# We Have the Same Birthday!

Activity Overview

In this activity, students use simulations to answer a popular question involving probabilities. They will use the **randInt** and **mean** commands to determine the average number of people that need to be in a room to share a birthday.

Topic: Statistics and Probability

- Understand and apply basic concepts of probability
- Understand and use appropriate terminology to describe complementary and mutually exclusive events

Teacher Preparation and Notes

- **To download the student worksheet, go to education.ti.com/exchange/whtsb**
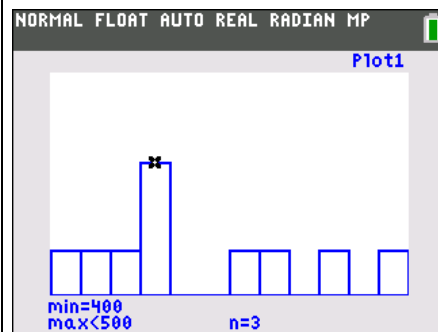
This activity utilizes MathPrint™ functionality and includes screen captures taken from the TI-84 Plus C Silver Edition. It is also appropriate for use with the TI-83 Plus, TI-84 Plus, and TI-84 Plus Silver Edition but slight variances may be found within the directions.

Compatible Devices:
- TI-84 Plus Family
- TI-84 Plus C Silver Edition

Associated Materials:
- We_Have_The_Same_Birthday_ Student.pdf
- We_Have_The_Same_Birthday_ Student.doc

Tech Tips:
- Access free tutorials at http://education.ti.com/calculators /pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Part 1 – Birthdays in Your Class

In this problem, students will collect data for the birthdays had by each person in the class. Students should assign a 3- or 4-digit number for their birthday, 101 being January 1st and 1015 being October 15.

Questions 1–2

Press STAT and select **1:Edit…** to access L1. If there are data values in L1, you can move to the top of the list (▲) and press CLEAR ENTER.

Ensure students understand the format needed for their birthday. You may want to have them write their birthday (April 21) along with the number (421). To collect the data into one list, you may want to have students read off their numbers and you enter the values into **L1** or have them come one at a time to your calculator and enter the values.
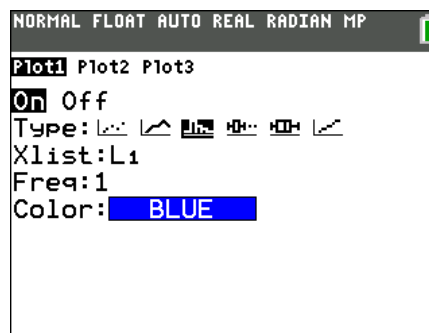
Once all the numbers have been entered, you can send the large list back to all calculators. Connect two calculators using the unit-to-unit cable and press 2nd [LINK] 4 to select sending a list.

Note: Another way to aggregate the data is to have the students come up to the board and write their numbers. Each student can enter the class values into L1 on his or her calculator. If you use this method it might be helpful if pairs of students check each other's data entry.
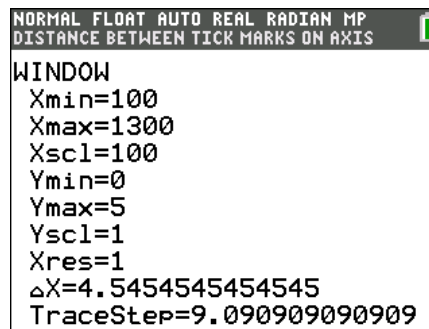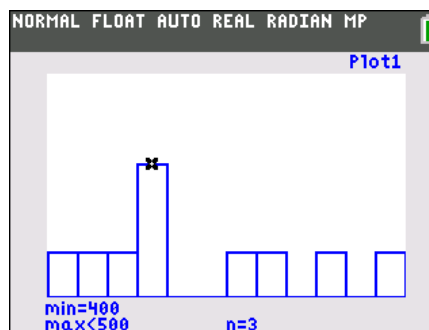
Questions 3–6

After students have received the whole list, have them set up a histogram using the data in L1. Press [2nd] [STAT PLOT] [ENTER] to access the **Plot1**. Configure as shown.

```
NORMAL FLOAT AUTO REAL RADIAN MP

Plot1 Plot2 Plot3
On  Off
Type:⊾⋮ ⟋ ⊫⊒ ⊪⋅ ⊪⊞ ⟋
Xlist:L₁
Freq:1
Color:    BLUE
```

After the plot is set up, students should press [WINDOW] to adjust the viewing window to see the data. If any of the bars extend past the top of the screen, continue adjusting the Ymax value. Xmin, Xmax and Xscl at the right were chosen so that each bar of the histogram represents a month, i.e. the 100s represent January, the 200s February…

```
NORMAL FLOAT AUTO REAL RADIAN MP
DISTANCE BETWEEN TICK MARKS ON AXIS
WINDOW
 Xmin=100
 Xmax=1300
 Xscl=100
 Ymin=0
 Ymax=5
 Yscl=1
 Xres=1
 ▵X=4.5454545454545
 TraceStep=9.090909090909
```

Press [GRAPH] to view the histogram. For the example shown at the right, there are 3 birthdays in April. Pressing [TRACE] and using the left and right (◄ and ►) arrow keys will allow students to see the number of birthdays per month.

```
NORMAL FLOAT AUTO REAL RADIAN MP
                                  Plot1



min=400
max<500          n=3
```

Questions 7–8

Have students sort L1 to see if any of the numbers are the exact same. On the Home Screen press [2nd] [LIST] ► [1] to select the **SortA** command and then press [2nd] [L1][ )][ENTER] to execute the SortA command.. Then press [STAT] and select **1:Edit…** to view L1. Use the ▲ and ▼ arrows to scroll through the list. If there are two numbers the same, this means students share that birthday. It will not be unlikely for students to find shared birthdays in a class or 20+ students.

```
NORMAL FLOAT AUTO REAL RADIAN MP

SortA(L₁)
                            Done
```
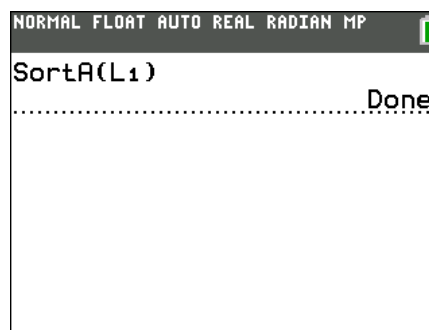
Part 2 – A 50/50 Chance of Sharing a Birthday

In this problem, students will generate random "birthdays" to perform a simulation of how many people need to be in a room before you have a greater than 50/50 chance of at least two people sharing a birthday.

Questions 9–10

Students will likely initially guess a very large number of people that need to be in the same room in order to have two people share a birthday. Through this simulation, they will discover that the number is much smaller than expected.
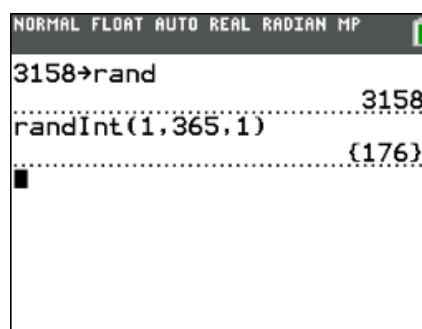
To begin, ensure that all students set a different random number seed. This will ensure they generate different random numbers for the experiment.

Questions 11–14

Have students enter a unique number, either their student ID or the last four digits of their phone number, and store it to the random number seed. Enter the number, press
STO► MATH ► ► ► ENTER ENTER.

Then, students will select the **randInt(** command (under MATH and **PROB**) to generate random birthdays. The randInt wizard acts as before in Part 1.
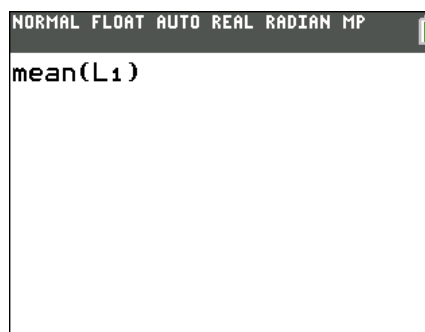
Students can then continue to press enter to generate the next random number.

Students will record each random number generated and then will note when they receive a duplicate number. With the randomness of the simulation, each student will receive different numbers as well as different numbers of "people" in the room before a duplicate birthday is found.

Questions 15–17

Aggregate the different number of people in the room data as in Part 1.

Students will likely be surprised by the results of the experiment. Find the mean by pressing 2nd [LIST] ► ► 3 2nd [L1]) ENTER. The mean number of people needed in a room should be close to 23 people.

Solutions – student worksheet

Part 1

1. Write your birthday as entered in the list: **Answer: Answer is based on students' birthdays.**

2-3. **Data will vary.**

4. What window is most appropriate for your data?

    Answer: The window will vary but should have Xmin=100, Xmax=1300, Xscl = 100 and Ymax will need to adjust based on the number of students born per month.

5. Draw your histogram at the right. Label the graph appropriately.

    Answer: Graphs will vary. Check for proper labels

6. What does the shape of the graph tells us about the distribution of birthdays throughout the year?

    Answer: Graphs will likely indicate that birthdays are spread out throughout the year.

7. Now, sort L1 in ascending order. On the Home screen, press 2nd [LIST] ► 1 and then 2nd [L1])
    ENTER. Then press STAT and select **1:Edit…** to view L1. Do any students share the same date? If so, how many dates are shared?

    Answer: Answers will depend on data collected. It is likely that 2 or more students will share the same birthday.

8. Did the outcome surprise you? Why or why not?

    Answer: Answers will depend on data collected and student's expectations. It will be likely that students are surprised if two or more students share the same birthday.

Part 2

9. How many people do you think need to be in a room together to have a better than 50/50 chance that at least two people share a birthday? **Answer: Answers will vary.**

10-11. **List is based on initial rand seed students use. All lists should be different.**

12. How many people (random numbers) were in the room before you had a duplicate birthday?

   Answer: Answer should reflect data collected in Question 11.

13. Was the number you found in Question 12 greater or less than your initial estimate from Question 9?

   Answer: It is very likely that the number found in Question 12 will be less than students' initial expections in Question 9.

14. Were the results from the experiment surprising? Explain.

   Answer: Students will likely be surprised by the results.

15. After the classroom has entered their number from Question 12 in list L1, create a histogram of the data in L1. Press ZOOM 9 to graph. Sketch the graph to the right. Label your graph appropriately.

   Answer: Graphs should show that most values center around the mean, 23.

16. Use the mean command to find the mean of the list. Press 2nd [LIST] ▶ ▶ 3 2nd [L1]) ENTER.

   Answer: Answers will depend on data collected but should be close to 23.

17. How does the class average compare to your estimate in Question 9? Does this surprise you? Explain.

   Answer: Very likely, the class average will be lower than the initial guess in Question 9. Explanation should indicate understanding of the probability as shown through the simulation.