

AQA Statistics 1

using a

TI-84 Graphical Calculator

Numerical Measures

Your calculator can do most of the calculations you need to for this chapter. But first you need to enter the data...

Raw data

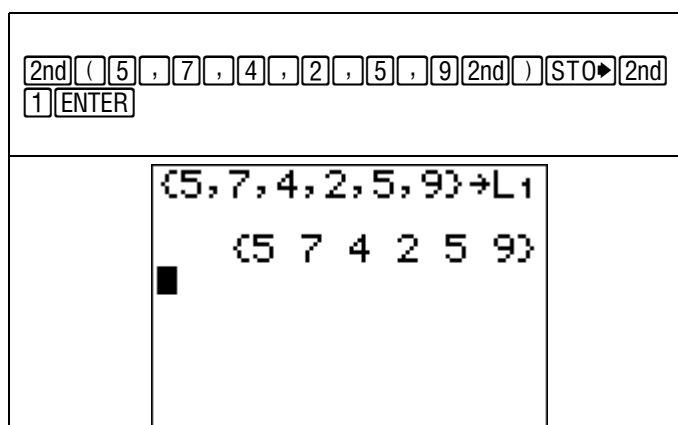
Suppose you are given the following list of raw data

- 5, 7, 4, 2, 5, 6, 9.

There are six lists you could store it in, named L1 to L6. The easiest way to access L1 is to press **2nd** then the **1** key. Suppose you want to store this data in list L1. There are two ways to do it

Entering directly

You need to enter the data, surrounded by curly braces { } and separated by commas, then store it in list L1.



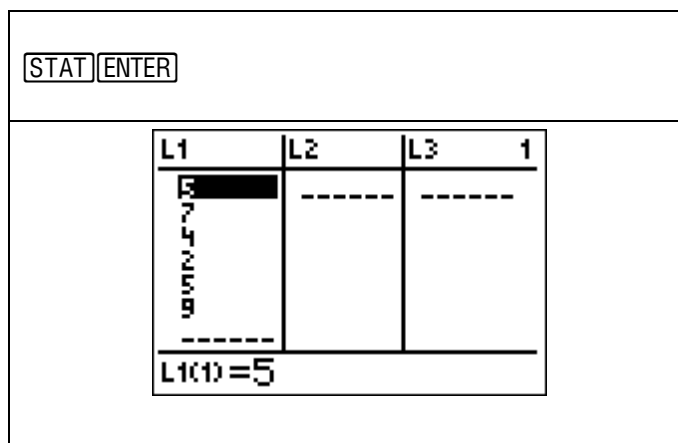
Entering in the Stat List Editor

To get to the Stat List editor, press **STAT** then choose **1:Edit**.

Once there you can use the cursor keys to move around and enter your data.

To clear a list, move to the heading row and press **CLEAR**

Make sure you return to the main screen after you've finished.



Now you are ready to calculate...

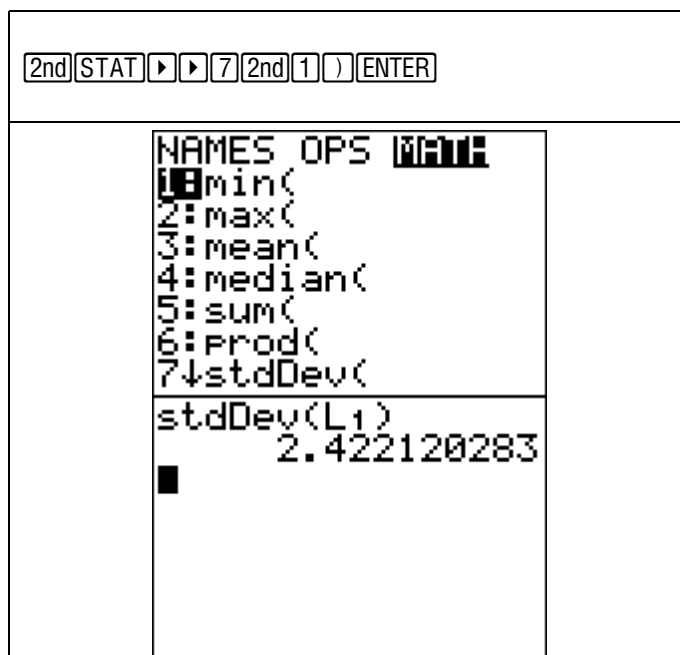
Using the LIST menu

Go to the LIST menu, then choose the MATH menu.

Choose which statistic you require, either by using the cursor keys or choosing its number.

Then tell the calculator which list your data is stored in.

Note – this calculates the *sample* standard deviation and variance.



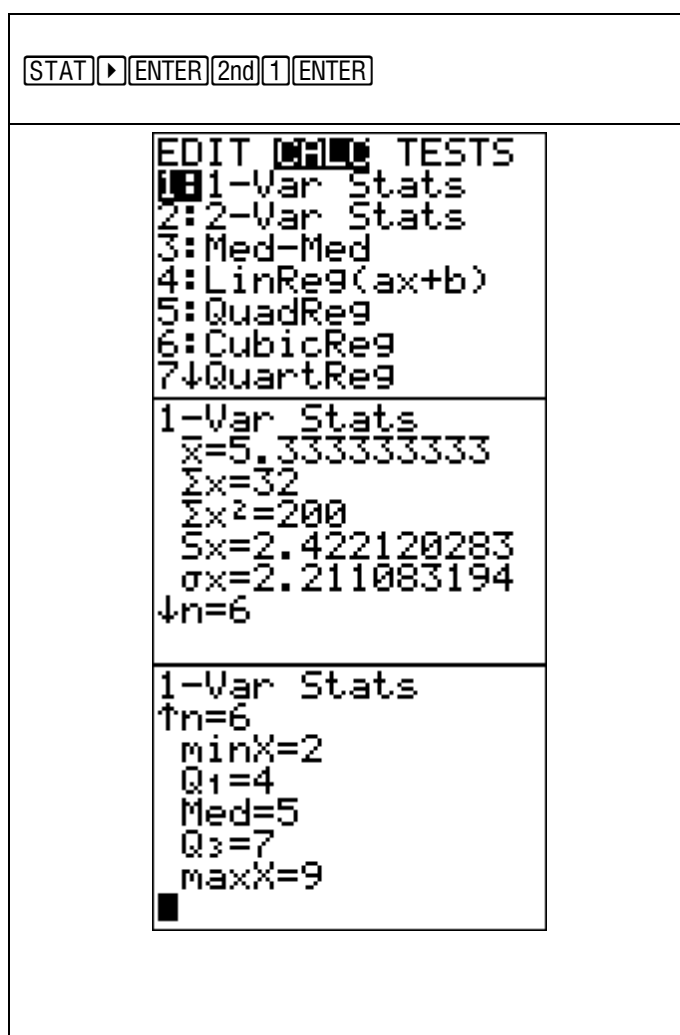
1-Var Stats

In the STAT menu, choose CALC. You are calculating statistics of one variable, so choose 1-Var Stats.

Tell the calculator which list your data is in – you don't need brackets this time.

You are now shown just about everything you might need. Use the cursor keys to move down the list.

\bar{x}	mean
Σx	sum
Σx^2	sum of the squares
S_x	<i>sample</i> standard deviation
σ_x	<i>population</i> standard deviation
n	number of items of data
$\min X$	minimum value
Q_1	lower quartile
Med	median
Q_3	upper quartile
$\max X$	maximum value



Data in Frequency Tables

If your data is presented in a frequency table, this is no problem. For example, suppose you wanted to calculate statistics for the data shown in the table.

x	1	2	3	4
f	12	35	22	19

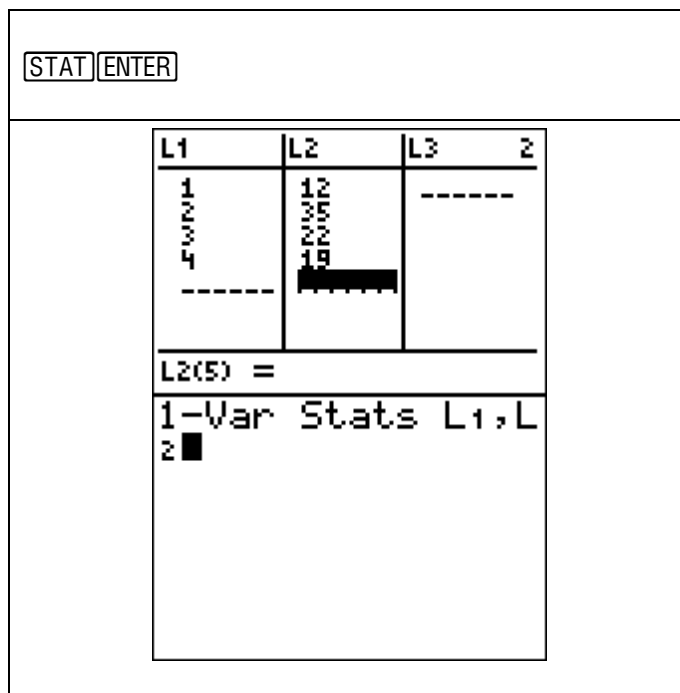
Entering the data

It's easiest to use the Stat List Editor.

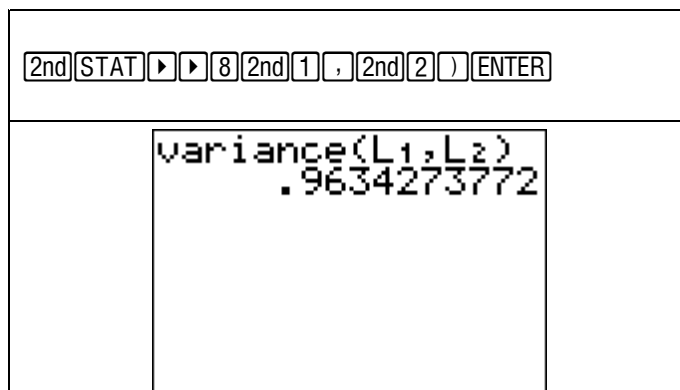
Enter the variables in one list, say L1, and the frequencies in the next list, say L2.

Don't forget to quit back to the main screen.

Then choose 1-Var Stats again, but this time you need to say where the frequencies are, so enter L2 after the L1, separated by a comma.



You could also use the LIST menu, particularly if you require the variance. You just need to tell it which list holds the frequencies again.



Grouped Data

For grouped data, you will need to enter the mid-interval values in the first list, then proceed as above.

WARNING – the values for $\min X$, $\max X$, the median and quartiles are not valid when you do this!!!

Binomial Distribution

Your calculator will easily work out both binomial probability distributions and cumulative distributions. They are both in the Distribution (DISTR) menu, which you get to by pressing **2nd****[VARS]**.

Binomial probability distribution function

For example, suppose you had to work out this problem

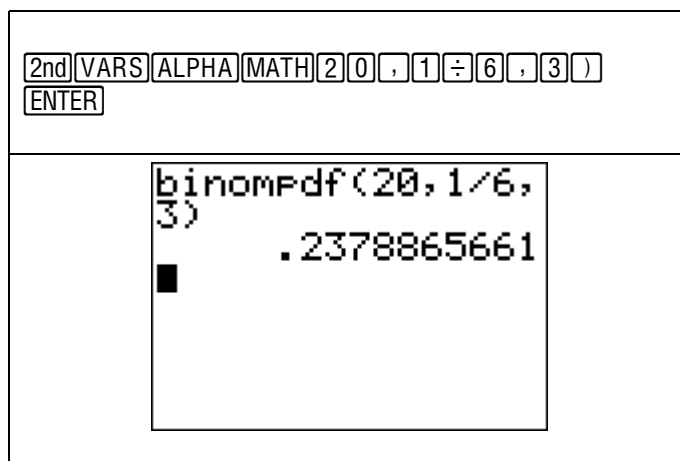
- Find the probability of getting exactly 3 sixes when you throw a die 20 times.

If random variable X is the number of heads, then $X \sim B(20, \frac{1}{6})$ and we want to find $P(X = 3)$.

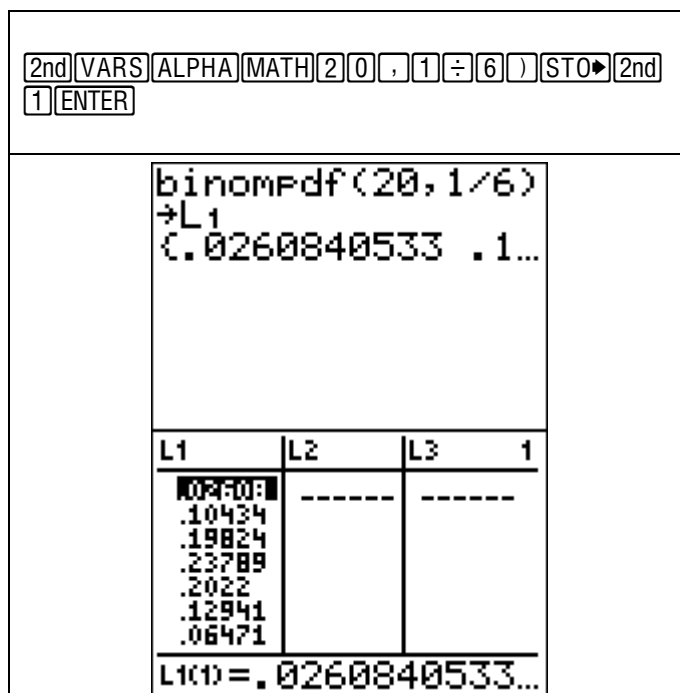
Choose **A:binompdf** from the list of distributions. (If you have a TI-83, it's option 0).

To select it you can either use the arrow keys, or enter **A** using the **[ALPHA]** key.

Notice we have entered $20, \frac{1}{6}, 3$ in the brackets, because we wanted 3 successes.



If you don't put in the 3, you will get a list of all the possible probabilities which you can store in **L1**. This can sometimes be useful.



Binomial cumulative distribution function

Rather than using the book of tables, you could use your calculator. Suppose you had to work this out

- Find the probability of getting 3 sixes or less when you throw a die 20 times.

This time we are trying to find $P(X \leq 3)$.

We need the cumulative binomial distribution, which is B:binomcdf in the list of distributions.

Apart from that it is exactly as before.

Notice we've entered 20, $\frac{1}{6}$, 3 in the brackets, because we wanted 3 successes.

2nd VARS ALPHA APPS 20 , 1 ÷ 6 , 3)
ENTER

binomcdf(20,1/6,
3)
.5665456388

As before, if you don't put in the 3, you will get all the cumulative probabilities which you can store in a list.

This is exactly the same as the list in your book of tables.

2nd VARS ALPHA APPS 20 , 1 ÷ 6) STO► 2nd
1 ENTER STAT ENTER

L1	L2	L3	1
.02608	-----	-----	
.13042			
.32066			
.56655			
.76875			
.89816			
.96286			

L1(1) = .0260840533...

Normal Distribution

Again, your calculator will save you searching through books of tables. It will also save you standardising to a normal distribution. It is the second option in the DISTR menu, `normalcdf`.

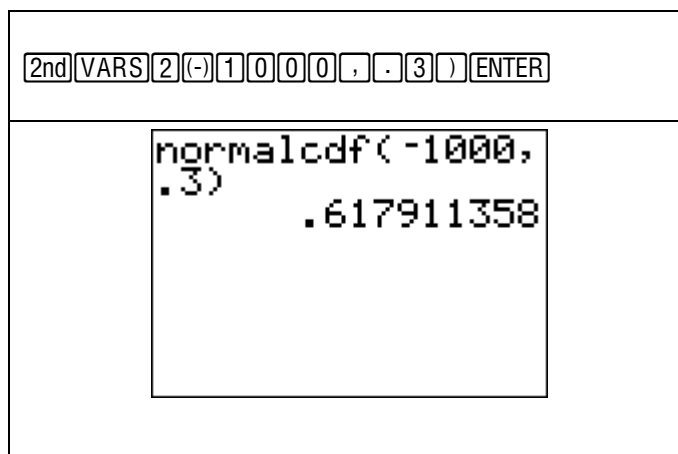
Standard Normal Distribution

This is the one in your book of tables, $Z \sim N(0,1)$. Suppose you were asked to find

- $P(Z < 0.3)$

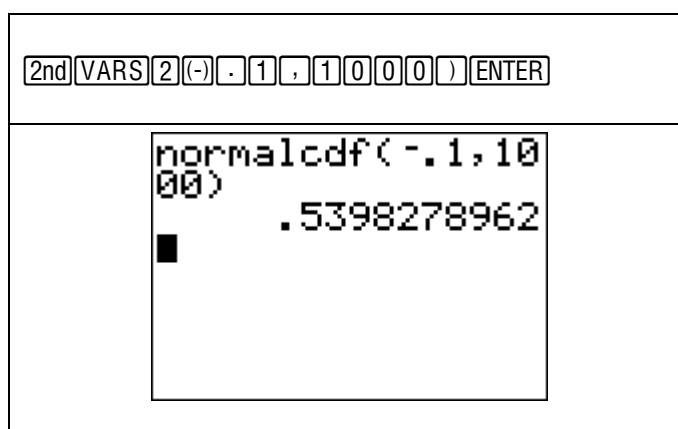
We need to enter the lower and upper limits for the parameters.

Entering a lower limit is a bit of a hassle. Strictly speaking, the lower limit is $-\infty$, but you can't enter this into the calculator. The lowest number you could enter is -10^{99} (as $-1E99$), but you could get away with -1000 .



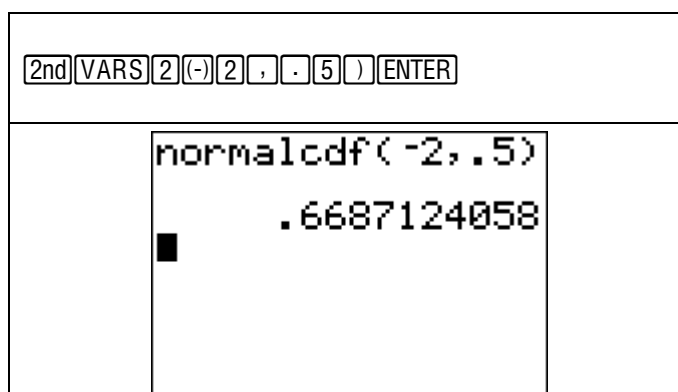
- $P(Z > -0.1)$

Now having to enter both limits starts to help, as you don't have to fiddle around finding the complementary event.



- $P(-2 < Z < 0.5)$

And now putting in limits really pays off!



General Normal Distribution

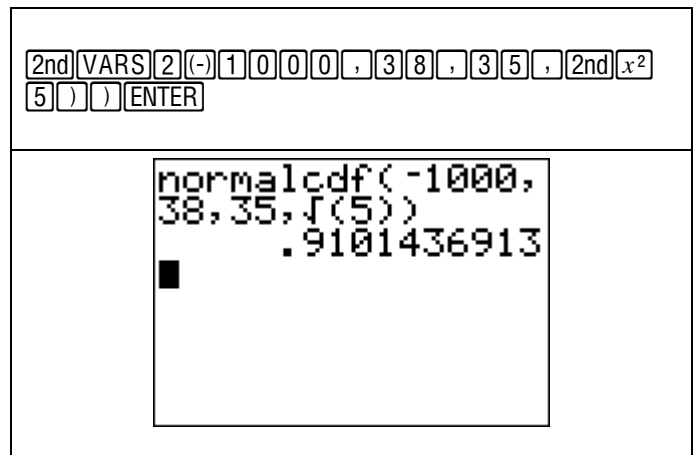
Suppose you are working with a normal distribution with a mean other than 0 and a standard deviation other than 1. If you are using tables, you would need to use linear scaling to standardise it. There is no need for this using the TI-84!!

For example, given that $X \sim N(35, 5)$, find

- $P(X < 38)$

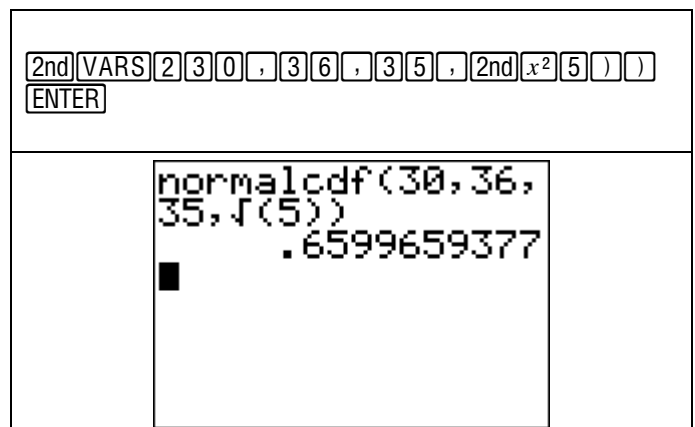
This time we enter two extra parameters after the limits, the mean and the **standard deviation**.

BE VERY CAREFUL!! Notice that above the distribution was given as $N(35, 5)$ and that 5 is the *variance*. But the calculator needs the standard deviation, so we had to enter $\sqrt{5}$.



- $P(30 < X < 36)$

Now having to enter both limits starts to help, as you don't have to fiddle around finding the complementary event.

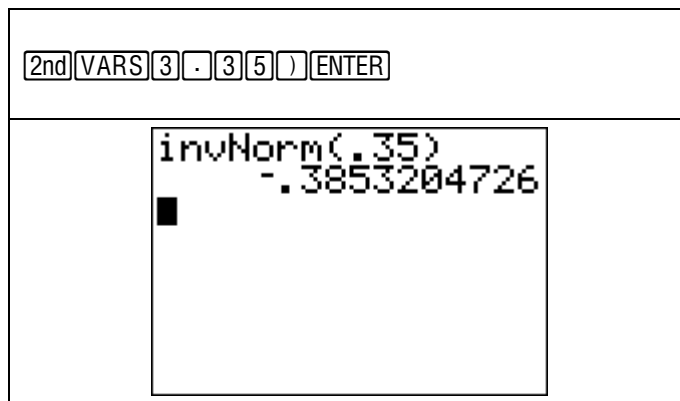


Inverse Normal Distribution

Instead of tables of percentage points, the TI-84 has an inverse normal function which you can use. For example

- Find a such that $P(Z \leq a) = 0.35$.

Again, it is in the DISTR menu, and it is 3: invNorm



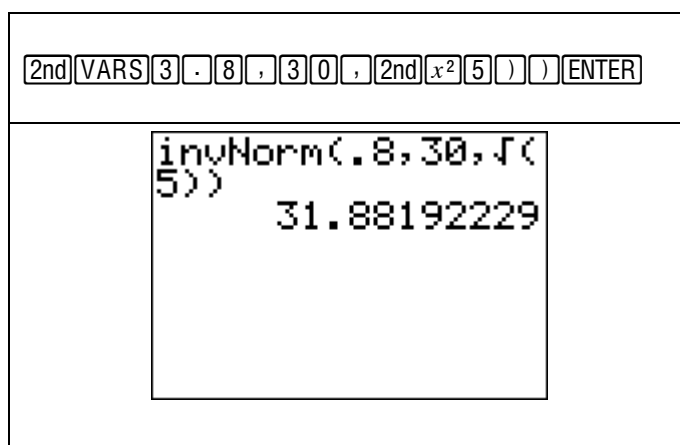
If it is not a standardised Normal distribution, you do not need to scale it. For example

- given that $X \sim N(30, 5)$, find a such that $P(X \leq a) = 0.8$

Notice that probability we are looking for, 0.8, is entered first.

Also, notice again that we have had to enter the **standard deviation**, $\sqrt{5}$, into the calculator, but in the question we were given the **variance**, 5.

WATCH OUT FOR THIS!!!.



Although the calculator takes a lot of the donkey work out of standardising Normal distributions, ***you still need to know how to do it!*** Particularly for the work on confidence intervals and estimation. Make sure you understand it.

Estimation

The TI-84 will can calculate confidence intervals easily. For example

- A random variable X has a normal distribution with a mean of μ and a variance of 20. A random sample of 20 observations on X has a mean of 45.4. Find a 95% symmetric confidence interval for μ .

We need the TEST sub-menu that you get by pressing the **[STAT]** key.

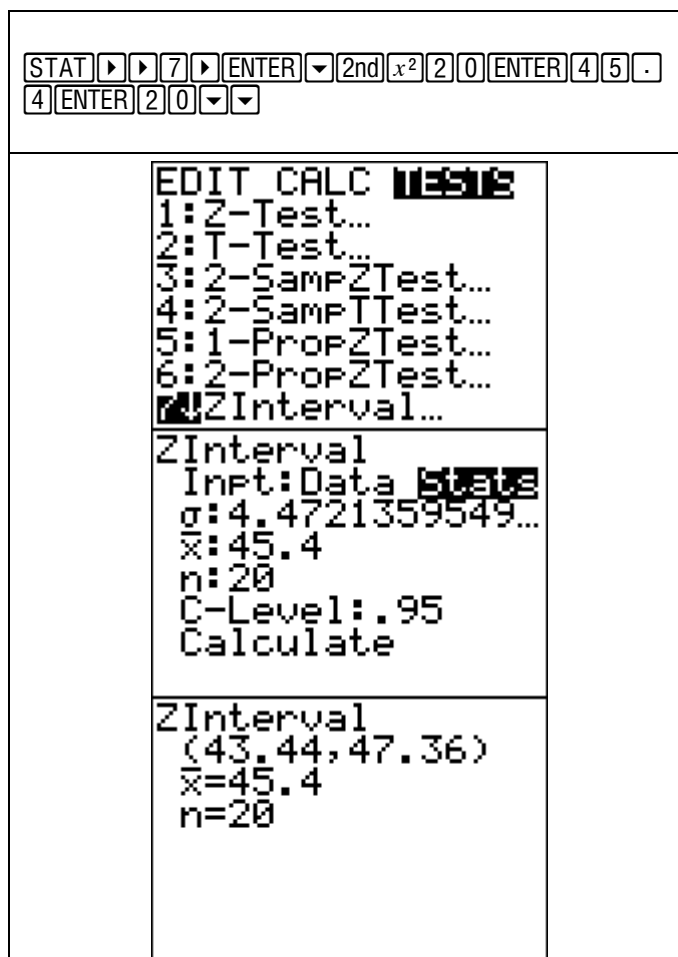
Choose 7:ZInterval

You need to choose the Stats option, as we know the mean of our sample. Then enter the statistics if the correct fields.

WATCH OUT – again, the calculator requires the standard deviation but we have been given the variance. You can enter $\sqrt{20}$ here though.

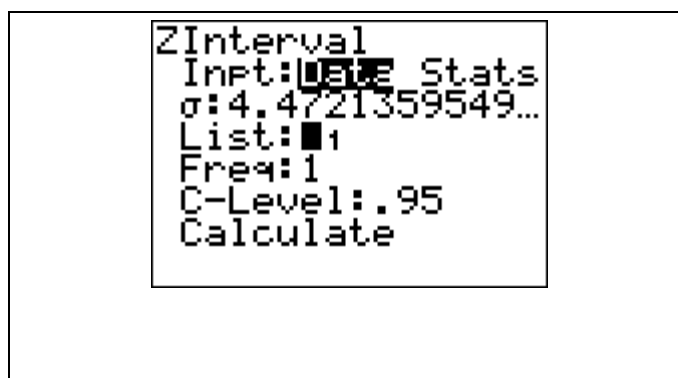
Then, with the cursor on Calculate, press **[ENTER]**.

The confidence interval is given.



If the sample data is stored in a list, you can still calculate a confidence interval by choosing the Data option.

You will need to specify which list contains your data. If the data is in the form of a frequency table, enter which list contains the frequencies. Otherwise leave this as 1.



Correlation and Regression

Again, your calculator will make a lot of the calculations for this topic a lot easier. Let's work with the data given in example 1 in the textbook (chapter 6).

x	65	45	40	55	60	50	80	30	70	65
y	60	60	55	70	80	40	85	50	70	80

Entering the data

We will use the Stat List editor again, storing the x values in L1 and the y values in L2.

When you have entered all the data, return to the main screen.

STAT ENTER

L1	L2	L3	2
60	80		
50	40		
80	85		
30	50		
70	70		
65	80		
-----	-----		
L2(11) =			

2-Var Stats

All of the numbers required for calculating the correlation coefficient are now easily available.

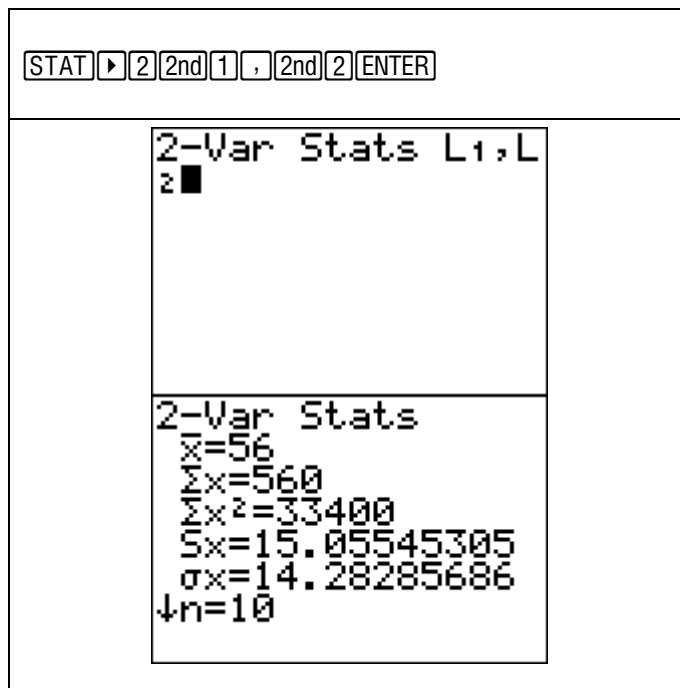
We now have 2 variables, so we use 2-Var Stats from the STATS menu.

Tell the calculator that the x variables are in L1 and the y variables are in L2.

Scrolling down through the list will provide $\sum x$, $\sum y$, $\sum x^2$, $\sum y^2$ and $\sum xy$. It is a good idea to write these down now.

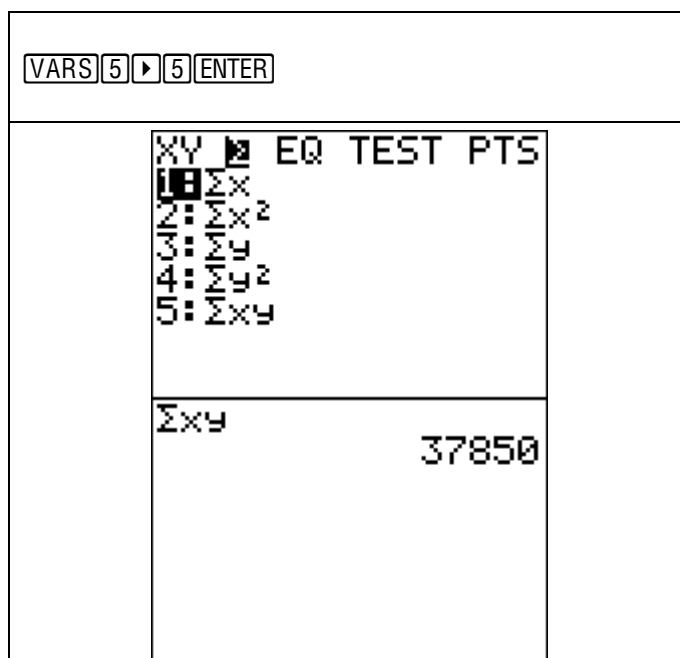
You can use these to calculate S_{xx} , S_{yy} and S_{xy} . With these you can calculate r .

Notice you've also been given the mean and standard deviation for both x and y .



If you want to use any of these variables in a calculation, you can access them directly from the VARS menu, instead of writing them down.

You need to choose 5:Statistics from the VARS menu.



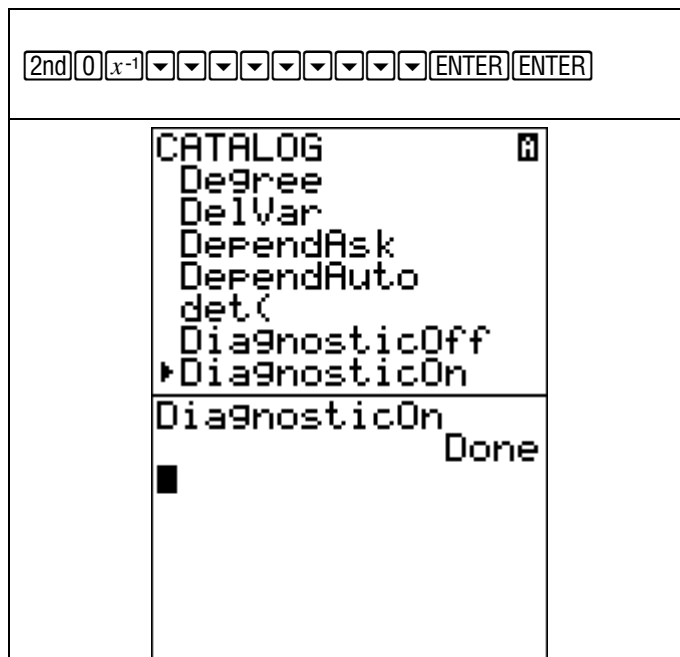
Least Squares Regression Line

The calculator will also calculate the equation of the least squares regression line. In doing so, it will directly calculate r , the product moment correlation coefficient. However, for you to be able to see this, you need to turn the Diagnostics on.

This option is stored in the Catalog.

You can quickly move to the Ds in the catalog by pressing the key with alphabetical D above it, x^{-1} .

You should see a screen like this when you have done.

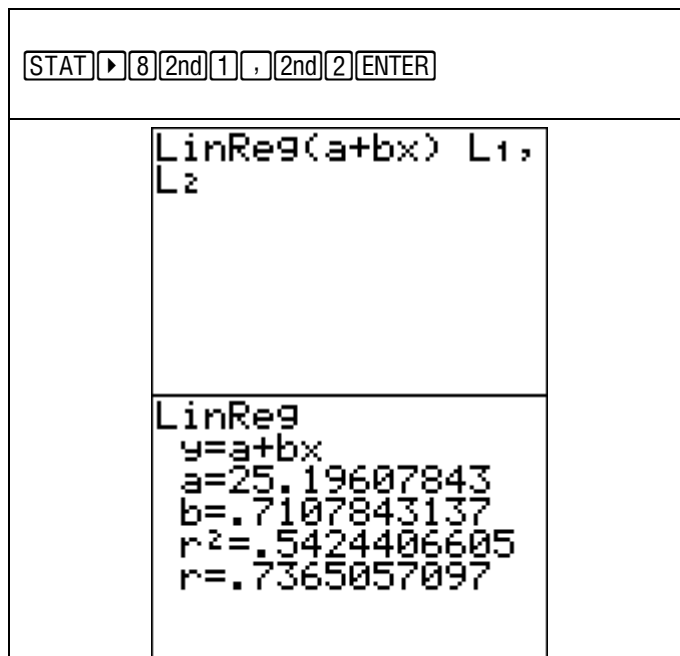


To find the equation of the line of best fit, go to the STAT menu and choose the CALC sub-menu.

There are two options we could use here, either
4:LinReg($ax+b$) or
8:LinReg($a+bx$)

The only difference is which letter, a or b , will give the gradient and which gives the y -intercept. In order to be consistent with the textbook, we shall choose 8. Make sure you don't get muddled up which one you have chosen.

Again, we need to tell the calculator that L1 holds the x values and L2 holds the y values.



Graphing the Data

Drawing a Scatter graph

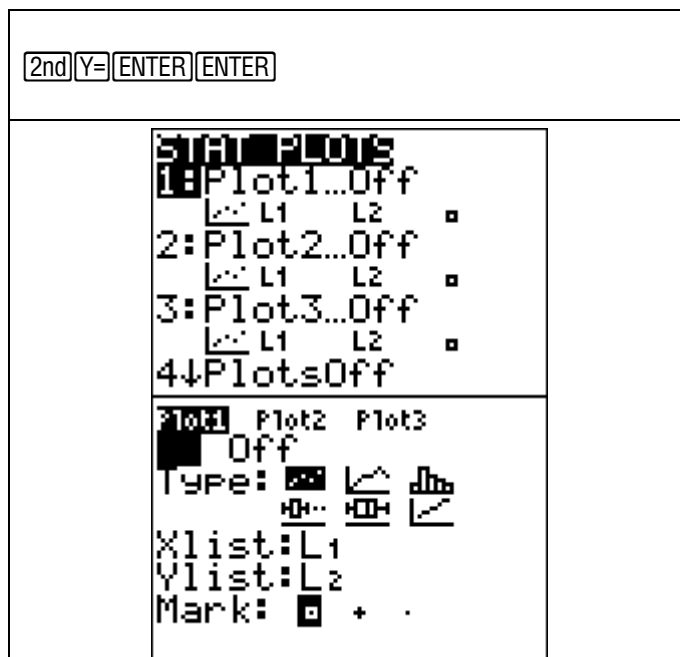
It is fairly straightforward to obtain a scatter graph of your data and on it plot the line of best fit.

First we need to set up the Stat Plots.

Turn Plot1 on by selecting it, and make sure you have a scatter graph selected (first in the list of graph types).

Make sure you have Xlist, where the x values are stored, as L1 and Ylist as L2.

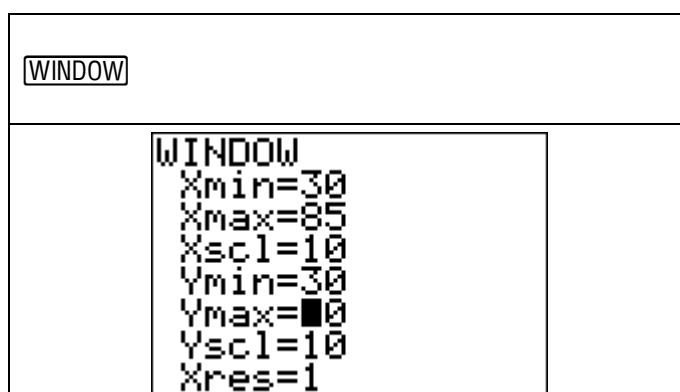
The screen should look like this.



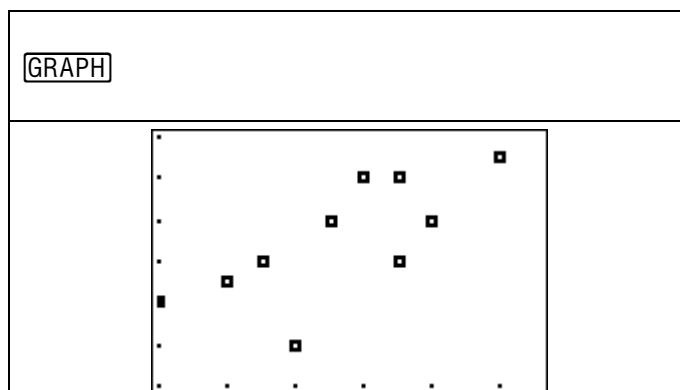
You will probably need to set the axes. You can either do this manually, by pressing **WINDOW** and entering appropriate scales.

Or else press **ZOOM** and choose 9:ZoomStat.

It's often easier to get useful scales by doing it yourself!



Then graph it!



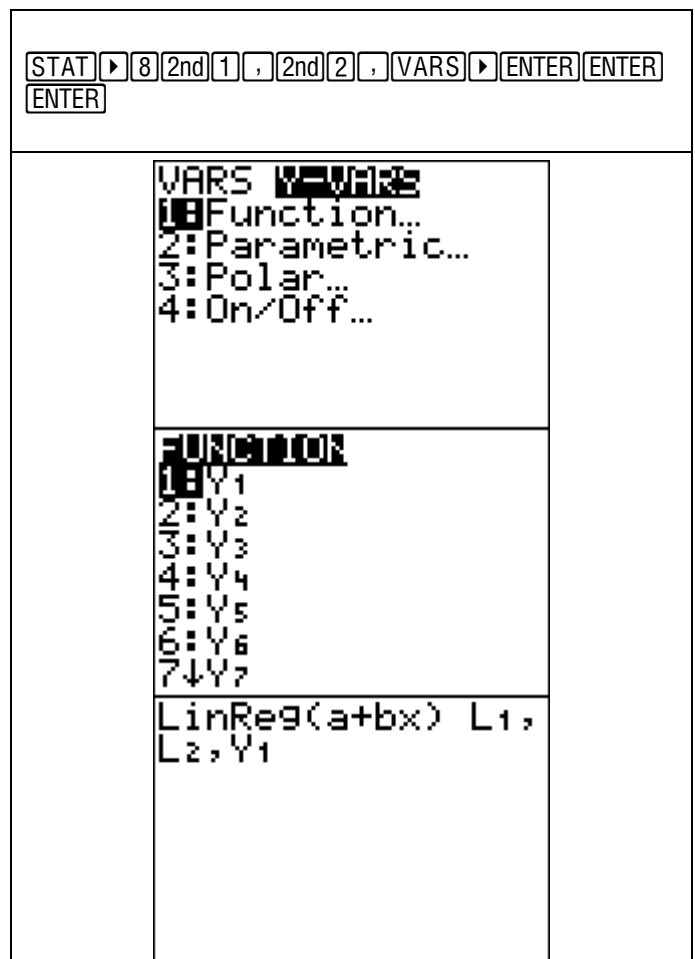
Plotting the Least Squares Regression Line

You can draw the line of best fit onto this by entering it manually as an equation. Alternatively, you can get the calculator to automatically store it as an equation when it is calculated. Here is how...

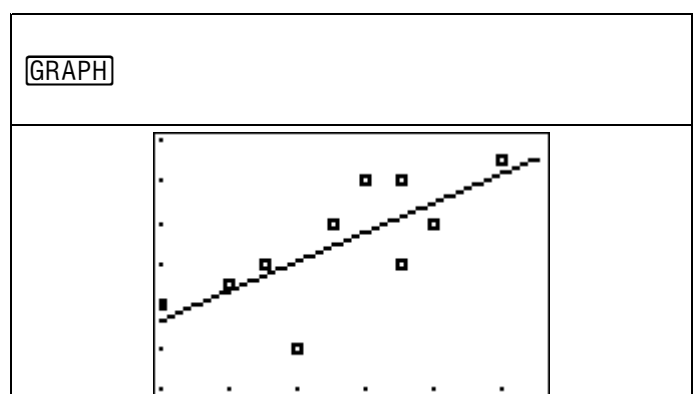
When you tell the calculator to calculate the regression line, after the L1 and L2 tell it to store the equation in Y1.

To get Y1 up, you need to use the VARS menu. Choose Y-VARS, then 1:Function. Choose Y1 (or any other one) from the menu.

Then when you press enter the equation of the line is stored in the formulas. You can check this by pressing $\boxed{Y=}$



Then when you graph it, you will also get the line of best fit.



Residuals

One final thing the calculator can help with is finding residuals. Each residual is calculated and stored in a list called RESID.

You can access this from the LIST menu, but it is easier to work with if you get it into the Stat List editor.

To do this, go to the Stat List editor, and move the cursor to the heading row of L3.

Then go to the list menu and choose RESID. Press ENTER and it will be stored in L3.

You can now read off the residuals for each of the data points.

STAT▶82nd1,2nd2,VARSP▶ENTERENTER
ENTER

L1	L2	3
65	60	-----
45	60	
40	55	
55	70	
60	80	
50	40	
80	85	

L3 =

NAME: OPS MATH
1: L1
2: L2
3: L3
4: L4
5: L5
6: L6
7: RESID

L1	L2	L3	3
65	60		
45	60	2.8186	
40	55	1.3725	
55	70	5.7108	
60	80	12.157	
50	40	-20.74	
80	85	2.9412	

L3()= -11.3970588...