About the Lesson

In this activity, students learn about each of the four types of probability sampling methods and use the **randInt** command to find each kind of sample for a given population. For stratified sampling, students find both a proportionate and a disproportionate sample.

As a result, students will:

- Distinguish between types of probability sampling methods.
- Use a calculator to find probability samples.

Vocabulary

- population
- sample
- probability sample
- representative

Teacher Preparation and Notes

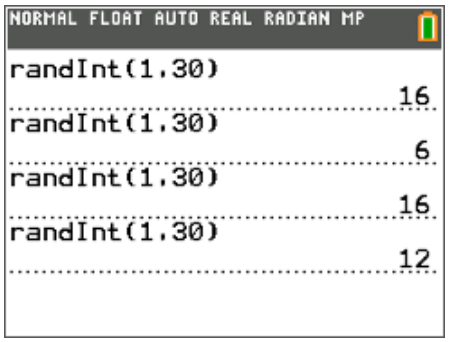
- This activity is designed to be used for students studying Statistics and Probability. There are no prerequisite skills for this activity.

Activity Materials

- Compatible TI Technologies:

  TI-84 Plus*
  TI-84 Plus Silver Edition*
  TI-84 Plus C Silver Edition
  TI-84 Plus CE

***** *with the latest operating system (2.55MP) featuring MathPrint™ functionality.*



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- 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.

Lesson Files:

- Sampling_Student.pdf
- Sampling_Student.doc

Before beginning the activity, introduce the following definitions and information to students.

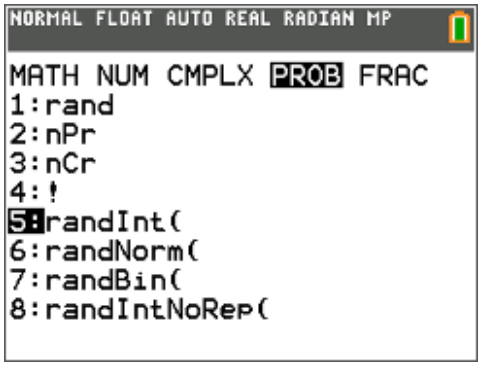
- A population is a group of individuals or things we can use to collect data. If the population is large, it may be easier to find information about just part of the population.
- A sample is a part of a population.
- The information found about the sample may or may not be true about the whole population in general. In that case, the sample is not *representative* of the population. Use an example where 90% of the population would vote 'no' on a bill, but the sample chosen happens to include a lot of people in the 10% category that would vote 'yes.'
- You can ensure that a sample is representative by using probability sampling methods and selecting a large enough sample.
- In a probability sample, every individual in the population has a known, nonzero chance of being selected. You will study and find four types of probability samples.

Problem 1 – Find a Simple Random Sample

Explain that the simplest way to perform an SRS is to put names of everyone in the population in a hat and then select some of the names. This however can become a hassle for large populations. The next best thing is to assign numbers to the individuals and use a random number generator.

Students will need to seed their calculators before using the random number generator. This will ensure unique numbers among students. Have students use either the last 4 digits of their phone number or their birthday. To do this press the number, followed by [sto→] [math] [▶] [▶] [▶] [1] [enter].

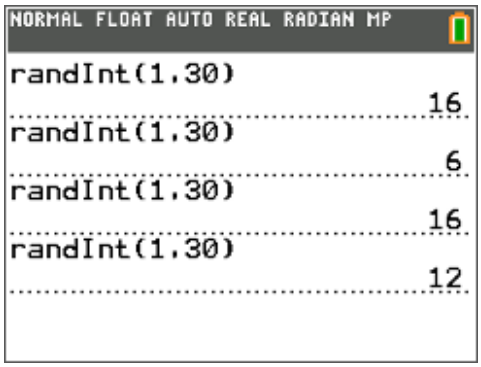
To perform the first SRS, students are to select a sample of 8 people from the population by pressing [math], choosing the **PRB** menu, and then selecting **randInt(**. Enter the starting number in the range next to **lower**, the ending number in the range next to **upper**, and press [enter] twice.



Teacher Tip: When students are first using the randInt command, ask them what they should do if the same number appears twice. (They should redo the command until the list is all unique numbers.)

For the screen at right, the result of 16 indicates that the initials of the first person in the sample would be **RU**.

Students should press enter 7 more times to get a total of 8 numbers.



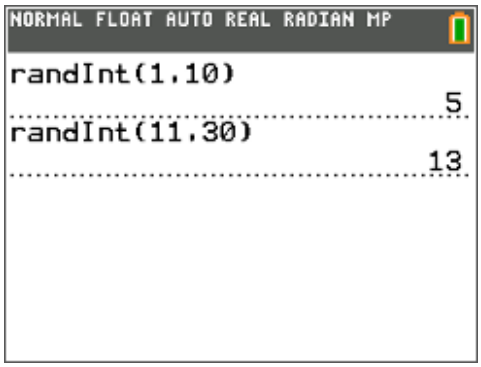
1. Use **randInt** to select a sample of 8 people from the population. Record them below.

Sample Answer: RU, HS, HT, PS, LS, VN, ZA, GK

Problem 2 – Find a Stratified Random Sample

Discuss with students other ways to create a stratified random sample. Some examples of ways to divide groups can be age, gender, or political party.

To find the stratified random sample in this problem, students will use two commands, **randInt(1,10)** and **randInt(11,30)**. They should use the first command until they have 6 women and then use the second command until they have 6 men.



2. Use **randInt** to select a group of 12 people so that half are women and half are men. Record the numbers below.

Sample Answer: BL, TW, AK, GN, OR, TB, VN, KR, CI, HW, DI, MT

3. Explain why the sample is disproportionate to the population.

Answer: Half the sample is female, but only one-third of the population is female.

4. Explain how you could find a proportionate sample of 12 people.

Answer: The sample must be one-third female and two-thirds male, just like the population. Choose four women and eight men.

5. Find a proportionate stratified sample of 12 people from the list.

Sample Answer: BM, SC, TW, HS, VN, GK, JS, FV, PS, EP, RJ, RU

Problem 3 – Find a Cluster Sample

After students are introduced to a cluster sample, discuss a real-life application of cluster sampling, such as selecting members for face-to-face interviews. To save on travel expenses, the population is grouped by location, such as by neighborhoods or city blocks.

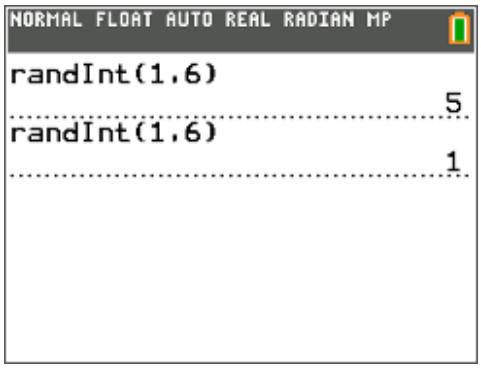
After students answer Question 6 on the worksheet, explain that cluster sampling should only be used if a list cannot be made, or if the cost would be too great to use another method.

6. Do you think cluster sampling would be more or less precise than finding a SRS or a stratified sample? Justify your answer.

Sample Answer: Less precise. If the quantity being studied is strongly tied to what defines each cluster (e.g. location), the distribution of results may not be accurate. An extreme example: a random sample covering 10% of a city's population will give a much better picture of the income distribution than breaking the city into 20 clusters and randomly selecting 2 of them, which would likely show a bimodal distribution.

To get the cluster sample, students will use **randInt(1, *x*)**, where *x* should be the number of *clusters* in the total population.

For example, for the screenshot at the right, since 6 and 1 are the random groups, students would record the initials for numbers 26–30 (group 6) and numbers 1–5 (group 1).



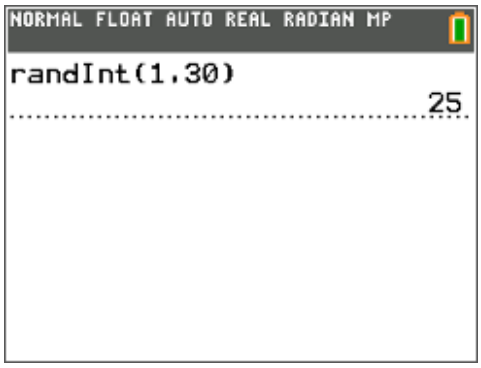
7. Suppose in the list that every multiple of 5 people (1-5, 6-10, etc.) live in the same apartment complex. Randomly select 2 clusters and record the initials of the people.

Sample Answer: EP, RJ, JS, EB, KR, GN, TB, BM, OR, BL

Problem 4 – Find a Systematic Sample

For the systematic sample, a common error is to always start with the first name on the list. The first name for the sample should be randomly chosen.

For example, for the screenshot at the right, since 25 is randomly generated, the first name for the sample will have the initials KR. Every subsequent fifth name will be chosen to complete the sample.



8. Use **randInt** to select the starting point. Then choose every fifth name on the list until you get back to the starting point. List your sample of 6 people here.

Sample Answer: KR, OT, BL, SC, MT, ZA

9. Explain why systematic sampling is not a type of simple random sampling.

Answer: Not all possible groups of size *n* have an equal chance of being selected. If choosing every fifth person, for instance, a group with members 01, 02, 03, 04, and 05 is not possible.

10. Discuss advantages and disadvantages of each sampling method and when one would be used over another.

Sample Answer: Simple random samples give every member of the population an equal opportunity to be picked. Stratified random samples allow a sample that represents the population, but is complex and requires a lot of extra work. Cluster samples are convenient for face-to-face sampling to cut down on travel, but must make sure that clusters are divided by characteristics that we aren't looking for. Systematic samples are easy to generate from a population, but the results are not random samples.

11. Using **randInt**, replace each pair of initials in the table at the start of the exercise with a random number between 1 and 30, and then find the mean value for each sample taken in the above problems. Repeat by replacing each pair of initials with a 1 if the random number between 1 and 30 is less than or equal to 10 and with a 2 if the number is greater than 10. Repeat a third time by replacing each pair of initials in a column with the same random number chosen between 1 and 30, and a fourth time by replacing each pair with the number of the row it is in. Compare your results with those of the other students, and discuss what the similarities and differences say about each sampling method.

Open Discussion: Results, in general, should show that SRS and stratified random sampling give similar results regardless of the population, with a proportionate stratified sample being relatively representative of the total population. Results should also show strong variations in results for cluster and systematic samples depending on the nature of the population. Use the example of gerrymandering to show that, while the fourth case may seem formulated to skew the results of systematic sampling, it is sometimes manipulated to do exactly that. (Note: while this final portion of the activity may seem to require a lot of additional calculation of mean values, the results for the third and fourth cases can simply be read from the tables.)