

Graphing Calculator Workshop III **Statistics using the TI-83/84**

Statistics on the TI-83/84

How do I create a list of values?

As an example, we are going to consider the sale of a number of CD's that cost \$19.95, \$13.95, \$12.79, and \$15.99. Initially, I would like to include these as a list of values in my calculator.

Press STAT

Select EDIT and enter the numbers in list L_1

```

2ND STAT CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
  
```

L1	L2	L3	1
19.95	-----	-----	
13.95			
12.79			

L1(4)=15.99			

Now let's suppose I sell 5 of the \$19.95 CD's, 8 of the \$13.95 CD's, only 1 of the \$12.79 compact disks, and 6 of the \$15.99 kind. I would like to list these figures in list L_2 .

As long as I haven't left the listing screen, I can arrow over to list L_2 and put in this information.

L1	L2	L3	2
19.95	5	-----	
13.95	8		
12.79	1		
15.99	6		
-----	-----		
L2(5) =			

How do I perform computations using lists?

If I would take each price in the first column times the corresponding number sold in the second column, I could obtain the total sales for each type of compact disk. That means I want to take L_1 times L_2 which can be done directly!

Use the arrows to highlight L₃,
type in $L_1 \times L_2$,

L1	L2	L3
19.95	5	-----
13.95	8	
12.79	1	
15.99	6	
-----	-----	
L3 = L1 * L2		

and then press ENTER.

L1	L2	L3
19.95	5	99.75
13.95	8	111.6
12.79	1	12.79
15.99	6	95.94
-----	-----	-----
L3(1)=99.75		

Of course, we also have to worry about a 6% sales tax. We can show the tax in column L₄ by taking .06 times values in column L₃.

Use the arrows to highlight L₄,
type in $.06 \times L_3$

and then press ENTER.

L2	L3	L4
5	99.75	-----
8	111.6	
1	12.79	
6	95.94	
-----	-----	
L4 = .06 * L3		

L2	L3	L4
5	99.75	5.985
8	111.6	6.696
1	12.79	.7674
6	95.94	5.7564
-----	-----	-----
L4(1)=5.985		

(We'll overlook the extra decimal places being shown by the calculator, although this could have been controlled by changing MODE FLOAT to 2.)

Finally, we need to add the sales amounts in column L₃ and the tax in L₄. Certainly it is reasonable to put all of this in column L₅.

Use the arrows to highlight L₅,
type in $L_3 + L_4$

and then press ENTER.

L3	L4	L5
99.75	5.985	-----
111.6	6.696	
12.79	.7674	
95.94	5.7564	
-----	-----	
L5 = L3 + L4		

L3	L4	L5
99.75	5.985	105.735
111.6	6.696	118.3
12.79	.7674	13.557
95.94	5.7564	101.7
-----	-----	-----
L5(1)=105.735		

But can I calculate the sum of a single list?

We must first QUIT the editing screen. Then we will select LIST for access to a wide variety of lists commands for which we will only use one!

We want the sum of the four values in list L_5 , for this represents the total cost of all of the compact disks.

Press 2nd STAT to get LIST
(your calculator will **not** show
the list of names as indicated
below)

Arrow over to highlight MATH

```

NAMES OPS MATH
1:AAA
2:AAA
3:DEF
4:GNP
5:INC
6:LOWER
7↓MIDPT

```

```

NAMES OPS MATH
1:min(
2:max(
3:mean(
4:median(
5:sum(
6:Prod(
7↓stdDev(

```

Select choice 5 to activate the sum. Of course it is the sum of column L_5 that is needed, so you will need to choose the L_5 key (that is, 2nd 5). (Note: Closing the parentheses is not necessary, but it is probably a good habit to get into!)

```

sum(L5)
339.2848

```

Apparently the total cost of the CD's is \$339.28.

**Do you want to look at the lists again?
Just press STAT and choose the EDIT option.**

How do I clear information out of these lists? After all, I have other lists I want to set up.

There are at least three different ways to clear out lists. One way is to choose one of the options available through the STAT key itself. We'll use this to clear out lists L_1 and L_2 .

Press STAT and choose option 4

```

30000 CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
  
```

Then type in L_1 , L_2 to specifically clear these two lists. Press ENTER.

```

sum(L5)      339.2848
ClrList L1,L2
Done
  
```

You can also clear a list directly from the STAT Edit screen. We'll clear L_3 and L_4 this way.

Press STAT and choose
option 1

```

30000 CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
  
```

Highlight heading L_3 ,

L1	L2	3
-----	-----	99.75
		111.6
		12.79
		95.94

L3 = (99.75, 111.6...		

press CLEAR
and arrow down

L1	L2	3
-----	-----	99.75
		111.6
		12.79
		95.94

L3 =		

Repeat this for L_4 . The press 2nd QUIT.

By the way, you'll probably want to look into named lists later!

Statistical Computations and Graphs (One Variable)

How can I find an average for data (and perform other statistical computations)?

We are going to gather some real data (involving the number of chips found in chocolate chip cookies). This data will be stored in list L_1 . In fact, I've already counted the chips in two cookies, so we will start by listing 18 and 23, the number of chips I found.

Press STAT and choose EDIT

```

2ND [STAT] CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
  
```

Start to enter the data we have

L1	L2	L3	1
18			
23			
L1(3)=			

Now we can either use some actual data that we'll gather together, or else we'll just continue with the following information: that in addition to the 18 and 23 values you already entered, the rest of the data includes: 17, 20, 24, 19, 15, 16, 25, 21, 21, 23, 18, 24, 22, 18, 22, 19, 17, 21, 20, and 19.

Let's perform some statistical computations using these data.

Press STAT and highlight CALC

```

2ND [STAT] CALC TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg
  
```

Choose option 1 for 1-variable statistics, and indicate L_1

```

sum(Ls)      339.2848
ClrList L1,L2
Done
1-Var Stats L1
  
```

Now press ENTER, and the first of two screens full of information appears.

```

1-Var Stats
 $\bar{x}$ =20.09090909
 $\Sigma x$ =442
 $\Sigma x^2$ =9040
 $S_x$ =2.758693461
 $\sigma_x$ =2.695266742
↓n=22

```

Of course, our numbers in class will probably be quite different from what appears here. For your information, \bar{x} is the symbol for the mean (what you normally think of as the "average" of a group of data). S_x and σ_x are the sample and population standard deviations (something that is taught in a statistics course--and very messy to figure out if you're doing this without a calculator). Finally, n is the number of data values we have in our list.

Now use the down arrow key to see the rest of the statistical results.

```

1-Var Stats
↑n=22
minX=15
Q1=18
Med=20
Q3=22
maxX=25

```

Again, our numbers in class will probably be quite different. On this screen minX indicates the smallest data value, maxX is the largest, Med is the median value (that is the middle value), and Q_1 and Q_3 are quartiles. These are the locations of the 1/4 and 3/4 points for the data.

How can I display a graph of my data? In particular, how do I create a histogram or bar chart?

First of all, press Y= and turn off or clear out any equations you already might have.

```

Plot1 Plot2 Plot3
\Y1=
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=

```


Now we are ready to make Plot 1 a bar chart.

Press 2nd Y= for STAT PLOT.

```

STAT PLOTS
1:Plot1...Off
  L2  L1  ▢
2:Plot2...Off
  L4  RESID ▢
3:Plot3...Off
  INC RESID ▢
4↓PlotsOff
  
```

Choose option 1, and start to make the necessary changes.

```

Plot1 Plot2 Plot3
On Off Off
Type: ▢ ▢ ▢
Xlist:L2
Ylist:L1
Mark: ▢ + .
  
```

Turn the plot On, choose the bar chart icon, make Xlist L1, and Freq 1.

```

Plot1 Plot2 Plot3
On Off Off
Type: ▢ ▢ ▢
Xlist:L1
Freq:1
  
```

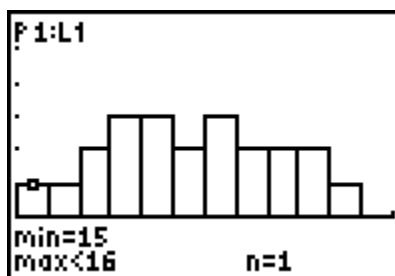
We might need to spend some time changing the dimensions of our window, but the calculator can do some of this for you! Specifically, choice 9 under the ZOOM key automatically adjusts the horizontal scale for you.

Select Zoom 9 for ZoomStat

```

ZOOM MEMORY
3↑Zoom Out
4:ZDecimal
5:ZSquare
6:ZStandard
7:ZTrig
8:ZInteger
9↓ZoomStat
  
```

And press TRACE and the arrow keys to read the graph values.



Of course, we could use the WINDOW key to make some adjustments that we like better--and we'll experiment with this a bit together.

```

WINDOW
Xmin=15
Xmax=27
Xscl=1
Ymin=-1.50345
Ymax=5.85
Yscl=1
Xres=1
  
```

Note: Xscl controls the widths of the bars.

Warning: Sometimes, if the values of Xmin and Xmax are very far apart (over 95 times as large as Xscl is), you can get a very bothersome and confusing error message when you try to draw the bar chart!

Now let's look at some more data with a different kind of chocolate chip cookie. Either we will actually gather some data from real cookies or we will simply use the data set: 6, 10, 11, 12, 14, 10, 9, 7, 10, 14, 12, 12, 9, 13, 12, 10, 7, 11, 9, 8, 11, and 13.

```

30000 CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor

```

L1	L2	L3
23	6	
25	10	
18	11	
18	12	
17	14	
19	10	
23	6	
L2(10)=9		

We want to calculate statistical averages, standard deviations, etc. for this new data. We can proceed just like we did before.

Press STAT, CALC, Choice 1 (for 1-Var Stats), but this time enter L₂.

```

EDIT 00000 TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg

```

```

1-Var Stats
n=22
minX=15
Q1=18
Med=20
Q3=22
maxX=25
1-Var Stats L2

```

And again, we can look at these values and use the down key appropriately to see all of the values.

What other type of graph is available for single-variable data?
What in the world is a box-and-whiskers plot anyway?

Let's change the graph we made earlier to a box-and-whiskers plot (or, more simply, a box plot).

Of course, we are going to need to change the settings we selected before when we set up the bar graph.

Press 2nd Y= for
STAT PLOT

Choose Plot 1

And change the set-up
appropriately.

```

STAT PLOTS
1:Plot1...On
  L1 1
2:Plot2...Off
  L4 RESID
3:Plot3...Off
  INC RESID
4:PlotsOff
  
```

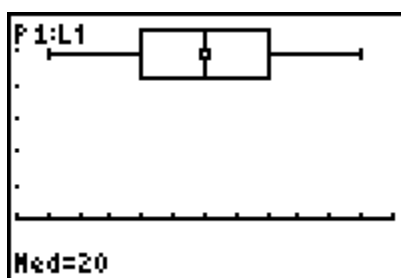
```

Plot1 Plot2 Plot3
Off Off
Type: [L1] [L2] [L3]
      [L4] [L5] [L6]
Xlist:L1
Freq:1
  
```

```

Plot1 Plot2 Plot3
Off Off
Type: [L1] [L2] [L3]
      [L4] [L5] [L6]
Xlist:L1
Freq:1
  
```

Our old window setting might not be appropriate anymore, so use ZOOM 9 to produce the graph.



Try pressing the TRACE key and use the arrow keys to see what is going on here!

Now, let's also get a box-plot for the data in the second list, L_2 , and look at it at the same time!

Press 2nd Y= for
STAT PLOT

Choose Plot 2, and change its set-up: Turn it
On, make its type a box plot, and make Xlist
correspond to L_2 .

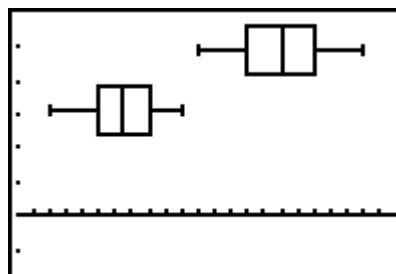
```

STAT PLOTS
1:Plot1...On
  L1 1
2:Plot2...Off
  L4 RESID
3:Plot3...Off
  INC RESID
4:PlotsOff
  
```

```

Plot1 Plot2 Plot3
Off Off
Type: [L1] [L2] [L3]
      [L4] [L5] [L6]
Xlist:L2
Freq:1
  
```

Your graphs will look similar to this:



How do I turn off these statistical plots? Otherwise, they'll keep interfering with other graphs I need to work on in my other classes!

One more time, press 2nd Y= for the STAT PLOT options. In particular, notice option 4. This is PlotsOff.

```

STAT PLOTS
1:Plot1...On
  L1 1
2:Plot2...On
  L2 1
3:Plot3...Off
  INC RESID
4:PlotsOff

```

Select this option, and press ENTER.

```

minX=6
Q1=9
Med=10.5
Q3=12
maxX=14
PlotsOff
Done

```

As soon as the word *Done* appears on the screen, all of your plots have been turned off. (For what it's worth, STAT PLOT option 5 will turn all of the statistical plots back on--we have not made use of that key in this session.)

One Variable Statistics Practice

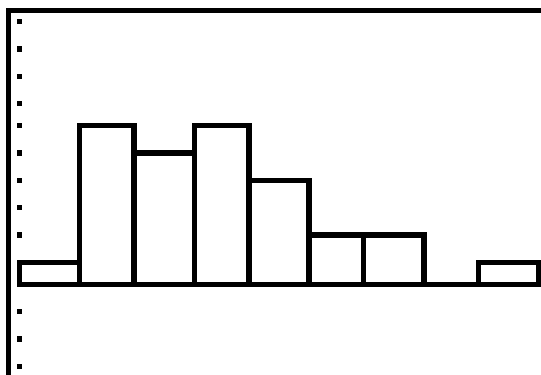
(The first problem given below is taken from *Elementary Statistics*, 5th edition, by Mario Triola, Addison Wesley Publishing, pp. 62 #12. Answers are provided at the end of this sheet.)

The following are ages of motorcyclists when they were fatally injured in traffic accidents (based on data from the U. S. Department of Transportation).

17	38	27	14	18	34	16	42	28
24	40	20	23	31	37	21	30	25
17	28	33	25	23	19	51	18	29

1. Enter this data into list L_1 of your calculator. Then use the STAT key to calculate the one-variable statistics for these data, in particular finding:
 - a) the mean age (remember, this is shown as \bar{x})
 - b) the median age
 - c) the sample standard deviation of the ages (given by S_x)
 - d) the population standard deviation of the ages (given by σ_x)
 - e) the age below which 3/4 of the data fall (given by Q_3)

2. Create a histogram (or bar chart) using STAT PLOT. In particular, try using ZOOM9 first, and then use your WINDOW key to start off the ages with Xmin equal to 10 years of age, Xmax equal to 55, and make the class width of 5 years (which you can do by letting Xscl = 5). Your graph should look something like the following. (You would need to play around with Ymin, and Ymax to make it look "exactly" like this.)



- a) Use trace to find the height of the second bar from the left. This is the number of motorcyclists between the ages of 15 and 20.)
 - b) Continue to use trace to find the number of motorcyclists between 35 and 40 years of age.
3. Now draw a box-and-whiskers plot (or a box plot) using STAT PLOT. Once this is done, decide which end (the left or the right) has the longest "whisker" sticking out!

This next problem will also be our starting point in the paired-data investigation that follows these practice problems!

We have decided to follow the weight reduction program of eleven individuals who have enrolled in a diet and nutrition program. The following table is a summary of the original weights and final weights of these persons while enrolled in the diet regimen.

Original Weight	Final Weight
210	194
196	186
193	184
115	113
127	120
163	151
185	161
200	188
165	159
173	163
168	161

Use the STAT key to create three lists from this data. Put the original weights in list L_1 , put the final weights in list L_2 , and use the computing capability of the calculator to put the weight losses in list L_3 .

4. Use the STAT key to calculate the one-variable statistics for the original weights in list L_1 . What is the mean of the original weights?
5. Now find the mean of the final weights in list L_2 .

6. Find the mean of the weight losses in list L_3 .
7. Is the mean of the original weights minus the mean of the final weights equal to the mean of the weight losses?

ANSWERS!

1.
 - a) mean = 26.96296296 years
 - b) median = 25 years
 - c) sample standard deviation = 9.108244285 years
 - d) population standard deviation = 8.937981716 years
 - e) $Q_3 = 33$ years
2.
 - a) 6 persons
 - b) 2 persons
3. The right whisker is longer
4. 172.2727273 pounds
5. 161.8181818 pounds
6. 10.45454545 pounds
7. Yes

Dealing With Paired Data

Two-variable Statistics

**How can I plot data that comes from paired data--
two sets of closely related information?**

We have decided to follow the weight reduction program of eleven individuals who have enrolled in a diet and nutrition program. The following table is a summary of the original weights and final weights of these persons while enrolled in the diet regimen.

Original Weight	Final Weight
210	194
196	186
193	184
115	113
127	120
163	151
185	161
200	188
165	159
173	163
168	161

Use the STAT key to create three lists from this data. Put the original weights in list L_1 , put the final weights in list L_2 , and use the computing capability of the calculator to put the weight losses in list L_3 . (That is, highlight L_3 , type in the formula $L_1 - L_2$, and press ENTER.)

Your calculator should now show the following:

L1	L2	L3	1
210	194	16	
196	186	10	
193	184	9	
115	113	2	
127	120	7	
163	151	12	
185	161	24	
L1(1)=210			

How do I create a scatter plot of the data?

I would like to compare the original weights (scaled along the x-axis) and the weigh losses (scaled along the y-axis). Let's perform the following steps:

Press 2nd Y= to trigger
STAT PLOT

Select Plot 1

Set up choices: Turn the plot
On, select the Scatter Plot,
and graph L_1 versus L_3 .

```

STAT PLOTS
1:Plot1...Off
  L1 1
2:Plot2...Off
  L2 1
3:Plot3...Off
  INC RESID
4:PlotsOff
  
```

```

2nd Y= Plot2 Plot3
On Off
Type: [Scatter] [Line] [Bar]
Xlist:L1
Freq:1
  
```

```

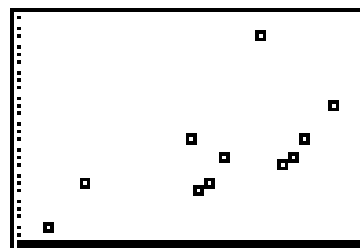
2nd Y= Plot2 Plot3
On Off
Type: [Scatter] [Line] [Bar]
Xlist:L1
Ylist:L3
Mark: [Scatter]
  
```

Now Select ZOOM 9
for ZoomStat

And examine the Scatter Plot.
You might want to try the TRACE.

```

ZOOM MEMORY
3:Zoom Out
4:ZDecimal
5:ZSquare
6:ZStandard
7:ZTrig
8:ZInteger
9:ZoomStat
  
```



How do I find a regression line that fits through this data?

Since some of you are not familiar with the idea of regression, a few "casual" comments are called for. Sometimes we are convinced that paired data shows a strong enough trend to indicate a relationship that might be linear, quadratic, exponential, or some other standard type of curve. What we will be looking for is three things:

- 1) How do I produce the best fitting line (or parabola, or.....)
- 2) How do I use the value of r the calculator provides to judge the fit?
- 3) How do I "paste" in the equation and sketch it along with the data?

First press CATALOG (2nd 0), press the D key (the x^{-1}), arrow down to DiagnosticOn, and press ENTER twice so *Done* appears.

Press STAT, highlight CALC, and choose option 4 (or option 9) for Linear Regression

Indicate clearly that we want L_1 , L_3

```

EDIT  [F1] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
  
```

```

LinReg(ax+b) L1,
L3
  
```

Once this is entered, you will see the regression information. For our data, the regression line $y = ax + b$ is $y = .1196077221x - 10.15060303$ and r is .6126370243. The closer r is to 1 or to -1, the better the fit.

```

LinReg
y=ax+b
a=.1196077221
b=-10.15060303
r²=.3753241236
r=.6126370243
  
```

How do I automatically "paste" this regression equation into the Y= screen? I don't feel like writing this mess down and then typing it in!

Method 1:

Press Y= and, if necessary, clear out any equations

Press the VARS key, and choose option 5 for Statistics

```

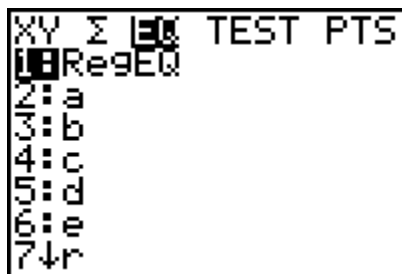
Y1= Plot2 Plot3
Y1=
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
  
```

```

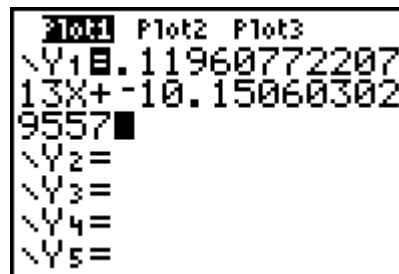
VARS Y-VARS
1:Window...
2:Zoom...
3:GDB...
4:Picture...
5:Statistics...
6:Table...
7:String...
  
```

Now we want to select the regression equation we calculated earlier.

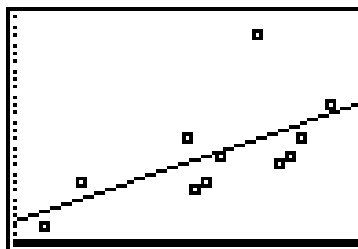
Highlight EQ to get to equation options and choose option 1 for the regression equation



The equation is pasted into Y_1 .



Of course, if we now press the GRAPH key, we get a picture of the scatter plot and the least squares regression line.



Method 2: The calculator would have put the equation automatically into Y_1 earlier if, when we looked for the linear regression capability, we used STAT CALC to put in the LinReg (ax + b) option as above, but instead listed it as LinReg(ax + b) L_1 , L_2 , Y_1 thus asking for equation Y_1 right away. This Y_1 can be found under VARS YVARS 1: FUNCTION 1: Y_1

What if the trend doesn't appear to be a straight line?

We are going to throw a ball in the air from the roof of a building. We are able to measure the height of the ball above the ground at half-second time intervals, and we obtain the following data:

Time (in seconds)	Height (in feet)
0.5	270
1	280
1.5	275
2	270
2.5	250
3	225

Clear out your lists, and put these times in L_1 and heights in L_2 .

Here is the data

L1	L2	L3	2
.5	270	-----	
1	280		
1.5	275		
2	270		
2.5	250		
3	225		

L2(7) =			

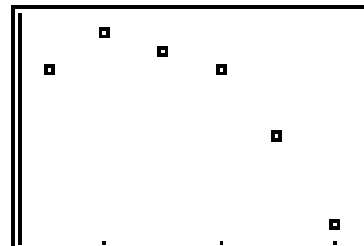
Press 2nd Y= for STAT
PLOT and adjust L_2

```

PLOT1 Plot2 Plot3
OF Off
Type: [ ] [ ] [ ]
      [ ] [ ] [ ]
Xlist:L1
Ylist:L2
Mark: [ ] + .

```

Choose ZOOM 9



These points really do not seem to lie along a straight line . . . nor does the trend seem linear. However, we could proceed as before and find the linear regression line.

Choose STAT, highlight CALC, and choose option 4 for linear regression

```

EDIT [ ] [ ] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg

```

Clearly indicate L_1 , L_2 as the lists used in this regression.

```

LinReg(ax+b) L1,
L2

```

Press ENTER to get the equation.

Choose Y= and clear out the old equation.

Select VARS and highlight 5: Statistics.

Highlight EQ and select 1 for the regression equation.

This will paste the equation into Y_1 .

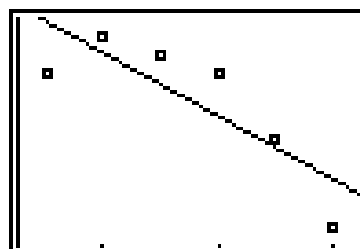
Finally, press GRAPH (possibly with ZOOM 9 first)

The line really doesn't fit very well.

```

Y1 [-] -18.285714285
714X+293.6666666
6667 [-]
Y2=
Y3=
Y4=
Y5=
Y6=

```



The original scatter plot suggests that a quadratic curve (a parabola) might be a better fit. Let's try that!

Press STAT, highlight CALC, and choose 5 for Quadratic Regression. Indicate L_1, L_2 for our two lists and press ENTER

```

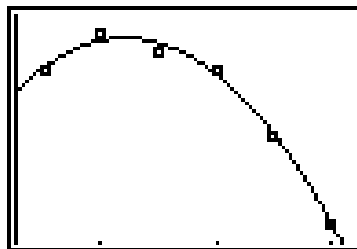
EDIT  [2ND] [F5] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
  
```

Paste the equation into Y_1 . That is, press Y=, CLEAR the old equation, select VARS, select 5: Statistics, highlight EQ, and select 1: RegEQ

```

[2ND] [F1] Plot2 Plot3
\Y1 [-16.78571428
5715X^2+40.46428
5714288X+254.5
\Y2=
\Y3=
\Y4=
\Y5=
  
```

Finally, press GRAPH. Notice how much better this quadratic curve fits the data. Notice that the equation we obtained was $y = -16.79x^2 + 40.46x + 254.5$



How can I use the regression equation to make predictions?

How far above the ground will the ball be after 3.5 seconds? What I need to do is evaluate the y_1 function when $x = 3.5$ seconds. I must find $Y_1(3.5)$.

Press VARS and arrow right to get Y-VARS. Select option 1: Function

Select 1 for the Y_1 function.

Type in (3.5) and press ENTER. You should get 190.5 feet. Try 4.5 seconds.

```

VARS [2ND] [F5]
1:Function...
2:Parametric...
3:Polar...
4:On/Off...
  
```

```

FUNCTION
1:Y1
2:Y2
3:Y3
4:Y4
5:Y5
6:Y6
7↓Y7
  
```

```

a=-16.78571429
b=40.46428571
c=254.5
R^2=.9938895089
Y1(3.5)
190.5
  
```

Another Example

Projecting the Price of 4-Year-Old Used Car

The average price of 4-year-old used cars is given below for a six-year time span:

YEAR	PRICE (\$)
1993	3380
1994	3850
1995	4300
1996	4610
1997	4950
1998	5200

We want to use this information to find a regression line of best fit and forecast the price of a 4-year-old car in the year 2003.

1. Clear all equations out of the Y= options and delete all current lists.
2. Enter the car data into L₁ and L₂ using the STAT EDIT options. QUIT from the STAT screen.
3. Use the STAT, CALC choices to get to the option 4 regression line. (If you have done this correctly, you should now see that the value of $r = .9936244488$, which is very close to 1. The fit between the data and the line is very, very good.) As we did earlier, store this equation as equation Y₁ (going to Y= and using VARS, choice 5, EQ, choice 1). Be sure that STAT PLOT 1 is the desired scatter plot, and then ZOOM 9 to see the regression line.
4. We want to project the data to predict the estimated cost of a 4-year-old used car in the year 2003. That is, we want to evaluate Y₁(2003). To do this:
 - a) Choose VARS, highlight Y-VARS, select the first option for FUNCTIONS, and again the first option for Y₁.
 - b) Now finish out the function by typing (2003). Once Y₁(2003) appears on the home screen, press ENTER and the predicted value of \$7105 should appear.

5. Somebody suggests that a quadratic regression might be a better fit! Try this! That is, go back to STAT, CALC to get to the option 5 QuadReg. Notice that the r-value is even greater at .9993680627.

Now go back to the Y= key, clear out the old regression equation we had before, and store the new equation as Y_1 (using VARS, choice 5, etc.). Finally, graph this curve against your scatter plot. You will find that this appears to be a better fit than the line.

If you try to re-estimate the cost in the year 2003, you should discover that $Y_1(2003)$ now predicts \$5639.

Time could be spent in a statistics course discussing the big differences between our two predictions--suffice it to say in this calculator course that great care should be taken when projecting and predicting into the future! In fact, if you think about it, you can probably come up with a reason to explain why the quadratic fit is not really appropriate!

One and Two Variable Statistics Practice

The first portion of this homework (questions 1-7) uses the data shown below. You are to put the times into list L_1 in your calculator and the temperatures into list L_2 . Answers to the questions are provided at the end of this sheet.

Time (in minutes)	Temperature (°F)
2	180
4	170
6	162
8	154
10	146
12	139
14	132
16	125
18	119
20	113
22	108
24	102

As a check on column L_2 , you should find that the mean \bar{x} equals 137.5° Fahrenheit.

- For the temperature readings in column L_2 , what is the value of the sample standard deviation S_x which you find by computing one-variable statistics?

Answer:

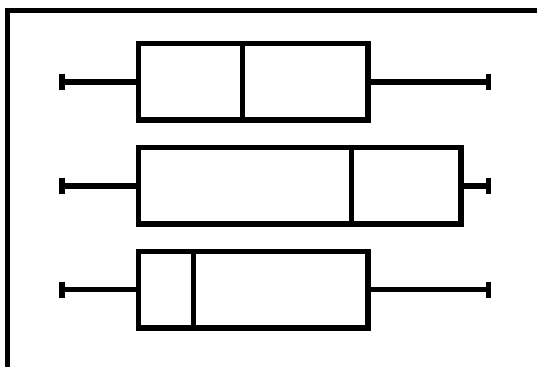
- For the temperature readings, what is the value of the median (Med)?

Answer:

- For the temperature readings, what is the value of the first quartile, Q_1 ?

Answer:

4. Use your calculator to draw a box-plot of the Temperature data in the second column. Which of the three graphs shown below does your graph most closely resemble (circle one)?



5. When objects cool down, as in this example, the regression fit is exponential regression. Use the STAT key to calculate this regression curve. Be sure to arrow down far enough under the CALC options to find choice 0: ExpReg for this problem.

You find that $a =$ _____ $b =$ _____
and $r =$ _____

6. Paste this equation into $Y=$, using the VARS key as we did in class.

Once this is done, use the Y-VARS to predict the temperature of the liquid after 30 minutes. That is, find $Y_1(30)$.

Answer:

7. Go back to STAT and choose EDIT. Highlight column heading L_3 and ask the calculator to compute $50000/(3.6L_1 + L_2)$. Now arrow down through this third column, L_3 . What is the largest value that you find in the list?

Answer:

(Note: The computation you performed in part 7 really is artificial--it doesn't really represent anything at all about cooling. I just wanted to remind you how to perform computations with the various lists of data!)

In the next situation (questions 8 to 11), you are to use the following information. This data represents the loads (in pounds) on a spring along with the corresponding lengths (in inches) that the spring is stretched.

Weight (pounds)	Length (inches)
0	5
1	6
3	8
2	7
6	12

Put the weights into list L_1 and the lengths into list L_2 .

8. Under the STAT, CALC option, choose the second item, 2-Var Stats.

What is the value of \bar{x} , the mean weight? Answer

What is the value of \bar{y} , the mean amount of stretch? Answer

9. Now find the linear regression line (option 4 of the statistical calculations) to determine the following:

value of a = _____ value of b = _____

value of r = _____

10. Paste the equation of this regression line into Y_1 (using $Y=$ and the VARS keys as necessary). Then check to make sure the Stat Plot 1 is turned on to produce a scatter plot of this data. Finally, use Zoom 9 for ZoomStat to produce a graph of the scatter plot and the regression line. (You also might want to go into WINDOW to make some other changes in the y-direction). Does the line seem to fit closely to the plotted data?
11. Finally, estimate the amount of stretch on the spring if a 5 pound weight were attached. That is, find $Y_1(5)$ using VARS, Y-VARS, etc., to estimate this stretch.

Answer:

Answers

1. $25.35027344^{\circ}\text{ F}$
2. 135.5° F
3. 116° F
4. The top plot is correct
5. $a = 188.8906738$ $b = .9746980031$ $r = -.9999272378$
6. $87.56142184^{\circ}\text{ F}$
7. 274.73° F (or, more precisely, $274.725274^{\circ}\text{ F}$)
8. 2.4 pounds, 7.6 inches
9. $a = 1.169811321$ $b = 4.79245283$ $r = .996763955$
10. Yes
11. Approximately 10.6 inches (the calculator says 10.64150943)