EXPLORATIONS

APPENDIX A

Numerical Integration

The numerical integration program NINT shown below gives the left sum, right sum, trapezoid, midpoint, and Simpson approximations for

$$\int_a^b f(x)\,dx$$

where $a < b$ and n is the number of subdivisions. The program employs the **sum** and **seq** commands similar to the way they were used in Sections 2 and 3 of Chapter 6.

```
NINT

:Input "a=",A
:Input "b=",B
:Input "n=",N
:(B-A)/N→H
:A→x
:y1→L
:sum seq(y1,x,A+H,B-H/2,H)→S
:(L+S)H→L
:B→x
:y1→R
:(R+S)H→R
:Disp "LEFT=",L
:Disp "RIGHT=",R
:(L+R)/2→T
:Disp "TRAPEZOID=",T
:sum seq(y1,x,A+H/2,B,H)→M
:M*H→M
:Pause
:Disp "MIDPOINT=",M
:(2M+T)/3→SIMP
:Disp "SIMPSON=",SIMP
```

Numerical Integration *(Continued)*

The size of n is limited by the amount of available free memory. (*With 96500 bytes of free memory, an upper bound for n is about 9600. With 45500 bytes of free memory an upper bound for n is about 4500.)*

The program is easy to use. In (A.1)–(A.4) the results are shown when the NINT program is run for

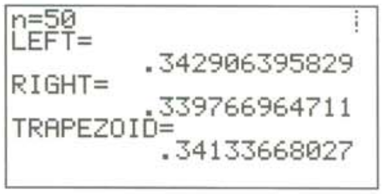
$$f(x)=\left(\frac{1}{\sqrt{2\pi}}\right)e^{-x^2/2},\ a=0,\ b=1,\ n=50\ .$$

1. Before starting the program, enter the function $f(x)$ as $y1$ in the ⟨**y(x)=**⟩ graph editor. Then return to the home screen and start the program.

(A.1)

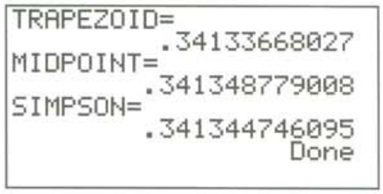
(A.2)

2. The program output pauses after giving the left, right, and trapezoid approximations.



(A.3)

3. When the busy indicator (a moving vertical bar) in the upper right-hand corner changes to the pause indicator (a dotted bar), press [ENTER] to resume output execution and to obtain the midpoint and Simpson approximations.



(A.4)

If you want to integrate the same function for different values of a, b, n, press [ENTER]. If you want to change the function $f(x)$, press [2nd] [QUIT] [GRAPH], select ⟨**y(x)=**⟩, enter the new $f(x)$ as $y1$, and press [2nd] [QUIT] [ENTER] to return to the program.

To quit the program immediately after obtaining the Simpson approximation, press [2] [ENTER]. To quit the program at any other point, press [ON], select ⟨**QUIT**⟩, and press [2] [ENTER].