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Frequentist Concepts Assignment

- **Q1 (2 pts.):** 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 you used to find it.
    - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

dbinom(x = 0:4, size = 4, p = 0.75, log = FALSE)

Output:

[1] 0.00390625 0.04687500

[3] 0.21093750 0.42187500

[5] 0.31640625

The chance of exactly 3 successes is 21.09%

- **Q2 (2 pts.):** 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?
    - Include your answer and the R code you used to find it.
    - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

pbinom(q = 0:4, size = 4, p = 0.75)

Output:

[1] 0.00390625 0.05078125

[3] 0.26171875 0.68359375

[5] 1.00000000

The chance of 3 or fewer successes is 68.36%

- **Q3 (2 pts.):** What is the probability of observing *more than* 3 successes in a binomial distribution with parameters n = **5** and p = 0.75?
    - Include your answer and the R code you used to find it.
    - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

pbinom(q = 0:5, size = 5, p = 0.75)

Output:

[1] 0.0009765625 0.0156250000

[3] 0.1035156250 0.3671875000

[5] 0.7626953125 1.0000000000

1 – [Probability 3 or fewer successes] = 0.6328125

The chance of more than 3 successes is 63.28%

- **Q4 (2 pts.):** - 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 you used to find it.
  - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

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

Output:

[1] 0.3445783

The probability of observing a value less than 1.2 is 34.46%

- **Q5 (2 pts.):** - 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?
  - Include your answer and the R code you used to find it.
  - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

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

Output:

[1] 0.3445783

1 – [Probability of less than 1.2] = 0.6554217

The probability of observing a value greater than 1.2 is 65.54%

- **Q6 (4 pts.):** - 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?
    - Include both your answer and the R code you used.
    - Note: To receive full credit, you cannot use `lower.tail = FALSE` in your code.

```
pnorm(3.2, mean = 2, sd = 2) - pnorm(1.2, mean = 2, sd = 2)
```

Output:

```
[1] 0.3811686
```

The probability of observing a value between 1.2 and 3.2 is 38.12%

- **Q7 (2 pts.):** Describe how the shape of the histogram changes as you continue to press the *sample* button.

The more you press the *sample* button, the more the histogram appears to resemble a meeting of the theoretical value, as a beta-skewed distribution.

- **Q8 (2 pts.):** Describe how the shape of the histogram changes as you continue to press the *sample* button.

The shape of the histogram starts to loosely resemble the theoretical shape, though it never quite reaches it, only a loose approximation. It now though has a more uniform shape befitting that of a normal distribution.

- **Q9 (2 pts.):** Describe how the shape of the histogram changes as you continue to press the *sample* button.

It again never fully reaches the theoretical shape, but it is now a much tighter distribution, with very little spread along the chart. It has the appearance of being significantly smaller than the previous histograms.

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

Because, as explained on the linked site, the larger the sample, the better the approximation. So an increase in sample size, even just from 1 to 2, results in a significantly more accurate approximation of a normal distribution.

- **Q11 (2 pts.):** What are the two main factors that determine the width of the sampling distribution of the mean?

The two main factors that determine the width of the sampling distribution are the sample size, because a larger sample size will tighten the distribution around the mean, and the alpha and beta parameters of the distribution, which will not only widen or shrink the distribution depending on the skew, but also move the distribution to the left or right.

- **Q12 (2 pts.):** How many 3-character words are possible?

There are 25^3 possible 3-character words, or 15,625 possibilities.

- **Q13 (2 pts.):** How many books would the Library contain if you added *one* additional position to the book size (i.e. one extra letter on the last page)? Express your answer in terms of B.

The library would then contain $25^{1,312,001}$ possible books due to the 1 additional character position per book.

$\boldsymbol{B} = 25^{1,312,001}$