What is a Confidence Interval Anyway??
(from *Activity Based Statistics*)

1. In this activity, you will be taking samples from a population in which 40% have some characteristics in order to see how close the proportions in the samples tend to come to 40%.

   Math → Prb →
   rand Int
   (0,9,40) →
   sto(L₁)

   a. Using a random number generator to simulate taking a sample of size 40 from a population with 40% "successes". Let the digits <u>0</u>, <u>1</u>, <u>2</u>, <u>3</u>, represent a "success" and <u>4</u>, <u>5</u>, <u>6</u>, <u>7</u>, <u>8</u>, <u>9</u> represent a "failure". Tally the number of "successes" for each trial (you will do 3-4 total trials).

   stat → Sort A(L₁)   *out of 40*

   b. Provide your results to the class in order to have tally marks from 100 different samples.

   c. Complete the following sentences based on the frequency table from the class.

      i. Less than 5% of the time, there were <u>**11**</u> successes or fewer.

   ii. Less than 5% of the time, there were <u>**21**</u> successes or more.

   d. About 40% of Americans aged 19 to 28 claim that they have used an illicit drug other than marijuana. If a random sample of 40 Americans aged 19 to 28 finds 25 people who claim to have used an illicit drug other than marijuana, would you be surprised? Explain.
      Yes, this seems unlikely because 25 is not in the interval of 90%.

   e. According to the US Bureau of Labor Statistics, about 40% of women with children under the age of 6 do not participate in the labor force. Would it be plausible for a survey of 40 randomly chosen mothers of children under the age of 6 to find that 12 are not working? Explain.
      Yes, it would be plausible because 12 is inside the 90% CI.

2. The chart titled 90% Box Plots from Samples of Size 40 will be used to complete the following questions. The following box plot is the intended to help you understand what the chart represents:

   | Rare | 5% Unlikely | 90% Likely | 5% Unlikely | Rare |
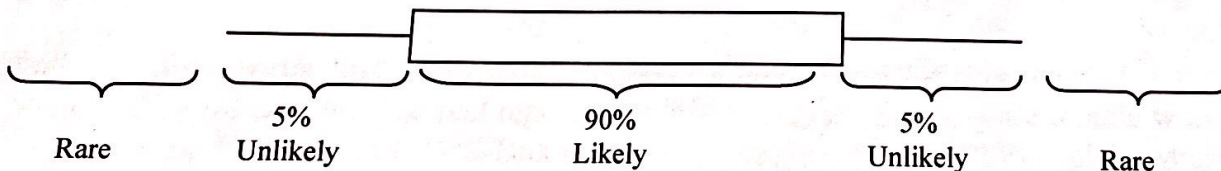
3. Use the chart (90% Box Plots from Samples of Size 40) to answer the following questions: (Please read #2 if you are confused understanding the chart) $p = 0.3$

   a. According to the 1990 U.S. Census, about 30% of people aged 25 to 44 live alone. In a random sample of 40 people aged 25 to 44, would it be likely to get 20 who lived alone? *[7,17] is 90% CI* $\hat{p} = \frac{20}{40}$

      Unlikely to get 20 people.

   b. We select a random sample of size 40 and get a sample proportion of 0.90 successes. Is this sample "likely" if the population has 75% successes? $\hat{p} = 0.9$

      [0.625, 0.85] is 90% CI $p = 0.75$

      Unlikely, because $\hat{p} = 0.9$ is not within the 90% CI.

$p = 0.8$ Key

c. According to the 1990 U.S. Census, about 80% of men aged 20 to 24 have never been married. In a random sample of 40 men aged 20 to 24, how many unmarried men is it likely to get? What proportion of unmarried men is it likely to get?

[28, 36]   [0.7, 0.9]

d. Suppose you flip a coin 40 times; how many heads is it likely for you to get? $p = 0.5$

[15, 25]

$p = 0.43$

e. In the 1992 presidential election, Bill Clinton got 43% of the vote. In a random sample of 40 voters, what is the largest proportion of people who voted for Clinton that it is likely to get? The smallest?   0.55

0.275

4. Suppose your draw an SRS of 40 people and find 24 successes. For what population percentages is this a likely outcome? This range of percentages is called **90% confidence interval**. For what range of population percentages is 13 success a likely outcome? $\hat{p} = \frac{24}{40} = 0.6$

$\hat{p} = \frac{13}{40} = 0.33$

[0.5, 0.7]   [0.25, 0.45]

5. Use the chart (90% Box Plots from Samples of Size 40) to find these *confidence intervals*:
   a. Suppose that a random sample of 40 toddlers find that 34 know what color Barney is. What is the 90% confidence interval for the percentage of toddlers who know what color Barney is?

   [0.75, 0.90] $\hat{p} = \frac{34}{40} = 0.85$

   b. Suppose that a random sample of 40 adults find that 10 know what color Barney is. What is the 90% confidence interval for the percentage of adults who know what color Barney is?

   [0.15, 0.35] $\hat{p} = \frac{10}{40} = 0.25$

skip ✗ Observe 40 students on your campus. Find the 90% confidence interval for the percentage of students who carry backpacks.

6. Polls usually report a "margin of error". Suppose a poll of 40 randomly selected statistics majors finds that 20 are female. The poll reports that 50% of statistics majors are female with a margin of error of 10%. Use the chart (90% Box Plots from Samples of Size 40) to explain where the 10% came from.

   [0.4, 0.6] could be female

7. This activity used 90% confidence intervals because it is easy computationally to find the bottom 5% and the top 5% of a distribution. Usually, 95% confidence intervals are reported. Will 95% confidence intervals be longer or shorter than 90% confidence intervals? Explain.

   Longer. Greater margin of error.   0.025 ↗ [0.95] ↖ 0.025
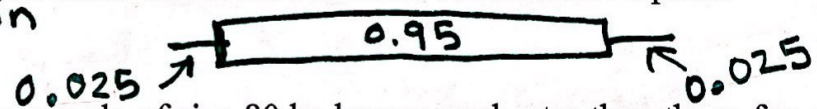
8. Will the confidence intervals for sample of size 80 be longer or shorter than those for samples of size 40? Explain.

   Shorter because SE will be smaller. $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ ↑ sample size