```
1             dm'log;clear;output;clear';
2             OPTIONS LS=99 PS=512 nocenter nodate nonumber;
3             **********************************************;
4             *** t-tests done with SAS Proc Univariate ***;
5             **********************************************;
6             ODS HTML style=minimal body='C C:\EXST 7005\SAS\Example02.html' ;
NOTE: Writing HTML Body file: C:\EXST 7005\SAS\Example02.html
7             ODS RTF style=minimal body='C:\EXST 7005\SAS\Example02.rtf';
NOTE: Writing RTF Body file: C:\EXST 7005\SAS\Example02.rtf
8             ODS PDF style=minimal body='C:\EXST 7005\SAS\Example02.PDF';
NOTE: Writing ODS PDF output to DISK destination
      "C:\EXST 7005\SAS\Example02.PDF", printer "PDF".
9
10            TITLE1 'Example02: One sample t-tests';
11
12            DATA monkeys; INFILE CARDS MISSOVER;
13                TITLE2 'Analysis of Blood Pressure change in Rhesus Monkies';
14                INPUT BPChange;
15            CARDS;
NOTE: The data set WORK.MONKEYS has 10 observations and 1 variables.
NOTE: DATA statement used (Total process time):
      real time              0.29 seconds
      cpu time               0.01 seconds
15       !        RUN;
26           ;
27            PROC PRINT DATA=monkeys;
28                TITLE3 'Raw data listing';
29            RUN;

NOTE: There were 10 observations read from the data set WORK.MONKEYS.
NOTE: The PROCEDURE PRINT printed page 1.
NOTE: PROCEDURE PRINT used (Total process time):
      real time              0.61 seconds
      cpu time               0.03 seconds


One sample t-tests
Analysis of Blood Pressure change in Rhesus Monkies
Raw data listing

Obs      BPChange
  1          0
  2          4
  3         -3
  4          2
  5          0
  6          1
  7         -4
  8          5
  9         -1
 10          4
```

```
30
31          PROC UNIVARIATE DATA=monkeys PLOT; VAR BPChange;
32              TITLE3 'Proc Univariate on Blood Pressure Change';
33          RUN;
NOTE: The PROCEDURE UNIVARIATE printed page 2.
NOTE: PROCEDURE UNIVARIATE used (Total process time):
      real time            0.10 seconds
      cpu time             0.01 seconds
```

One sample t-tests
Analysis of Blood Pressure change in Rhesus Monkies
Proc Univariate on Blood Pressure Change

The UNIVARIATE Procedure
Variable: BPChange

Moments

N	10	Sum Weights	10
Mean	0.8	Sum Observations	8
Std Deviation	3.01109061	Variance	9.06666667
Skewness	-0.157506	Kurtosis	-0.9577747
Uncorrected SS	88	Corrected SS	81.6
Coeff Variation	376.386326	Std Error Mean	0.95219046

Basic Statistical Measures

Location		Variability	
Mean	0.800000	Std Deviation	3.01109
Median	0.500000	Variance	9.06667
Mode	0.000000	Range	9.00000
		Interquartile Range	5.00000

NOTE: The mode displayed is the smallest of 2 modes with a count of 2.

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0.840168	Pr > |t|	0.4226
Sign	M	1	Pr >= |M|	0.7266
Signed Rank	S	6.5	Pr >= |S|	0.3984

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5.0
99%	5.0
95%	5.0
90%	4.5
75% Q3	4.0
50% Median	0.5
25% Q1	-1.0
10%	-3.5
5%	-4.0
1%	-4.0
0% Min	-4.0

```
Extreme Observations
----Lowest----          ----Highest---
Value      Obs          Value      Obs
   -4        7             1        6
   -3        3             2        4
   -1        9             4        2
    0        5             4       10
    0        1             5        8


   Stem Leaf   Boxplot
       4 000                    3  +-----+
       2 0                      1  |     |
       0 000                    3  *--+--*
      -0 0                      1  +-----+
      -2 0                      1     |
      -4 0                      1     |
         ----+----+----+----+

                    Normal Probability Plot
        5+                              *   *++++*++
         |                               *++++++
         |                         *  +*+*++
         |                      ++*++++
         |                  *++++*
        -5+     ++++++
           +----+----+----+----+----+----+----+----+----+----+
                -2        -1         0        +1        +2
```
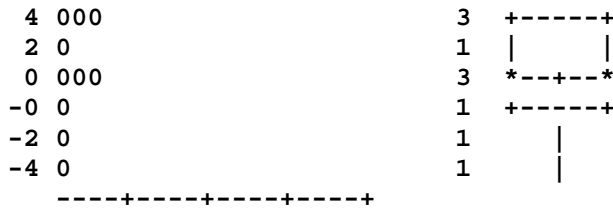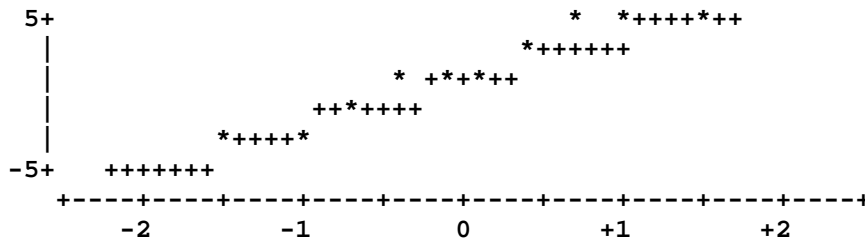
```
34          PROC ttest DATA=monkeys; VAR BPChange;
35              TITLE3 'Proc TTEST on Blood Pressure Change';
36          RUN;
NOTE: There were 10 observations read from the data set WORK.MONKEYS.
NOTE: The PROCEDURE TTEST printed page 3.
NOTE: PROCEDURE TTEST used (Total process time):
      real time           0.07 seconds
      cpu time            0.01 seconds


One sample t-tests
Analysis of Blood Pressure change in Rhesus Monkies
Proc TTEST on Blood Pressure Change


The TTEST Procedure
```

Statistics

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
BPChange	10	-1.354	0.8	2.954	2.0711	3.0111	5.4971	0.9522	-4	5

T-Tests

Variable	DF	t Value	Pr > |t|
BPChange	9	0.84	0.4226

```
43             ************************************************************;
44             *** A shipment of apples are supposed to have a diameter of  ***;
45             *** at least 2.5 inches.  Sample 12 apples and test the       ***;
46             *** hypothesis that the mean size is equal 2.5 inches.        ***;
47             *** Reject the shipment if LESS THAN 2.5 inches.              ***;
48             ************************************************************;
49
50             OPTIONS LS=99 PS=256 nocenter nonumber nodate;
51               TITLE1 'One sample t-tests';
52               TITLE2 'Test the diameter of apples against 2.5 inches';
53
54             data apples; infile cards missover;
55               LABEL diam = 'Diameter of the apple';
56               input diam; diff = diam - 2.5;
57             cards;
NOTE: The data set WORK.APPLES has 12 observations and 2 variables.
NOTE: DATA statement used (Total process time):
      real time            0.00 seconds
      cpu time             0.00 seconds
57         !          run;
70             ;
71             proc print data=apples; var diam diff;
72                 TITLE3 'Raw data listing';
73             run;
NOTE: There were 12 observations read from the data set WORK.APPLES.
NOTE: The PROCEDURE PRINT printed page 4.
NOTE: PROCEDURE PRINT used (Total process time):
      real time            0.06 seconds
      cpu time             0.00 seconds
```

```
One sample t-tests
Test the diameter of apples against 2.5 inches
Raw data listing
Obs     diam    diff

  1      2.9     0.4
  2      2.1    -0.4
  3      2.4    -0.1
  4      2.8     0.3
  5      3.1     0.6
  6      2.8     0.3
  7      2.7     0.2
  8      3.0     0.5
  9      2.4    -0.1
 10      3.2     0.7
 11      2.3    -0.2
 12      3.4     0.9
```

```
74
75             proc univariate data=apples plot; var diam;
76                 TITLE3 'Proc Univariate on Apple size';
77             run;
NOTE: The PROCEDURE UNIVARIATE printed page 5.
NOTE: PROCEDURE UNIVARIATE used (Total process time):
      real time            0.14 seconds
      cpu time             0.03 seconds
One sample t-tests
Test the diameter of apples against 2.5 inches
```

Proc Univariate on Apple size

The UNIVARIATE Procedure
Variable: diam (Diameter of the apple)

Moments
```
N                              12      Sum Weights                      12
Mean                    2.75833333      Sum Observations               33.1
Std Deviation           0.39418116      Variance                 0.15537879
Skewness                -0.1184219      Kurtosis                 -0.8352969
Uncorrected SS               93.01      Corrected SS             1.70916667
Coeff Variation         14.2905557      Std Error Mean            0.1137903
```

Basic Statistical Measures
```
     Location                      Variability
Mean      2.758333     Std Deviation            0.39418
Median    2.800000     Variance                 0.15538
Mode      2.400000     Range                    1.30000
                       Interquartile Range      0.65000
```

NOTE: The mode displayed is the smallest of 2 modes with a count of 2.

Tests for Location: Mu0=0
```
Test                -Statistic-      -----p Value------
Student's t     t   24.2405      Pr > |t|      <.0001
Sign            M         6      Pr >= |M|     0.0005
Signed Rank     S        39      Pr >= |S|     0.0005
```
Quantiles (Definition 5)
```
Quantile        Estimate
100% Max          3.40
99%               3.40
95%               3.40
90%               3.20
75% Q3            3.05
50% Median        2.80
25% Q1            2.40
10%               2.30
5%                2.10
1%                2.10
0% Min            2.10
```

Extreme Observations
```
----Lowest----          ----Highest---
Value       Obs         Value       Obs
  2.1        2           2.9         1
  2.3       11           3.0         8
  2.4        9           3.1         5
  2.4        3           3.2        10
  2.7        7           3.4        12
```
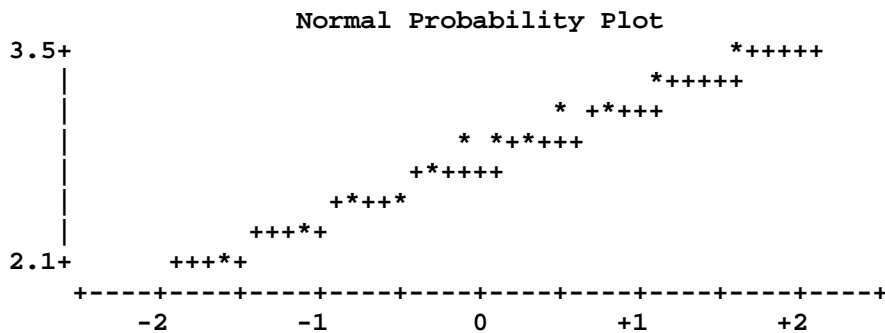
```
  Stem Leaf  Boxplot
    34 0                      1      |
    32 0                      1      |
    30 00                     2   +-----+
    28 000                    3   *-----*
    26 0                      1   |  +  |
    24 00                     2   +-----+
    22 0                      1      |
    20 0                      1      |
        ----+----+----+----+
    Multiply Stem.Leaf by 10**-1
```

```
                         Normal Probability Plot
     3.5+                                                 *+++++
        |                                             *+++++
        |                                          *  +*+++
        |                                      *  *+*+++
        |                                   +*++++
        |                              +*++*
        |                         +++*+
     2.1+              +++*+
        +----+----+----+----+----+----+----+----+----+----+
            -2        -1         0        +1        +2
```

```
78              proc univariate data=apples plot; var diff;
79                 TITLE3 'Proc Univariate on Apple size difference';
80              run;
NOTE: The PROCEDURE UNIVARIATE printed page 6.
NOTE: PROCEDURE UNIVARIATE used (Total process time):
      real time               0.10 seconds
      cpu time                0.04 seconds
```

One sample t-tests
Test the diameter of apples against 2.5 inches
Proc Univariate on Apple size difference

The UNIVARIATE Procedure
Variable: diff

Moments

N	12	Sum Weights	12
Mean	0.25833333	Sum Observations	3.1
Std Deviation	0.39418116	Variance	0.15537879
Skewness	-0.1184219	Kurtosis	-0.8352969
Uncorrected SS	2.51	Corrected SS	1.70916667
Coeff Variation	152.586256	Std Error Mean	0.1137903

Basic Statistical Measures

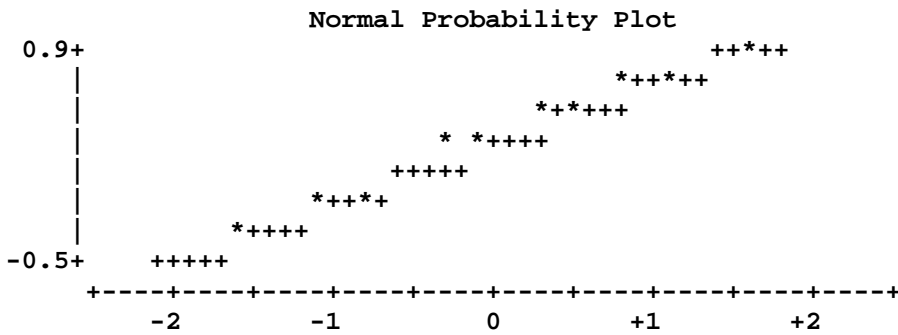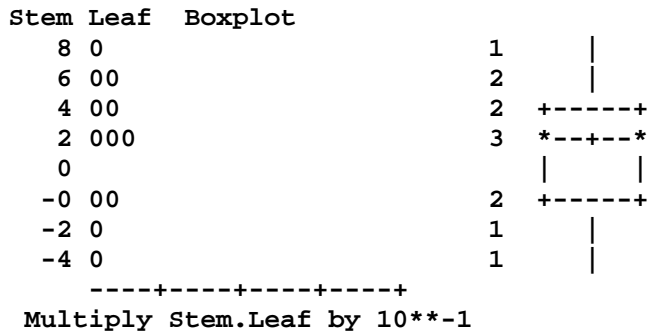| Location		Variability	
Mean	0.25833	Std Deviation	0.39418
Median	0.30000	Variance	0.15538
Mode	-0.10000	Range	1.30000
		Interquartile Range	0.65000

NOTE: The mode displayed is the smallest of 2 modes with a count of 2.

Tests for Location: Mu0=0

Test		-Statistic-		-----p Value------	
Student's t	t	2.270258	Pr > |t|	0.0443	
Sign	M	2	Pr >= |M|	0.3877	
Signed Rank	S	25	Pr >= |S|	0.0493	

Quantiles (Definition 5)

Quantile	Estimate		50% Median	0.30
100% Max	0.90		25% Q1	-0.10
99%	0.90		10%	-0.20
95%	0.90		5%	-0.40
90%	0.70		1%	-0.40
75% Q3	0.55		0% Min	-0.40

```
Extreme Observations
----Lowest----       ----Highest---
Value       Obs      Value      Obs
 -0.4        2        0.4        1
 -0.2       11        0.5        8
 -0.1        9        0.6        5
 -0.1        3        0.7       10
  0.2        7        0.9       12


   Stem Leaf  Boxplot
      8 0                      1      |
      6 00                     2      |
      4 00                     2   +-----+
      2 000                    3   *--+--*
      0                               |   |
     -0 00                     2   +-----+
     -2 0                      1      |
     -4 0                      1      |
        ----+----+----+----+
     Multiply Stem.Leaf by 10**-1


                   Normal Probability Plot
     0.9+                                      ++*++
        |                                  *++*++
        |                               *+*+++
        |                           *  *++++
        |                         ++++
        |                      *++*+
        |                  *++++
    -0.5+       +++++
        +----+----+----+----+----+----+----+----+----+----+
            -2        -1         0        +1        +2
```

```
81          proc ttest data=apples H0=2.5; var diam;
82              TITLE3 'Proc TTEST on Apple size';
83          run;
NOTE: There were 12 observations read from the data set WORK.APPLES.
NOTE: The PROCEDURE TTEST printed page 7.
NOTE: PROCEDURE TTEST used (Total process time):
      real time           0.12 seconds
      cpu time            0.00 seconds
```

```
One sample t-tests
Test the diameter of apples against 2.5 inches
Proc TTEST on Apple size

The TTEST Procedure
```

Statistics

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
diam	12	2.5079	2.7583	3.0088	0.2792	0.3942	0.6693	0.1138	2.1	3.4

T-Tests

Variable	DF	t Value	Pr > |t|
diam	11	2.27	0.0443

```
84
85
86           **********************************************************************;
87           *** Test for differences in seed production at two levels on a    ***;
88           *** plant (top and bottom).  We have ten vigorous plants bearing ***;
89           *** lucerne flowers.  We want to test for differences in the     ***;
90           *** number of seeds for the average of two pods in each position. ***;
91           **********************************************************************;
92
93           OPTIONS LS=99 PS=256 nocenter nonumber nodate;
94              TITLE1 'One sample t-tests';
95              TITLE2 'Test comparing seed production for lucerne flowers';
96
97           data flowers; infile cards missover;
98              TITLE3 'Seed production for top and bottom flowers';
99                LABEL top = 'Flowers from the top of the plant';
100               LABEL bottom = 'Flowers from the bottom of the plant';
101               LABEL diff = 'Difference between top and bottom';
102            input top bottom;
103              diff = top - bottom;
104           cards;
NOTE: The data set WORK.FLOWERS has 10 observations and 3 variables.
NOTE: DATA statement used (Total process time):
      real time              0.00 seconds
      cpu time               0.00 seconds
104      !         run;
115          ;
116          proc print data=flowers; var top bottom diff;
117             TITLE4'Raw data listing';
118          run;
NOTE: There were 10 observations read from the data set WORK.FLOWERS.
NOTE: The PROCEDURE PRINT printed page 8.
NOTE: PROCEDURE PRINT used (Total process time):
      real time              0.07 seconds
      cpu time               0.00 seconds


One sample t-tests
Test comparing seed production for lucerne flowers
Seed production for top and bottom flowers
Raw data listing
Obs     top     bottom     diff

  1     4.0      4.4      -0.4
  2     5.2      3.7       1.5
  3     5.7      4.7       1.0
  4     4.2      2.8       1.4
  5     4.8      4.2       0.6
  6     3.9      4.3      -0.4
  7     4.1      3.5       0.6
  8     3.0      3.7      -0.7
  9     4.6      3.1       1.5
 10     6.8      1.9       4.9


119
120          proc univariate data=flowers plot; var diff;
121             TITLE4'Proc Univariate on difference between top and bottom';
122          run;
NOTE: The PROCEDURE UNIVARIATE printed page 9.
NOTE: PROCEDURE UNIVARIATE used (Total process time):
      real time              0.15 seconds
      cpu time               0.06 seconds
```

```
One sample t-tests
Test comparing seed production for lucerne flowers
Seed production for top and bottom flowers
Proc Univariate on difference between top and bottom


The UNIVARIATE Procedure
Variable:  diff  (Difference between top and bottom)


Moments
N                              10    Sum Weights                  10
Mean                            1    Sum Observations             10
Std Deviation       1.59861051      Variance             2.55555556
Skewness            1.66938453      Kurtosis             3.93459317
Uncorrected SS                 33    Corrected SS                 23
Coeff Variation     159.861051      Std Error Mean       0.50552503


Basic Statistical Measures
     Location                      Variability
Mean      1.000000     Std Deviation           1.59861
Median    0.800000     Variance                2.55556
Mode      0.600000     Range                   5.60000
                       Interquartile Range     1.90000


Tests for Location: Mu0=0
Test              -Statistic-       -----p Value------
Student's t     t  1.978141     Pr > |t|     0.0793
Sign            M         2      Pr >= |M|    0.3438
Signed Rank     S      19.5      Pr >= |S|    0.0469


Quantiles (Definition 5)
Quantile        Estimate
100% Max            4.90
99%                 4.90
95%                 4.90
90%                 3.20
75% Q3              1.50
50% Median          0.80
25% Q1             -0.40
10%                -0.55
5%                 -0.70
1%                 -0.70
0% Min             -0.70


Extreme Observations
----Lowest----           ----Highest---
Value        Obs          Value        Obs
 -0.7          8            1.0          3
 -0.4          1            1.4          4
 -0.4          6            1.5          9
  0.6          7            1.5          2
  0.6          5            4.9         10


   Stem Leaf   Boxplot
     4 9                         1      0
     3
     2
     1 0455                      4   +--+--+
     0 66                        2   *-----*
    -0 744                       3   +-----+
       ----+----+----+----+
```
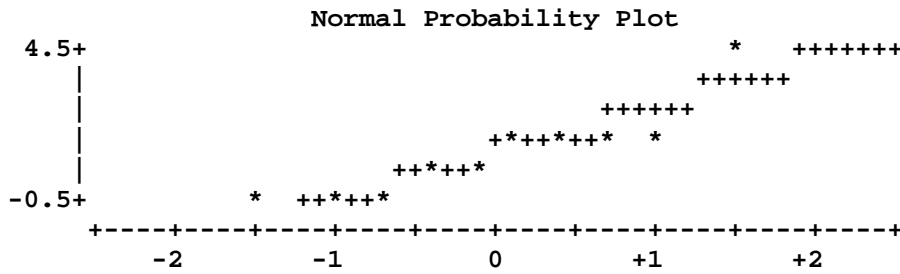
```
                        Normal Probability Plot
      4.5+                                         *    ++++++
         |                                      +++++
         |                                   ++++++
         |                          +*++*++*   *
         |                    ++*++*
      -0.5+           *   ++*++*
         +----+----+----+----+----+----+----+----+----+----+
              -2        -1         0        +1        +2
```

```
123          proc ttest data=flowers; paired top*bottom;
124             TITLE4'Proc Univariate on difference between top and bottom';
125          run;
NOTE: There were 10 observations read from the data set WORK.FLOWERS.
NOTE: The PROCEDURE TTEST printed page 10.
NOTE: PROCEDURE TTEST used (Total process time):
      real time           0.10 seconds
      cpu time            0.01 seconds
126
127          ods html close;
128          ods rtf close;
129          ods PDF close;
NOTE: ODS PDF printed 17 pages to C:\EXST 7005\SAS\Example02.PDF.
130
131          run;
132          quit;
```

One sample t-tests
Test comparing seed production for lucerne flowers
Seed production for top and bottom flowers
Proc Univariate on difference between top and bottom

The TTEST Procedure

Statistics

Difference	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err
top - bottom	10	-0.144	1	2.1436	1.0996	1.5986	2.9184	0.5055

T-Tests

Difference	DF	t Value	Pr > |t|
top - bottom	9	1.98	0.0793