```
>> Grades=[80 75 91 60 79 89 65 80 95 50 81];
>> [AveGrade StanDeviation] = stat(Grades)
AveGrade =
   76.8182
StanDeviation =
   13.6661
```

7.11 NESTED FUNCTIONS

A nested function is a user-defined function that is written inside another user-defined function. The portion of the code that corresponds to the nested function starts with a function definition line and ends with an `end` statement. An `end` statement must also be entered at the end of the function that contains the nested function. (Normally, a user-defined function does not require a terminating `end` statement. However, an `end` statement is required if the function contains one or more nested functions.) Nested functions can also contain nested functions. Obviously, having many levels of nested functions can be confusing. This section considers only two levels of nested functions.

One nested function:

The format of a user-defined function `A` (called the primary function) that contains one nested function `B` is:

```
function y=A(a1,a2)
.......
   function z=B(b1,b2)
   .......
   end
.......
end
```

- Note the `end` statements at the ends of functions `B` and `A`.
- The nested function `B` can access the workspace of the primary function `A`, and the primary function `A` can access the workspace of the function `B`. This means that a variable defined in the primary function `A` can be read and redefined in nested function `B` and vice versa.
- Function `A` can call function `B`, and function `B` can call function `A`.

Two (or more) nested functions at the same level:

The format of a user-defined function `A` (called the primary function) that contains two nested functions `B` and `C` at the same level is:

```
function y=A(a1,a2)
.......
   function z=B(b1,b2)
   .......
   end
.......
   function w=C(c1,c2)
   .......
   end
.......
end
```

- The three functions can access the workspace of each other.
- The three functions can call each other.

As an example, the following user-defined function (named `statNest`), with two nested functions at the same level, solves Sample Problem 7-4. Note that the nested functions are using variables (`n` and `me`) that are defined in the primary function.

```
function [me SD]=statNest(v)                    The primary function.
n=length(v);
me=AVG(v);

    function av=AVG(x)                          Nested function.
    av=sum(x)/n;
    end

    function Sdiv=StandDiv(x)                   Nested function.
    xdif=x-me;
    xdif2=xdif.^2;
    Sdiv= sqrt(sum(xdif2)/(n-1));
    end

SD=StandDiv(v);
end
```

Using the user-defined function `statNest` in the Command Window for calculating the average of the grade data gives:

```
>> Grades=[80 75 91 60 79 89 65 80 95 50 81];
>> [AveGrade StanDeviation] = statNest(Grades)
```

```
AveGrade =
   76.8182
StanDeviation =
   13.6661
```

Two levels of nested functions:

Two levels of nested functions are created when nested functions are written inside nested functions. The following shows an example for the format of a user-defined function with four nested functions in two levels.

```
function y=A(a1,a2)                    (Primary function A.)
.......
   function z=B(b1,b2)                 (B is nested function in A.)
   .......
         function w=C(c1,c2)           (C is nested function in B.)
         .......
         end
   end
   function u=D(d1,d2)                 (D is nested function in A.)
   .......
         function h=E(e1,e2)           (E is nested function in D.)
         .......
         end
   end
.......
end
```

The following rules apply to nested functions:

- A nested function can be called from a level above it. (In the preceding example, function A can call B or D, but not C or E.)
- A nested function can be called from a nested function at the same level within the primary function. (In the preceding example, function B can call D, and D can call B.)
- A nested function can be called from a nested function at any lower level.
- A variable defined in the primary function is recognized and can be redefined by a function that is nested at any level within the primary function.
- A variable defined in a nested function is recognized and can be redefined by any of the functions that contain the nested function.