1. **Date** _____

In Class Activity

Understanding "Confidence Level"

(Using Confidence Intervals for Proportions or Probabilities)

Group Member Names: _____

Problem 1 (worksheet):

1. You have each been given a sheet of paper with a data set representing 40 coin flips of a fair coin printed on it. Compare the set labeled **Problem 1** for each person in the group. What is the same about your sets? What is different?

2. For **Problem 1**, what proportion of your coin flips in problem number 1 were heads? _____ Did all the members of your group get the same value? _____ Why or why not?

3. You calculated a sample proportion in the previous question. What does the **"population proportion"** mean, in the context of this problem?

4. Do you think the population proportion or probability of heads for this scenario is equal to the sample proportion you calculated? _____ Why or why not?

5. Recall the formula and calculator commands for creating large-sample confidence intervals for proportions:

   a. We are approximately 100(1-α)% confident that *p*, the true population proportion, is between

$$\hat{p} - z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad \text{and} \quad \hat{p} + z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

   b. To generate the confidence interval using the TI 83/84 calculator:

Go to STAT → TESTS →A: 1-PropZInt, enter *x*, the number of successes; *n*, the number of trials, and *c*-level, the confidence level as a decimal; then select **Calculate**.

6.

a. Create a large-sample 90% confidence interval for *p*, the population proportion of heads, using your data set for **Problem 1** on your worksheet _____. (Show your work by-hand work or your calculator steps below)

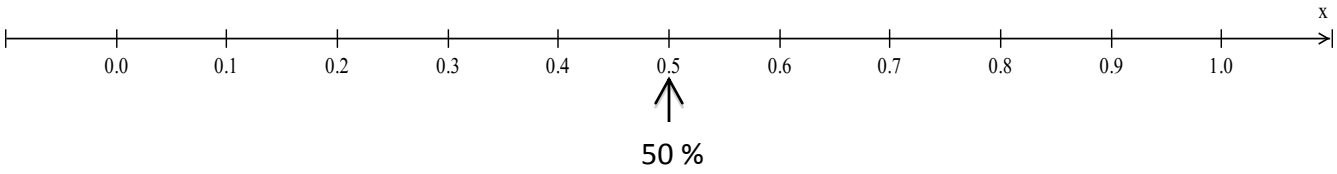
b. Identify the point estimate of *p* _____.

c. What is the width of your interval? _____. (Show your work)

d. What value is the *margin of error*? _____.

- NOTE – **margin of error**: the distance from the point estimate to the end of the interval.

7. Draw a segment representing your 90% confidence interval on the graph below. Put a dot at each endpoint and connect the two dots with a line. Draw the segment just above the given number line. Put your initials next to the right endpoint of the segment.



8. Put the confidence intervals for all the members of your group on the graph above, stacking them on top of each other. Did everyone in your group get the same interval? _____

9. Choose a group member to add your group's confidence intervals to the set of confidence intervals for the class on the board. Describe the intervals you see. What is similar about them, and what is different? Are there any intervals that stick out to you as different from the rest?

10. Because the data sets that you have were created through a simulation, we happen to know that the true value for the probability of getting heads is 0.5. [p = P(Heads) = 0.5]

    a. How **many** of the intervals in your **group** contained the true value of p? _____

    b. What is the **proportion** of the intervals in your group that contained the true value of p? (Write as a fraction and then round to two decimal places) _____

    c. How **many** of the intervals in the **class** contained the true value of p? _____

    d. What **proportion** of the intervals in the **class** contained the true value of p? (Write as a fraction and then round to two decimal places) _____

    e. Why did some of the intervals not contain the true value of p?

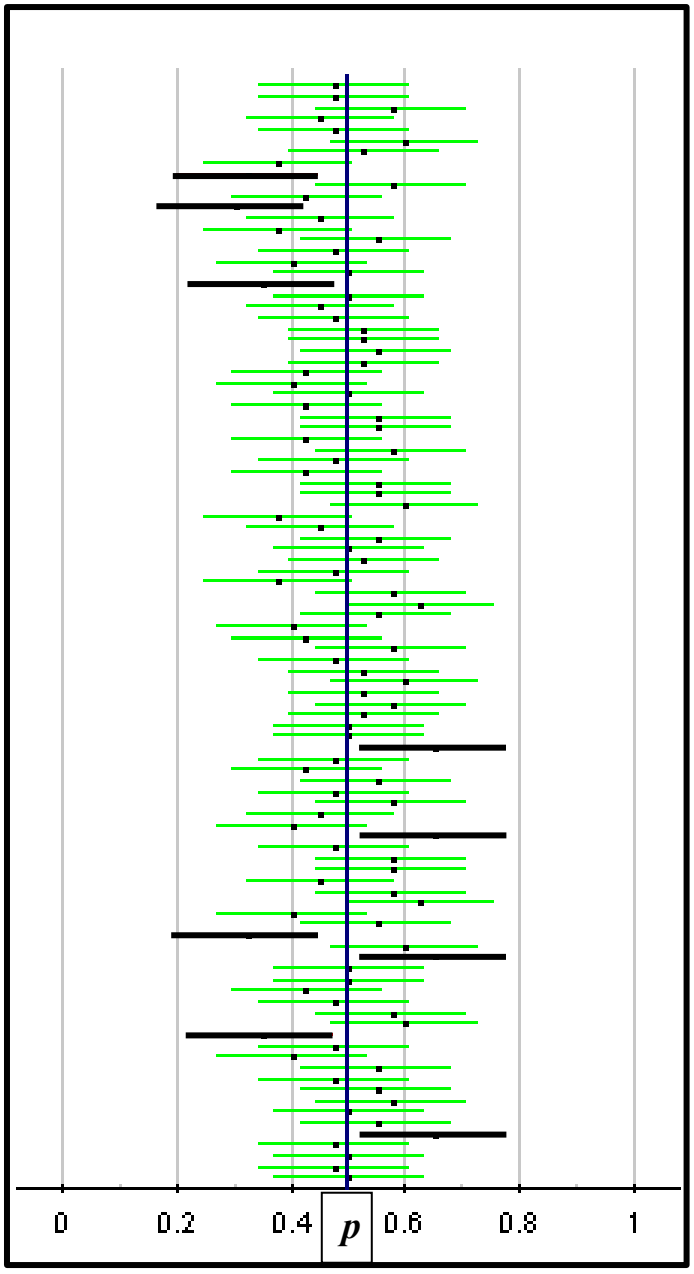
    f. Did the students who created those intervals make an error (Good to double-check)?

11. Each person in the class created a **90% confidence interval**.
    a. Is the number of class intervals with the true value of p close to **90%** of the class? _____
    b. What might happen if you had more repetitions of this simulated 40 flips of a fair coin?

12. If you had 100 repetitions of the 40 flips of the fair coin and then generated 100 corresponding 90% confidence intervals, approximately how **many** of them do you think would contain the true population proportion of 50%? _____ What percent would that be? _____

Turn the page to see an image of 100 confidence intervals which were generated from flipping a fair coin 40 times and counting the number of heads.

13. The image on the right represents 100 confidence intervals simulated from 100 repetitions of the experiment of flipping 40 coins and recording the number of heads. Since this is a fair coin, we know that the true population proportion of heads is $p = 0.50 = 50\%$. The dot in the center of each interval marks the point estimate for that repetition of the experiment.



Notice that the intervals that do **not** contain 0.5 have been marked **darker**.

a. How **many** of the intervals to the right do **not** contain 0.5? _____

Check with the members of the group to see if you got the same answers.
(Everyone has the same picture, but it is a little hard to read.)

b. What **percent** of the intervals contain the true population proportion? _____

c. How does this match with the confidence level you found earlier?

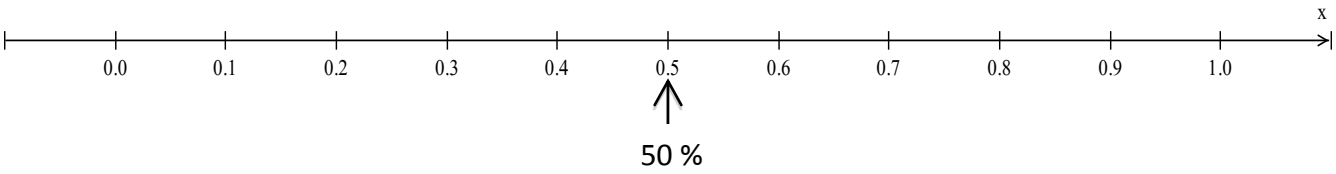
d. If you repeated this simulation 1000 times, what do you think would happen?

14. Discuss with your group about your idea of the meaning of the term ***confidence level***. (You used a 90% confidence level for this activity.)

15. How would the picture of 100 confidence intervals in question 13 change if we had a 95% confidence level instead of a 90% confidence level?

Problem 2 (worksheet)

1. Refer back to the original data sheet. Use your calculator or the formula to create confidence intervals with 90% confidence for **Problem 2**. For your individual data sets, draw the confidence intervals for each member of your group here (put your initials to the left of your interval):



2. Send a member of your group to combine your group's results with the class results. Summarize your findings from the class results here:

3. Based on the findings from the class, how would you answer the question, "Is the coin fair (50/50)?"

4. How do the results about the coin flipping in **Problem 2** compare with the results in **Problem 1**? That is, what can you conclude about the coin used in **Problem 1**? Is it a fair coin (50/50)?

MAIN IDEAS: RECAP OF LEARNING OUTCOMES

The **confidence level** in a confidence interval is the probability that this process yields an interval that contains the true population proportion.

If an experiment is repeated independently by many scientists, and each of them calculates a 95% confidence interval, about 95% of these intervals will contain the true population proportion.

VOCABULARY REVIEW:

- **Population Proportion** (p) – The underlying proportion of successes in the population. Could also be thought of as a theoretical probability.
- **Sample Proportion** ($\hat{p}$) – The proportion of successes in the sample. Also called a point estimate for p.
- **Margin of Error** (ME, or E) – The quantity added to and subtracted from the point estimate to form a confidence interval.
- **Confidence Level** – The proportion of confidence intervals that would contain the population value, if an extremely large number of repeated experiments were made.