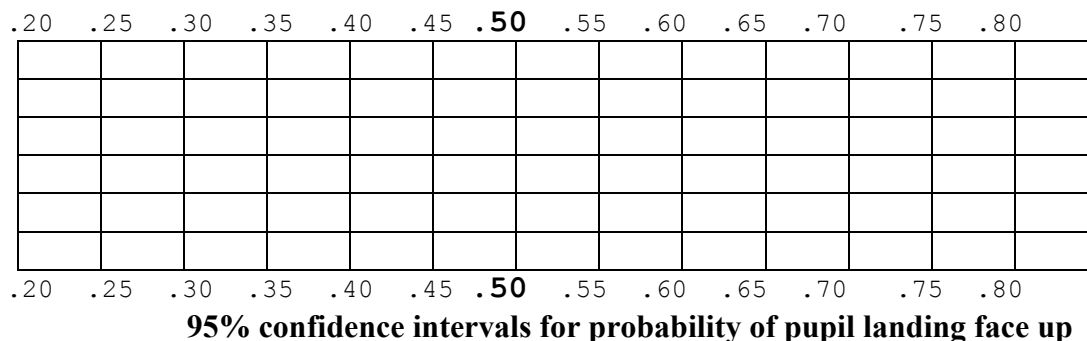


ANIMAL EYES (OR OTHER BINOMIAL) CONFIDENCE INTERVALS

Instructions for the Instructor

SUPPLIES FOR THIS PROJECT:

- Enough "animal eyes" or substitute so that each pair of participants can have five. The goal is to have something that can land face up or face down, but where the probability of landing face up is not already known. A good example is "animal eyes," which are used to put eyes on stuffed animals and can be found in a craft store. The eyes can land with the pupil face up or face down. You can also conduct a different type of binomial experiment, such as estimating the proportion of one color in a multi-colored candy. The important criteria are that the experiment mimics a binomial setting and that each student can get an individual result with $n = 100$ trials.
- A "Team Record Sheet" for each team. (See example provided.)
- A transparency with a grid for displaying confidence intervals, which looks something like this (except it has at least $1 + k + k/4$ rows, where $k =$ number of students; for example with 20 students you need at least 26 rows in the grid), and three colors of transparency pens:



When used, each confidence interval is drawn across one horizontal line of the grid. Use one pen color for individual confidence intervals, a second color for team confidence intervals and a third color for the combined class confidence interval.

PURPOSE:

The purpose of this project is to estimate an unknown probability in a binomial situation. If the animal eyes are used, we are estimating the probability that the eye will land with the pupil facing up when the eye is tossed. A secondary purpose is to notice how the width of a confidence interval depends on the number of observations. A third purpose is to illustrate how multiple confidence intervals all estimating the same probability are not all exactly the same.

STEP BY STEP INSTRUCTIONS FOR THE INSTRUCTOR:

1. Explain the experiment. Discuss how it meets the criteria for a binomial experiment. Explain that although this particular experiment doesn't estimate a binomial probability that is particularly important, it simulates the process of estimating any binomial probability (or proportion) and illustrates related concepts. Give examples of binomial proportions or probabilities that are important to estimate in the real world.
2. Divide students into teams of 4, and then divide into pairs within the team. Each pair needs 5 animal eyes. (It's easier to toss 5 eyes 20 times than to toss 1 eye 100 times, and the goal is to record 100 trials for each individual. Part of the discussion can be about whether trials are independent when the eyes are tossed in batches - the answer is that it depends on how they are tossed.)

Explain the process as follows:

1. One partner goes first. Toss the eyes repeatedly until you have 100 tosses. The other partner records the number of times they land "eyes up." Enter the data in the table on the Team Record Sheet. Then partners switch roles.
2. Carry out the calculations as instructed in the table on the Team Record Sheet, resulting in a 95% confidence interval for the true probability that the eye will land with the pupil up. (Depending on the level of the class, this step can be done without providing the formula to the students.)
3. Each person should draw his/her confidence interval on the grid on the overhead using the same pen color. (One representative from each team can come and draw them all for that team.)
4. Calculate the confidence interval for the team, as shown in the table.
5. Draw the team confidence interval on the overhead using a new pen color, with the same color used for all team confidence intervals.

After all teams have drawn their individual and team confidence intervals, reconvene the class and continue as follows:

1. Calculate the confidence interval for the entire class.
2. Discuss what has been demonstrated with this project. Which confidence intervals are the widest - the ones for each individual, the teams, or the whole class? Why? Are all of the individual confidence intervals the same? Are they all of the same width, for each person? For each team? Why?
3. Based on all of the results, what do you think the true probability is for the eyes (or substitute) landing face up?
4. Do you think it was appropriate to combine the results for everyone, or should they have been kept separate? Explain.