Birthday Problem
Student Activity

Name _____

Class _____

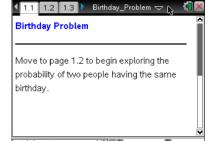**Open the TI-Nspire document *Birthday_Problem.tns.***

Students will use probability theory to investigate the probability of
two people having the same birthday in a crowd of a given size.
Topics covered include basic probability theory, sampling
distributions and infinite series approximations.

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1. The Birthday Problem refers to the probability that in a set of randomly chosen people,
    some pair of them will have the same birthday.

    a. What if someone offered to bet you that any two people in your math class had the
        same birthday? Would you take the bet?

    b. If there were only one other person in your math class, would you be surprised to
        find out that they had the same birthday as you? Explain.

2. Suppose you are in a classroom of 25 students**.** How likely do you think it is that two of
    the students in this class have the same birthday? It probably seems unlikely, since
    there are 365 days in the year and only 25 students. Write down your guess (as a
    percentage) of the likelihood that there will be two people that have the same birthday.

3. Make a conjecture about the probability of having at least one birthday match in a class
    of 25 students.

4. To solve the birthday problem, we need to use one of the basic rules of probability: the sum of the probability that an event *will* happen and the probability that the event *won't* happen is always 1. (In other words, the chance that anything might or might not happen is always 100%.) If we can work out the probability that no two people will have the same birthday, we can use this rule to find the probability that at least two people will share a birthday. Try this process:

    P(event happens) + P(event doesn't happen) = 1, so,
    P(two people share birthday) + P(no two people share birthday) = 1, and
    P(two people share birthday) = 1 – P(no two people share birthday).

    a. Assuming 365 days in a year, what is the probability that two people will not share a birthday?

    b. What is the probability that three or four people will all have different birthdays?

    c. Using this same process, what is the probability of NO birthday matches in a class of 25 students?

Move to page 1.3.

5. Page 1.3 contains a simulation of number of trials and a frequency distribution of the students that have a matching birthday. Set the number of students at the number of students in your class by pressing the slider up or down. The number of trials represents the number of independent classrooms of that size that you surveyed looking for at least one birthday match. You are not actually asking birthdays, just simulating. For example, if there are 25 students in the class, the number of students should be set at 25. You may conduct as many trials as you like. After pressing the arrow for a simulation, record on paper whether there was a match or no match. Press ⌈ctrl⌉ ⌈.⌉ to reset the number of trials.

    a. Record the number of trials with a birthday match.

    b. Using your results from part a, calculate the probability of two students in your classroom having the same birthday.

Move to page 1.4.

6. Page 1.4 uses the formula you found in question 4 to calculate the probability that two students in your class will have the same birthday given the number of students in the class. Type in the number of students to see the probability of two students having a match.

   a. How many students need to be in a class to find a probability of a match of more than .50?

   b. How many students need to be in a class to find a probability of a match of more than .99?

   c. Is there anything surprising about the probability of two students having the same birthday from the simulation you conducted?

7. Is it possible to have a probability of a match be 100% or 1? Explain your reasoning.