CHAPTER 10  Calculator Notes for the fx-7400G Plus

Note 10A • List of Random Integers

There are several ways to generate a list of random integers within an interval. Here we will combine the three commands \texttt{Seq}, \texttt{Int}, and \texttt{Ran#} to generate a sequence of up to 255 terms. We will also look at a short program that will allow you to repeat the procedure quickly. You will see that with slight modifications, you can apply the commands and program to a number of familiar situations.

Integers from 1 through 100

The following procedure will generate a sequence of four random integers from 1 through 100.

From \texttt{RUN} mode:

a. Press \texttt{OPTN F1 (LIST) F1 (Seq)}.

b. Press \texttt{OPTN F1 (NUM) F1 (Int)}.

c. Press \texttt{OPTN F1 (PROB) F1 (Ran#)}.

d. Press \texttt{EXE}.

After completing steps a–d, press \texttt{EXE}. Use the arrow key to scroll down to see the rest of the sequence. Press \texttt{EXE} and so on. Notice that each time you press \texttt{EXE}, a new sequence is generated.

By changing the 100 in step d to 50 and the 4 to 10, the same procedure would generate a sequence of ten random integers from 1 through 50. To make changes, press \texttt{QUIT}, then toggle the arrow \texttt{REPLAY} key to the left. Use the arrow key, \texttt{DEL}, and \texttt{SHIFT [INS]} to access the formula and change it.

By adding another step to the procedure, your calculator can store the sequence into a list. (See Note 10B.) Press \texttt{QUIT} and then toggle the arrow \texttt{REPLAY} key to the left to bring the commands back on the screen with the cursor positioned to continue. Add the following step:

e. Press \texttt{OPTN F1 (LIST) F1 (List)}.

Now when you press \texttt{EXE}, you do not see the sequence, but you see \texttt{Done}. Press \texttt{MENU}, select \texttt{STAT} or \texttt{LIST}, and look at List 1. Scroll down to see the rest of the list.

Unfortunately, when you change modes to look at the list and then return to \texttt{RUN} mode, your screen is blank and you need to reenter the steps.

(continued)
Note 10A • List of Random Integers (continued)  

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An alternative to the preceding procedure is to use the RNDINT program. Download, link to, or manually enter the RNDINT program. (See Notes 0F and 0G.) The program allows you to set the interval and to decide how many random integers you want in the sequence. The program stores the sequence in List 1 and displays it on the Run screen.

File Name: RNDINT

```
File Name: RNDINT
ClrText
"WHAT IS THE"～L
"LOWEST VALUE"～L
ClrText
"WHAT IS THE"～L
"HIGHEST "～L
```

```
ClrText
"WHAT IS THE"～L
"LOWEST VALUE"～L
ClrText
"WHAT IS THE"～L
"HIGHEST "～L
```

```
Seq(Int(Ran#*(H-L+1))+L,X,1,N,1)～List 1
```

List 1

To use the RNDINT program to generate a sequence of four random integers from 1 through 100, follow the steps below.

a. Press [MENU] and select PRGM. Arrow down to RNDINT and press [EXE] or press [EXE].

b. In response to the question What is the lowest value?, press [EXE].

c. In response to the question What is the highest value?, press [EXE].

d. In response to the question How many values?, press [EXE].

e. The Run screen shows a sequence of four integers. The same sequence is in List 1. You can check List 1 by going to STAT or LIST. Scroll down to see the other entry.

Two Possible Outcomes: Coin Toss/True-False Test

Suppose you want to simulate the results of 100 coin tosses with 0 representing tails and 1 representing heads. Use the arrow key, [INS], and [SHIFT] [INS] to change step d in the Integers from 1 through 100 section to the following:

d. Press [EXE].

The results of this sequence of commands can be stored in a list. (See step e in Integers from 1 through 100.) You will use this formula later.

You can also use the RNDINT program to simulate the results of 100 coin tosses. Run the program and answer 0 to the question What is the lowest value?. Answer 1 to the question What is the highest value?, and answer 100 to the question How many values?. The results appear on the Run screen and in List 1.
Six Possible Outcomes: Tossing a Die

Suppose you want to simulate the results of four throws of a die. Use the arrow key, [DEL], and [SHIFT] [INS] to change step d in Integers from 1 through 100 to the following:

- Press \( \boxed{0} \boxed{0} \boxed{0} \boxed{0} \boxed{1} \boxed{1} \boxed{1} \boxed{1} \). The results of this sequence of commands can be stored in a list. (See step e in Integers from 1 through 100.)

You can also use the RNDINT program to simulate the results of throwing a die four times. Run the program and answer 1 to the question What is the lowest value? Answer 6 to the question What is the highest value?, and answer 4 to the question How many values? The results appear on the Run screen and in List 1.

Two Possible Outcomes: Random Walk

Suppose you want to simulate a random walk back and forth on a road by generating a sequence of four \(-1\)'s and 1's. Use the arrow key, [DEL], and [SHIFT] [INS] to change steps a and d in Integers from 1 through 100 to the following:

- Press \( \boxed{2} \) [OPTN] \( \boxed{1} \) (LIST) \( \boxed{1} \) \( \boxed{1} \) (Seq).
- Press \( \boxed{1} \boxed{0} \boxed{0} \boxed{0} \boxed{0} \boxed{1} \boxed{1} \boxed{1} \boxed{1} \). The results of this sequence of commands can be stored in a list. (See step e in Integers from 1 through 100.)

To use the RNDINT program to simulate the random walk, generate a list of four 0's and 1's as in the Coin Toss/True-False Test procedure. That sequence is stored in List 1. Press [MENU] and select STAT. Define List 2 as 2List 1−1. (See Note 1K.) Your sequence of \(-1\)'s and 1's is in List 2. Remember, however, that each time you run the program, you will have to redefine List 2.

(continued)
Note 10A • List of Random Integers (continued)  

As an alternative, you can carefully edit the RNDINT program to give your desired results. (See Note 0G.)

a. Press \texttt{MENU} and select PRGM.

b. Arrow down to RNDINT and press \texttt{2} (EDIT).

c. Arrow to the next-to-last command line that begins with \texttt{Seq(}.

Use \texttt{SHIFT} \texttt{INS} to insert 2 before \texttt{Seq(} and add \texttt{−1} after the last closing parenthesis.

d. Press \texttt{QUIT} and then press \texttt{F1} (EXE) to execute the altered program.

Use 0 as the lowest value, 1 as the highest value, and 4 as the number of values.

Your sequence is on the Run screen and in List 1. Every time you execute the program, you generate a new sequence. When you finish, change the program back to its original form.

Viewing an Entry in a List

To avoid scrolling through a list to see a distant entry, you can view any term directly on the Run screen. If in List 1 you have 80 random integers from 1 through 100 and you want to see the fortieth term, from the RUN mode, press \texttt{OPTN \ F1 (LIST) \ F1 (List) \ 40 \ 0 \ \texttt{EXE}}.

Errors

The longest sequence you can make has 255 entries. If you get a Mem ERROR or Arg ERROR message, you are probably trying to construct a sequence that is too long or you are referring to a term of a list that does not exist.

Note 10B • List Operations

(See Note 1B for instructions on entering a list.)

Sorting a List

When working with long lists, it is often more convenient to order the numbers in the list rather than to scan the list looking for the smallest,
Note 10B • List Operations (continued)

Suppose that you have two related lists and you want to sort List 2 in ascending order, but you want each entry in List 1 to stay with its corresponding entry in List 2. From the STAT mode, press [3] (SRT-A). Press [EXE] when you see the prompt How Many Lists? (H). Press [EXE] when you see the prompt Select Base List (B), and press [EXE] when you see the prompt Select Second List (L). Notice that in the screen below on the far right, the entries in List 2 are in ascending order and the original pairings have not changed.

Filling a List with a Sequence

The sequence command Seq(X,X,1,50,1) will generate the sequence of integers from 1 through 50. The command Seq(X,X,10,40,2) will generate the sequence of even numbers from 10 through 40. To access Seq in RUN mode, press [OPTN] F1 (LIST) F9 (Seq). Then complete the command and press [EXE].

To fill List 1 with your sequence, press [QUIT] to return to the Run screen showing the commands followed by Done. Toggle the arrow [REPLAY] key to the left and then press [2] [OPTN] F1 (LIST) F9 (List) 1. (See Note 1B.)

You can also fill a list in STAT or LIST by defining the list name with the Seq command. (See Note 1K.)
Note 10B • List Operations (continued) fx-7400G Plus

Cumulative Sum of a List
The program CUMSUM will generate the cumulative sums of the entries in List 1 and store them in List 2. Be sure you have stored your data in List 1 before running the program. If you get a Dim ERROR message, you probably did not have data in List 1. In this example, List 1 contains [2, 5, 6, 10, 10, 10, 13].

Other List Functions
In RUN, you can find the mean, median, sum, and other important numbers associated with a list by pressing OPTN [LIST] X. Press D again to see more options. Always specify the list name and close any parentheses. (Also see Note 1C.)

- min the minimum value in a list
- max the maximum value in a list
- mean the mean of the list entries
- median the median of the list entries
- sum the sum of the list entries

To get the screen at right, press OPTN [F1] (LIST) [F5] (Max) [F2] [F1] [F3] (List) [F1] [F2] EXE.

Note 10C • Calculator Coin Toss
100 Trials

a. Enter the sequence of integers from 1 through 100 into List 3. This list will number the trials. (See Note 10B.)

b. Enter 100 randomly generated 0’s and 1’s into List 1. List 1 will represent the 100 coin tosses. Let 0 represent tails and 1 represent heads. (See Note 10A.)

c. Run the CUMSUM program to calculate and store the cumulative sums of List 1 in List 2. (See Note 10B.)

d. Calculate the ratio of List 2 to List 3 and store the results in List 4. (See Note 1K.)

e. Enter the probability of tossing a head into Y1 in GRAPH mode. Graph this equation. Set an appropriate view window to accommodate this equation and the scatter plot in step f. (See Note 1F.)

f. Make a scatter plot using List 3 for the x-coordinates and List 4 for the y-coordinates. Use the small dot as the mark. Graph the scatter plot on the same screen as the equation in step e. (See Note 1J.)
200 Trials

By changing 100 to 200 in steps a and b in the previous section, you can modify 100 coin tosses to work for 200 tosses.

Y1 can be changed to the probability of an event that does not have equally likely outcomes.

You can also enter the short program that follows so that you can rerun this simulation without reentering the commands each time. You will probably need to clear the screen with each new graph. If your old graph appears on the screen with your new graph, press \[\text{Sketch} \] (Cls) to clear the old graph. This program only enters data into lists. You then need to graph the probability equation and make a scatter plot as in steps e and f in the preceding section.

File Name: PROBSIM

Seq(X, 1, 200, 1) → List 3
Seq(Int (Ran#, 1), X, 1, 200, 1) → List 1

Note 10D • Permutations

To find numbers of permutations, use the \(nPr\) command. To find the \(nPr\) command, go to the Run screen, press \[\text{OPTN} \] \[F2\] \[F4\] \[F5\] \(\text{PROB} \, 2\) \((nPr)\). First, enter the value of \(n\), the number of objects. Enter the \(nPr\) command, and then enter the value of \(r\), the number of objects chosen. Then, press \[\text{EXE}\].

(continued)
Note 10D • Permutations (continued)

For example, to find the number of arrangements of 5 objects chosen 3 at a time, enter 5 nPr 3. The answer shows that there are 60 arrangements.

Note 10E • Combinations

To find numbers of combinations use the nCr command. To find the nCr command, go to the Run screen, press OPTN F4 (PROB) F3 (nCr). First, enter the value of n, the number of objects. Enter the nCr command, and then enter the value of r, the number of objects chosen. Then, press EXE.

For example, to find the number of groupings of 5 objects chosen 3 at a time, enter 5 nCr 3. The answer shows that there are 10 different groupings.

Note 10F • Factorials

To find the factorial command, go to the Run screen and press OPTN F4 (PROB) F1 (!). For example, to find 5!, press 5 OPTN F4 F1 EXE.

In the order of operations, factorial has higher precedence than negation, so −3! is equivalent to −(3!).

Note 10G • CITIES Program

The CITIES program will simulate random travel among six cities, stopping when a previously visited city is revisited.

Run the program and choose whether you’d like to view one, ten, or some other number of trips. If you choose 1. ONE TRIP, you’ll see travel among the six cities labeled A–F, and the histogram will show you the total number of cities visited on this trip. When the program stops, retrieve the histogram by choosing STAT from the Main Menu and selecting Gph1. Press EXE to simulate another trip, or quit.
If you choose 2. TEN TRIPS, you'll see ten trips simulated, and the histogram will show how many cities were visited during the ten trips. As the program runs, you will see a map of the six cities and a trace of the route taken during each trip. When the program stops, retrieve the histogram by choosing STAT from the Main Menu and selecting $\text{Gph1}$. Selecting $\text{Gph2}$ instead will allow you to see the tenth route taken before the program finished. The first screen below shows that five cities were visited during the tenth trip. The second screen shows that in the ten trips, three trips visited only one city, two trips visited two cities, two trips visited three cities, one trip visited four cities, and two trips visited five cities.

If you choose 3. PICK N, you can choose any number of trips up to the limit of your calculator’s available memory. The program won’t show each trip, but it will show a histogram with the number of trips that visited one, two, three, four, five, and six cities. After you run this option, press 2nd [QUIT] to continue.

```
File Name:CITIES
ClrList.1
ClrGraph.1
Lbl 0:1-\text{N}
"CITY HOPPING".
"WHEN DONE PRESS MENU,
\text{STAT TO VIEW GRAPHS}"
"1. ONE TRIP"
"2. TEN TRIPS"
"3. PICK N"
"4. QUIT"
?\text{A}
ClrText.1
A=1\text{Goto 1}
A=2\text{Goto 2}
A=3\text{Goto 3}
A=4\text{Goto 4}
Lbl 2:10-\text{N}
Lbl 1.1
\{0,0,0,0,0,0\}\text{List 1}
\{0,0,0,0,0\}\text{List 3}
\{0,0,0,0,0\}\text{List 4}
S-Gph1 DrawOn,Hist,List1,1
S-Gph2 DrawOn,xyLine,List3,List4,1,Square
ClrGraph.1
S-Gph3 DrawOn,Scatter,List 5,
\text{List 6},\text{Cross}
\{2,5,6,5,2,1\}\text{List 5}
\{4,4,2,5,1,2.5\}\text{List 6}
ViewWindow 0,7,1,0,5,1
```

Note 10G • CITIES Program (continued)
Note 10G • CITIES Program (continued)

Note 10H • Infinite Sums

To find the sum of terms of a recursive sequence, you can use a recursive routine. Rather than finding the terms of a recursive sequence, as you did in Chapters 0 and 3 (See Notes 0D and 3A), here you'll find the sum of the terms of a recursive sequence.

For example, to find the sum of

\[\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots\]

you'll create the sequence 1, 1.5, 1.75, and so on. This sequence shows the sum of the first one term, the first two terms, the first three terms, and so on. To find the sum after any number of terms has been added, you'll first write a formula that will generate each term. Each term is defined by \((\frac{1}{2})^{n-1}\), where \(n\) is the term number.

To enter this formula into your calculator, follow these steps. From the Run screen, press `OPTN` `F1` (LIST) `F1` (Seq). Now, you are ready to build the formula. The formula is followed by values that tell the calculator how to evaluate the sequence. If, for instance, you want to generate a sequence of 11 terms, you'll enter X to indicate the variable, 1 and 11 to indicate the first and last term, and 1 to indicate that you want the values 1 to 11 to increase by one unit each time. Next, send this sequence to List 1 by pressing `OPTN` `F1` (List) `1` `EXE`. Finally, find the sum of List 1 by pressing `OPTN` `F1` (List) `2` (Sum) `OPTN` `F1` (List) `1` `EXE`. The sum appears to be approaching 2. Test this conjecture by finding the sum of more terms.
Note 10H • Infinite Sums (continued)

Now consider the sum
\[ 1 \cdot \left( \frac{1}{3} \right) + 2 \cdot \left( \frac{2}{3} \right) \cdot \left( \frac{1}{3} \right) + 3 \cdot \left( \frac{2}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) + 4 \cdot \left( \frac{2}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) + 5 \cdot \left( \frac{2}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) \cdot \left( \frac{1}{3} \right) + \ldots \]

Notice that one factor in each term is the counting numbers, another factor in each term is always \( \frac{1}{3} \), and the remaining factor is a power of \( \left( \frac{2}{3} \right) \), beginning with \( \left( \frac{2}{3} \right)^1 \). So, an expression for the terms is \( x \cdot \frac{1}{3} \cdot \left( \frac{2}{3} \right)^{x-1} \). Enter the formula into the calculator as described before and evaluate the sum after some number of terms. In this case, the sum appears to approach 3. Experiment by taking the sum of a greater number of terms to confirm this guess.

Note 10I • Pie Charts and Relative Frequency Graphs

Entering the Data

A pie chart (also called a circle graph) requires a list of no more than eight items. In this example, List 1 contains the data \{6, 2, 5, 1, 2, 4\}. There is no need to set a view window for a pie graph.

Displaying the Pie Graph or Relative Frequency Graph

a. Press \( \text{MENU} \) and select \( \text{STAT} \).

b. Press \( \text{F2} \) (GRPH) \( \text{F4} \) (SET).

c. Press \( \text{F1} \) (GPH1) or whichever graph you like.

d. Arrow down to G-Type and press \( \text{F3} \) (Pie). Arrow down to Data and select the list that contains your data. In this case, choose List 1. Arrow down to Display and choose \( \text{F1} \) (\%) if you want a circular relative frequency graph or \( \text{F2} \) (Data) if you want a pie chart. Press \( \text{QUIT} \).

e. Press \( \text{F1} \) (GRPH) \( \text{F1} \) (GPH1).

Tracing on a Pie Chart or Regular Frequency Graph

Press \( \text{SHIFT} \) [Trace] and use the arrow key to move around the circle.