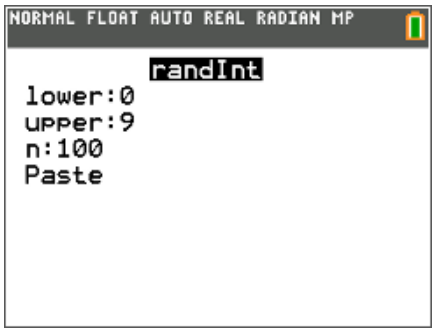
Problem 1 – Free Throws

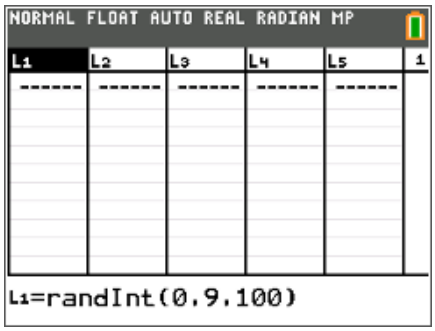
You are watching a basketball game. There is no time on the clock and your favorite team is down by one point. A 70% free throw shooter is fouled and will be able to shoot two free throws, each worth one point. You will use a simulation to find the probability that your team will win the game without any overtime.

A random number generator can be used to help simulate the problem. In this case, use the digits 0 – 9. Choose 7 of them (or 70%) to represent a completed basket and 3 of them (or 30%) to represent a miss. You will simulate 100 trials, which is 100 two-shot opportunities.

Open the List Editor by pressing [STAT] [ENTER]. Let **0, 1, 2** represent a miss and let **3 – 9** represent a made shot.

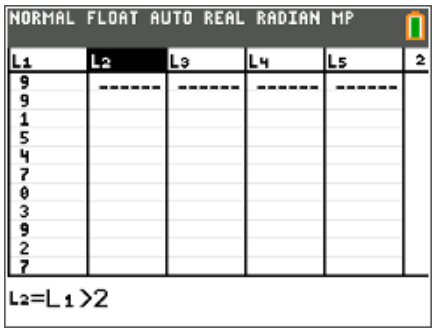
Step 1: Simulate the first shot by using the **randInt(** command in the formula bar of **L1**. **RandInt(** is found by pressing [MATH] and arrowing to the PRB menu. Set the **lower:0**, **upper:9**, and **n:100**. Once the information is entered, arrow to **Paste** and press [enter].



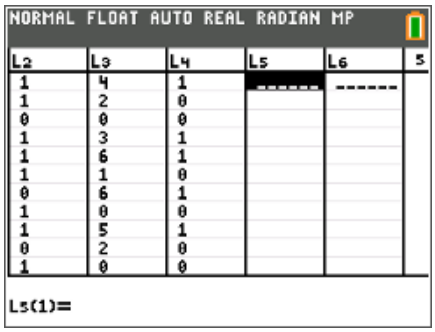


Step 2: Evaluate if a basket is completed by typing **L1>2** in the formula bar of **L2**. Press [2nd] [test] to enter **>**.

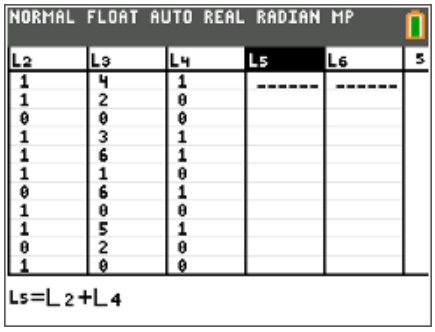
A **0** will indicate a missed basket and a **1** will indicate a completed basket.



Step 3: Repeat steps 1 and 2 to simulate the second shot in **L3** and **L4**.



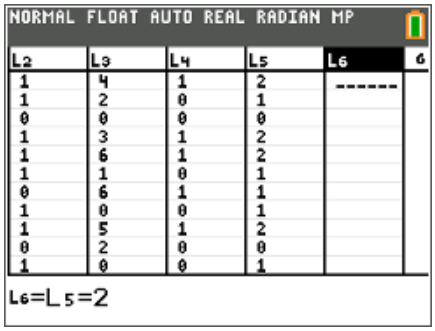
Step 4: Calculate the number of baskets made per trial by typing **L2+L4** in the formula bar of **L5**.



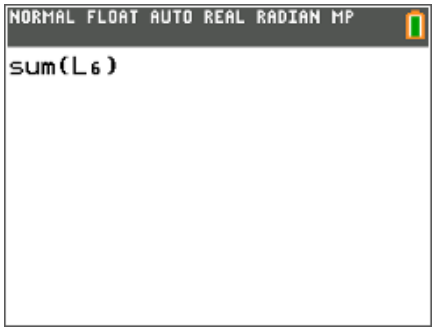
Step 5: Evaluate if a trial is a win for the team by typing **L5=2** in the formula bar of **L6**.

The ones represent a "match" (both shots were made).

The zeroes represent "no match" (both shots were not made).



Step 6: On the Home screen, calculate the number of wins out of 100 trials by choosing the **sum(** command by pressing 2nd [list] and arrow to the **MATH** menu. Type **L6** (or select it from the menu). Press enter to view the sum.



1. What is the experimental probability that your team won?

2. How does it compare to the theoretical probability?

3. If the percentage of the free throw shooter decreased to 60%, how much would the probability of your team winning decrease?

4. If the percentage of the free throw shooter increased to 80%, how much would the probability of your team winning increase?

Problem 2 – Birthday Problem

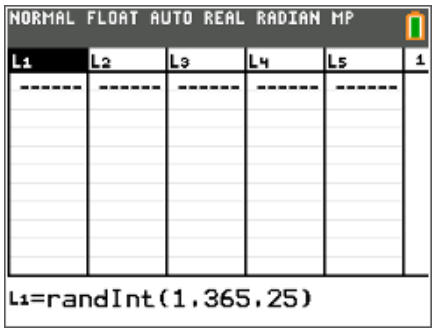
There are 25 unrelated people in a room. What is the probability that two of them share the same birthday?

Take a guess. What do you expect the probability to be?

Now, let's investigate. How can random numbers be used to represent this problem? Discuss ideas with your group.

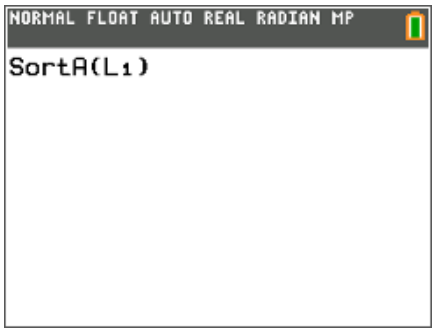
Clear any data from the lists (arrow to the top of each list and press CLEAR).

Step 1: Simulate the day of each person's birthday using the command **randInt(1,365,25)** in the formula bar of **L1.**



Step 2: Sort **L1** to see if any numbers are the same. Arrow to the top of the list. Then press [stat] and choose **SortA(**, type **L1,** and press [enter]. This will sort the birthdays in ascending order. Return to the List Editor to view the sorted birthdays. Use the arrow keys to scroll through the list.

Do you have two people with the same birthday?



Step 3: Repeat this process 9 more times. You will need to re-enter the formula to randomly generate the birthdays because it was overwritten with the sort. You will also need to resort the list. Keep a tally of how many trials there are with same birthdays.

5. What is the experimental probability of having a shared birthday?

6. How does it compare to the theoretical probability?

7. What happens to the experimental probability if the number of the people in the room increases? Decreases?

8. What birthday was not included in this simulation?

Extension – Casey at the Bat

There is a famous poem titled *Casey at the Bat* by Ernest Lawrence Thayer. Your teacher will provide you with a copy. After reading the poem, let's change the scenario just a little.

Let's assume the coach of the Mudville baseball team knows two things: (1) Casey is a poor hitter and (2) the pitcher for the opposing team throws strikes only 40% of the time. So, the coach tells Casey not to swing the bat. What is the probability that Casey walks to first base?

Create a simulation that will represent the scenario above. Remember, three strikes and Casey's out; four balls and Casey walks to first base.

9. Discuss ideas with your group. As a group, decide on the specifics for the simulation. Record them below.

10. Perform your simulation 25 times and record the experimental probability below.

11. How does the experimental probability compare to the theoretical probability?

12. Did the coach make a good decision?