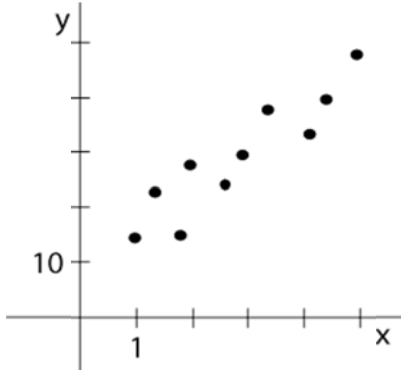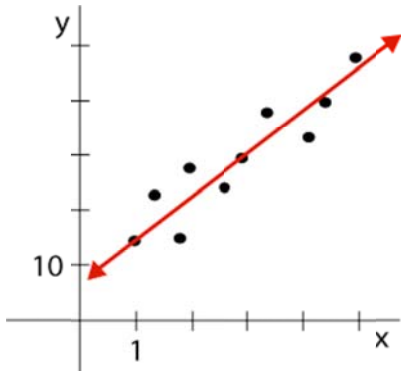**Linear regression on your calculator (TI 82, 83, 84, 85, 86)**   NAME:

Consider the scatter diagram below. Notice there is a general pattern to the points. They kind of follow a linear pattern that slopes up from left to right.

Regression is the art of finding an equation that mimics this pattern. Notice the line superimposed on the graph below basically follows the pattern of the points. This is called a regression line. We will investigate using our calculator to find regression lines.

The table below gives the coordinates of the ten points. We will use our calculator to plot the points and then find the regression line that fits the pattern of points.

x	y
1	14
1.3	22
1.9	14
2	28
2.6	23
3	29
3.5	38
4.2	33
4.5	40
5	48

First, we'll input these points into our calculator.

On the **TI82, 83,** or **84**, press **STAT** (located left of the arrows) and select **EDIT** from that menu. (You want **EDIT** on the top to be highlighted, and select **Edit** from the list.) It should open a table with columns labeled **L1**, **L2**, and **L3**.

> (If your screen does not look like this on the **TI83** or **84**, exit and reenter the **STAT** menu, select **SetUpEditor**. The home screen will read "SetUpEditor". Press **ENTER** so it does it. It will say **DONE** if it does it correctly.
> If your screen does not look like this on the **TI82**, exit and reenter, select **CALC** from the top, and select **SetUp** from there. Under the heading "**2-Var Stats**", you should make sure **L1** is highlighted for **Xlist** and **L2** is highlighted for **Ylist**.)

Enter the *x* values from the table above in the column under **L1**. Enter the *y* values in the column **L2**. If you already have numbers in these columns, you can erase them by moving your cursor all the way to the top until you highlight the **L1** or **L2**, then pressing **CLEAR**. When you move your cursor away, the column will clear.

On the **TI85**, press the **STAT** button (directly right of the **GRAPH** button). Select **EDIT** from this menu. It should say "**xlist Name=xStat**" and "**ylist Name=yStat**". Press **ENTER** twice to accept these default names and enter the screen where you will input the data. If there are points already there, press **F5** for **CLRxy**, which will clear the values. Your cursor should be next to "**x1=**". Enter the first *x* value of the table above, and press **ENTER**. It then goes to the line "**y1=**". Enter the corresponding *y* value here. Press **ENTER** to continue until you have entered all of the points. Notice the subscript of the *x* and *y* coordinates denote which point you are on (first, second, etc).

On the **TI86**, press **2nd**, then the **plus** sign. Notice the second function of the plus sign is **STAT**. Select **EDIT** from this menu. It will open a table with three columns labeled **xStat**, **yStat**, and **fStat**. If there are already numbers in this table, move your cursor so it highlights the column heading (**xStat** or **yStat** or **fStat**) and press **CLEAR**. When you move the cursor, the column will clear. Enter the *x* values from the table above in the **xStat** column and the *y* values in the **yStat** column. Fill the first ten spaces in the **fStat** column with 1's.

Once you enter all of the values, you should quit out of that screen by pressing **2nd**, then **MODE**. Notice the second function of the **MODE** key is **QUIT**.

Now let's draw a scatter plot of these points. We'll need to set up the window so we can see all the points and then tell the calculator to graph them.

On all calculators, set the viewing window to [0, 7] x [0, 60]. I picked these values by looking at the original set of numbers. Since we do not want other unnecessary things graphed, erase all other functions in the **y=** editor.

On the **TI82, 83,** or **84**, press **2nd** then **y=**. Notice the second function of the **y=** button is **STATPLOT**. We'll turn **Plot1** on and tell it what to graph. Select **Plot1** and press **ENTER**. Highlight **On** and press **ENTER**. Under the heading **Type**, make sure the first picture is highlighted (it looks like a little scatter diagram). Make sure it has **L1** for **Xlist** and **L2** for **Ylist**. (If not, on the **TI82**, simply select **L1** and **L2** from the appropriate lists. On the **TI83** or **84**, enter **L1** and **L2** by using the second functions of **1** and **2** in the number pad.) The **Mark** can be set to anything. It is simply the character it will use to plot the points.

On the **TI85**, press the **STAT** button and select **DRAW**. Then select **SCAT**. It will draw the scatter plot. You may want to press **EXIT** once to reduce your menus so you have a clearer view.

On the **TI86**, enter the **STAT** menu again by pressing **2nd** then the **plus** sign. Select **PLOT**. Select **PLOT1** by pressing **F1**. Highlight **On** and press **ENTER**. Make sure it reads "**Xlist Name=xStat**" and "**Ylist Name=yStat**". Exit out of this menu by pressing **EXIT** twice.

On all calculators except the **TI85**, you'll need to press **GRAPH** to see the graph.

Again, notice the pattern of points. We'll find the equation of the (linear) function that mimics this pattern.

On the **TI82, 83,** or **84**, quit to get to the home screen. Press the **STAT** button and move the cursor to the right to select **CALC**. Go down the list and select **LinReg (ax + b)**. This puts that phrase on the home screen. Press **ENTER** to have the calculator calculate the regression line. A line is always in the form $y = ax + b$ where a and b are real numbers, such as $y = 2x + 5$. Round the values of a and b to two decimal places and write the equation in the form $y = ax + b$ (substituting the values for a and b).

Note: On newer **TI84** calculators, you might see an intermediate screen. Here, we can set up a graph (in the line **Store RegEQ:**, enter Y_1 by pressing **VARS** > **Y-VARS** > **Function** > Y_1) and other options. Mostly, the default settings are okay. You just need to scroll down the screen to **Calculate** and press **ENTER**.

On the **TI85**, exit until you get to the home screen. Press **STAT** and then select **CALC**. Press **ENTER** twice to tell it you want to use **xStat** and **yStat**. Then select **LINR** (**F2**) from the resultant menu. This will calculate the regression line. A line is always in the form $y = a + bx$ where a and b are real numbers, such as $y = 5 + 2x$. Round the values of a and b to two decimal places and write the equation in the form $y = a + bx$ (substituting the values for a and b).

On the **TI86**, exit until you are on the home screen. Enter the **STAT** menu. Select **CALC**. Select **LinR** (**F3**) from the resultant menu. You must press **ENTER** to make it find the equation. A line is always in the form $y = a + bx$ where a and b are real numbers, such as $y = 5 + 2x$. Round the values of a and b to two decimal places and write the equation in the form $y = a + bx$ (substituting the values for a and b).

What is the equation of your regression line? Again, make sure your coefficients are rounded to two decimal places.

Did your calculator also give you the value of r and r^2? What is r and what does it mean?

For the **TI83 or 84**: If your calculator did *not* give you values for r and r^2, do the following to turn Diagnostics on.

On the **TI83 or 84**, press **2nd** and then the **0** button. Notice the second function of the **0** key is **CATALOG**. Arrow down until you get to **DiagnosticOn**. Select it and then press **ENTER** twice to get back to the home-screen and turn it on. Your screen will read "Done" if you do it properly. Redo the regression calculation and it will show the correlation coefficient.
[I believe the **TI85** and **86** will display the correlation coefficient by default. Tell me if you have issues.]

Let's get the calculator to graph this line on top of the scatter plot.

On the **TI82, 83,** or **84**, enter the **y=** editor. Place your cursor in the space for **y1**. Press the **VARS** button (below and to the left of the arrows). Go down the list and select **Statistics**. Move the cursor to the right and select **EQ**. Then select **RegEQ**. This should place the regression equation into the space for **y1**. Press **GRAPH** and it'll graph the line over the scatter plot. Notice how the line mimics the pattern of the points.

On the **TI85**, enter the **y=** editor. Place your cursor in the space for **y1**. Press **STAT** and select **VARS**. Press **MORE** twice to get over to **RegEq** and select it (**F2**). This should place the phrase "**RegEq**" in the space for **y1**. Press **STAT** again and select **DRAW** (**F3**). It will show you the regression line. Now press **F2** for **SCAT** and it will add the points. Press **EXIT** so you can see more of the screen. Notice how the line mimics the pattern of the points. That is the whole idea of regression.

On the **TI86**, enter the **y=** editor. Place your cursor in the space for **y1**. Enter the **STAT** menu (second function of the plus sign). Select **VARS** (**F5**). Press **MORE** twice to get over to **RegEq** and select it (**F2**). This should place the phrase "**RegEq**" in the space for **y1**. Press the **GRAPH** button and select **GRAPH** (**F5**). It should graph both the points and the line. Notice how the line mimics the pattern of the points.

Let's try one for practice.

An economist wishes to find a linear function that relates personal consumption expenditures and disposable income. (You can think of personal consumption expenditures as how much the household spends on personal stuff. Disposable income is the money they have left over after buying necessary items.) She interviews eight households and obtains the following data.

Disposable income (x) (in 1000s of dollars)	Personal consumption expenditures (y) (in 1000s of dollars)
20	16
20	18
18	13
27	21
36	27
37	26
45	36
50	39

The following scatter diagram shows these points. Notice the linear pattern of points. Use your calculator to find the regression line. On the graph, draw the line using a straight edge. Next to your line, give its equation, rounding the two values to two decimal places. Also, give the value for the correlation coefficient. Is the line a good fit?