Percent Ball

Materials
- trash can or bucket
- 6 sheets of paper
- HP39gs calculator with PERCENTBALL HP Aplet

Introduction

If you try to toss a ball of paper into a trash can 6 times and make 4 shots, your success rate is $\frac{4 \text{ shots made}}{6 \text{ attempts}}$ or about 67%. If you then repeat this and make 5 shots out of 6 attempts, the success rate for that round is $\frac{5 \text{ shots made}}{6 \text{ attempts}}$ or about 83%. So far, your overall success rate, or *cumulative* score is $\frac{9 \text{ shots made}}{12 \text{ attempts}}$ or 75%.

Complete this activity with a partner. You will each take 6 shots at a trash can or bucket and repeat this for ten rounds. You will investigate how your score for each round affects your cumulative score for the game.

Procedure

Crumple each sheet of paper into a ball. Turn on the HP 39gs and press the APLET key. Look for the HP Aplet **PERCENTBALL** (you may have to scroll). See your teacher if you don't have the HP Aplet. Once you have **PERCENTBALL**, highlight it and press the START menu key. Read the starting note. Press the NUM key to go to the numeric view, where you will enter your results. On your turn, take the following steps:

- Try to toss 6 paper balls into a trash can from about 5 feet away.
- Record your score as the number of made shots out of six attempts. Enter the number into column C1 on your calculator. In the sample screen below, rounds 1, 2, and 3 have been completed and the student has made 3 shots, 5 shots, and 4 shots during those rounds.

After 10 rounds, press the VIEWS key and then choose **Tabulate**. The screens below show sample results.

The calculator has converted your scores for each round into percents and put the percents into column C2. In column C3, the total or cumulative number of made shots through that round is recorded, and in column C4, the cumulative percent of made shots so far is recorded. Column C5 keeps track of the number of the rounds, 1 through 10.

Exercises
1) Look at the percents in column 2 for you and your partner. Are there certain scores that occur over and over? Explain where these numbers came from.

2) Look at the cumulative percents in column C4. Explain where the second value in column C4 came from.

3) Do the same values that you saw in column C2 repeat in column C4? Explain why or why not.

4) Look at the turns when your cumulative percent score went up. Can you see a pattern that could help you predict whether your score for a particular round would make your cumulative percent go up? You might try pressing the PLOT key to look at the graph to help you make your prediction. When you do so, you'll see two line graphs. The horizontal axis represents the number of the round. For S1, the vertical coordinate represents the percentage of made shots in that round , and for S2, it represents the cumulative percentage through that round. Describe the pattern.

Now press the VIEWS key and choose **Reset**. All your data will be cleared out. Now play again. This time, though, after you record the number of made shots in column C1, try to predict whether the cumulative percent in column C4 will go up or down as a result of the score on that round. Then press the VIEWS key and choose Tabulate. Check your conjecture with the calculated cumulative percent. Play until your prediction method works every time.

5) Describe your prediction method.

6) Suppose a student made 3 out of 6 shots. Shooting with the same rate of success, how many shots would this student make out of 100 attempts?

Now you'll explore how the cumulative score could change under various situations. Start by clearing all the columns as before. Suppose a student made 4 out of 6 shots in each of the first 5 rounds. Choose Reset from the VIEWS menu and enter data into column C1 for this student, then press the VIEWS key and choose Tabulate. You should see 66.6667 % in every row of C2 and C4. Now suppose the student makes 6 out of 6 in round 6. Enter 6 at the bottom of C1 and re-tabulate.

7) How much did the cumulative percent go up?

Another student makes 4 out of 6 shots in each of the first 100 rounds.

8) Show the calculation that gives a cumulative percent of 66.6667 for this student.

This student then makes 6 out of 6 in the 101st round.

9) What is this student's cumulative percent after 101 rounds?

10) How much did the cumulative percent go up?

Compare your answers to question 6 and question 9.

11) Now suppose another student has averaged 66.6667 % over 1000 rounds, then makes 6 out of 6 shots on the 1001st round. Would this student's cumulative percent change by more or less than the two previous students? Do the calculations to check your answer.