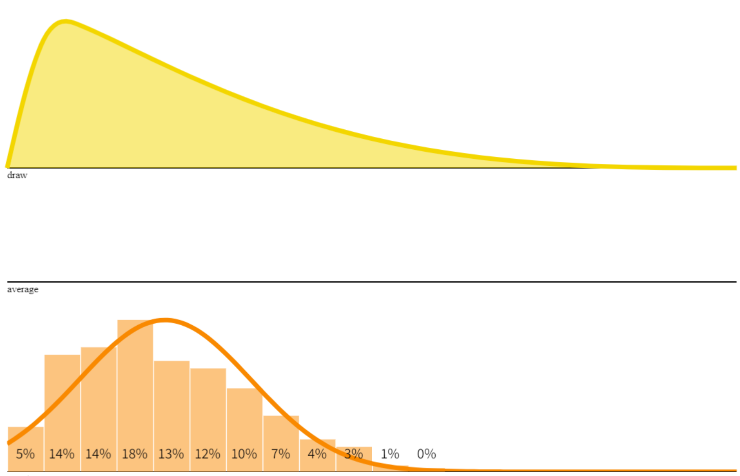
Q7. Central Limit Theorem on Seeing Theory: where a = 1.11 and b = 4.02. Sample size = 1 and Draws = 50. Describe how the shape of the histogram changes as you continue to press the sample button.

We start off with a skewed distribution. We have a very small sample size, but with 50 draws/trials. The histogram starts off not resembling the theoretical distribution, however, as I continued to click Sample several times the histogram bars grew as more samples were added and the bars evened out to resemble the theoretical distribution curve. This does not appear to be a normal distribution though, as it is still right skewed like the original beta distribution based on the a and b values. There is also a wide spread of resulting values.



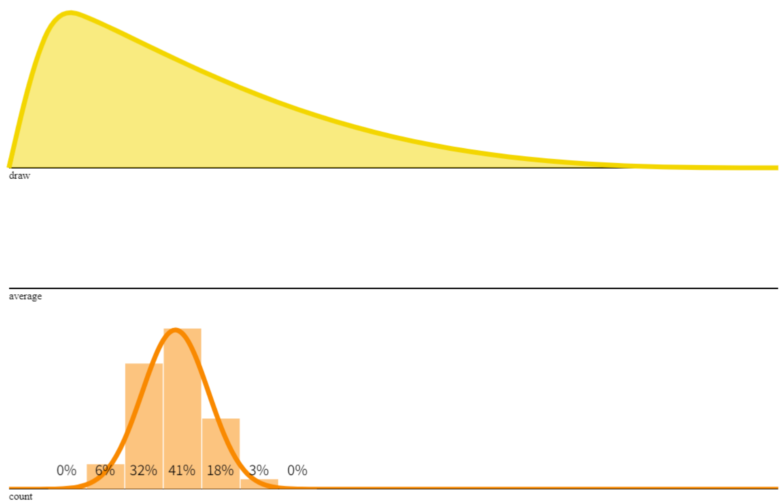
Q8. Central Limit Theorem on Seeing Theory: where a = 1.11 and b = 4.02. Sample size = 2 and Draws = 50. Describe how the shape of the histogram changes as you continue to press the sample button.

I kept the a and b values the same from Q7, as they still represent an original skewed beta distribution. I only changed the sample size from 1 to 2 per the instructions. The histogram starts off not resembling any particular distribution, however, as I continued to click sample, the histogram appear to resemble more of a normal distribution. The histogram bars begin to stabilize in the shape of a bell curve we would expect under a normal distribution. There still appear to be a slight right skew to the histogram/theoretical curve, however this is less apparent than in Q7 with a sample size of only 1.



Q9. Central Limit Theorem on Seeing Theory: where a = 1.11 and b = 4.02. Sample size = 15 and Draws = 50. Describe how the shape of the histogram changes as you continue to press the sample button.

Again, I kept the same values of a and b to represent a skewed beta distribution. I only changed the sample size to 15 and draws to 50. Immediately I notice the histogram bars appear to occupy a much narrower space for the resulting distribution. As the sample size increased, the more certain the sampling distribution becomes, and more centered around a mean value. The histogram bars also much better resemble a normal distribution bell curve from the start. As I continue to click sample using these values, the histogram bars don't appear to change that much, but still resemble the narrow normal distribution shape.



Q10. Why is there such a drastic change in the shape of the sampling distribution when you change the sample size from 1 to 2?

There is a drastic change because you are doubling the number of observations taken from the 50 draws. With only one observation from the beta distribution, you are only going to get 50 observations and your one observation serves as the mean. There can also be no sample standard deviation when you have only n=1 each draw. When you have at least a sample size of 2, your mean is the average between those two observations, and you can also calculate a standard deviation. Then you repeat this 49 more times with additional draws. The sampling distribution is the distribution of the values of the sample means. With sample size 1, that 1 observation must be the mean. In sample size 2, we have 2 observations to calculate the average/mean and standard deviation. Therefore, the sampling distribution relies heavily on the sample size and standard deviation where large sample sizes yield better approximations of a normally distributed sampling distribution.

Q11. What are the two main factors that determine the width of the sampling distribution of the mean?

The two main factors that affect the sampling distribution are 1. The sample size and 2. The population standard deviation (and therefore the sample standard deviation)

Library of Babel: There are 25 possible words consisting of a single character in the Library. There are 25×25=252=625 possible 2-character words.

Q12. How many 3-character words are possible?

25 x 25 x 25 = 25^3 = 15,625 possible 3 letter words.

Given the properties of the books in the Library:

410 pages

40 rows per page

80 positions per row

There are 410×40×80=1,312,000 positions for characters in each book.

Since there are 25 characters in the Library's character set, there are a total of $25^{1,312,000}$ possible books. That's a very large number. It's about $2\times10^{1,834,097}$. Imagine a 2 followed by almost 2 million zeroes! It certainly wouldn't fit on Earth. That's such a large number that it's easier to just think of it in symbols. Let's define the variable B as the number of books in the Library of Babel.

Q13. How many books would the Library contain if you added one additional position to the book size? Express your answer in terms of B.

*Just one position added for each book (not additional position per book)

Since B, $25^{1,312,000}$, is the total number of books with the original number of positions, just adding one more position per book would result in multiplying by 25^1 since the exponent is the total possible positions in the book, so the answer is $25^{1,312,001}$, and in terms of B it is:

B*25

*I worked with Matt on this assignment.