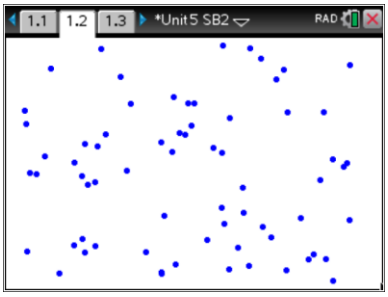
Unit 5: Lists, Graphics, and Dynamic Programs | **Skill Builder 1: Programming with Lists**

In this lesson, you will learn about using **Lists** in programs to produce interesting, interactive data graphs.

Objectives:

- Describe the basics of **lists** in programs
- Write programs that use **lists** to create scatter plots



TI-Basic does not provide direct graphical statements. A program can define functions for graphing and can create lists to produce scatterplots but cannot plot points directly.

In this unit, we will develop three big ideas:

1. working with lists in a program;
2. setting up a Graphs app to display a scatter plot of those lists; and
3. using 'dynamic' programs that can run 'on demand.'

Defining Lists

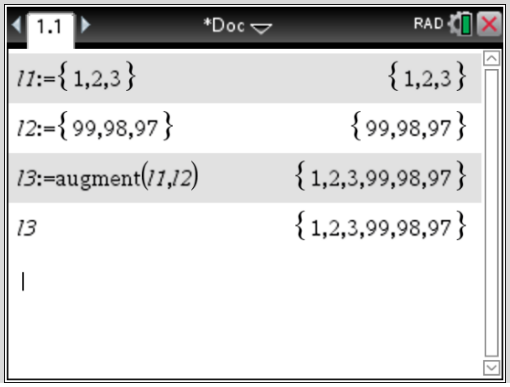
Lists are defined using the curly braces, { }. To create an empty list, use a statement such as **mylist:= { }** with nothing between the braces.

The list *elements* (values between the braces) are addressed using square braces after the list name, such as **mylist[3]**, which refers to the third element in **mylist**.

Add elements to a list by storing a value in the position immediately after the last value of the list. For example, if a list contains three elements such as {12, 7, 2} then you can add an element to this list by storing a value in list element number [4]. Entering **mylist[4]:= 17**, results in **mylist** = {12, 7, 2, 17}. Knowing how many elements are in a list is very helpful. **dim(***listname***)** tells how many elements are in the list (the dimension of the list). This command is often used to add an element to the end of a list. For example:

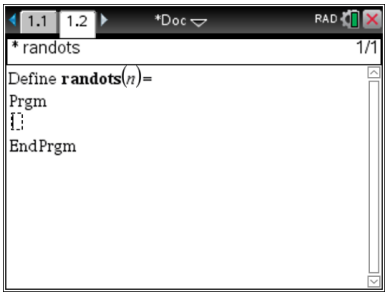
mylist [dim(mylist) + 1] := <*some value*>

Teacher Tip: In the TI-Nspire™ CX, there is also an **augment( )** function which merges or combines two lists. It appends the elements of the second list to the end of the first list. It returns the merged list:



Programming Random Dots

We'll begin by writing a program that will create a random dot pattern in a Graphs app.



1. Create a new program (we called it **randots**), and use the argument *n*.
   - *n* represents the number of dots the program will create.
   - The program will create (or revise) two 'global' lists of random numbers for use in a scatter plot in a Graphs app.

Random Number Generators

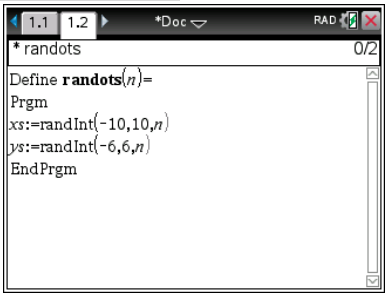
There are several random number functions in the TI-Nspire. The two most common are **rand( )** and **randInt( )**.

- **rand()** creates a random decimal between 0 and 1.
- **randInt(*a, b*)** creates a random integer between *a* and *b*, inclusive. Example: **randInt**(1,6) creates a random number from 1 through 6, inclusive. Try this command in a Calculator app.

> **Teacher Tip:** Computers use algorithms to produce 'pseudo-random' numbers. The function **RandSeed** *n* can be used to 'seed' the random number generator. Using the same value for *n* as the seed will cause the random number function to generate a specific list of random numbers. The 'randomness' comes from the concept that the numbers generated will be *uniformly distributed* on the interval chosen. To make the list 'random,' you can provide your own number to the **RandSeed** function.
> In the Program Editor, use the **Catalog** to locate the random number generator functions.

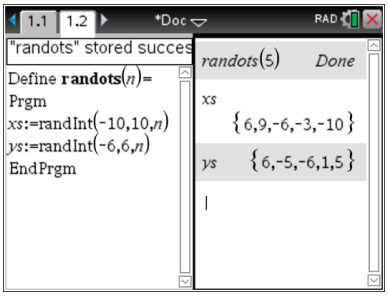
Our first lists of random numbers:

xs:= randInt(-10, 10, n)
ys:= randInt(-6, 6, n)



2. The third argument *n* in the two variable assignments above cause the **randInt( )** function to create a list of *n* random integers in the specified interval rather than a single random number.

3. Select **ctrl+R** to store and prepare to run the program. In the Calculator app, run the program with a small argument such as 5, and observe the values of *xs* and *ys*. Your values will probably differ from the ones to the right.

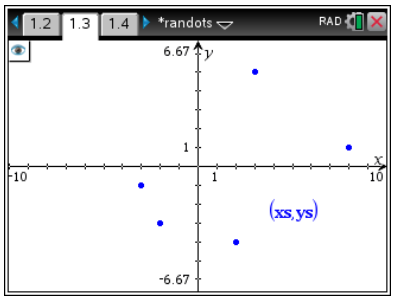


Note: To get a split screen with the Calculator app on the right from the Program Editor, select **doc > Page Layout > Select Layout,** and choose the vertical split icon (**Layout 2**). Add the Calculator app to the new window on the right.

> **Teacher Tip:** To group an app with the app on the following page, select **ctrl+4**. To ungroup, select **ctrl+6**.

> **Teacher Tip:** To see the values of *xs* and *ys*, simply type the list names in the Calculator command line, and press **enter**. Alternatively, press the **var** key, and select each name from the list.

4. Add a Graphs app to this problem, and set up a scatter plot of (xs,*ys*) by selecting **menu > Graph Entry/Edit > Scatterplot**.
5. Enter ***xs*** for the x← field, use the down arrow to move to the y← field, and enter ***ys***.
6. Press **enter** to plot the points.



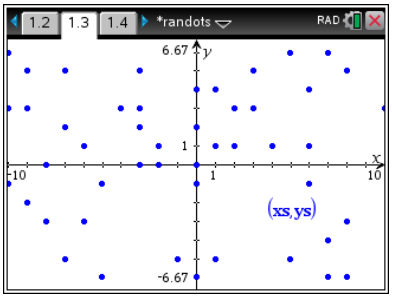
Teacher Tip:
To add a Graphs app:
Select **ctrl+doc** or **ctrl+I**, and select the Graphs app.

When setting up the variables for a scatterplot and after entering the *x* variable, it's a common mistake to press **enter** before entering the *y* variable. This causes an error because the function editor thinks you are finished but you have not yet entered the *y* variable. Simply press **tab** to try again. The graph screen can be 'cleaned up' by hiding the axes and the scatterplot label.

This lesson assumes that the Graphs app is using the default (Standard) viewing window.

Do you see why we chose those intervals for the random number functions? Study the Standard window settings using **menu > Window/Zoom > Window Settings**.

7. Now that we've tested the program, go back to the Calculator app, and rerun the program with a larger (but not too large) value for *n*.
8. Return to the graph to see the results.



randots(50)

Teacher Tips:

- The Standard window size is [-10, 10] x [-6.67, 6.67] so the lists were assigned integral values within those intervals.
- If you use a large value for *n,* then you might notice a delay in the completion of the program due to the large amount of processing involved to generate the lists.
- The subsequent lessons in this unit address the need to move between the Calculator app to run the program and the Graphs app to view the results; everything can and will be controlled from the Graphs app alone.
- It is possible that the program could randomly select one ordered pair more than once, so you might see fewer points in the scatter plot than you expect. This is a great opportunity to explore various questions. These could include: What's the probability in a set of *n* random integers chosen from [-10, 10] that two values are the same? What is the probability that that could happen twice (selecting the same *ordered pair* of numbers twice)?