

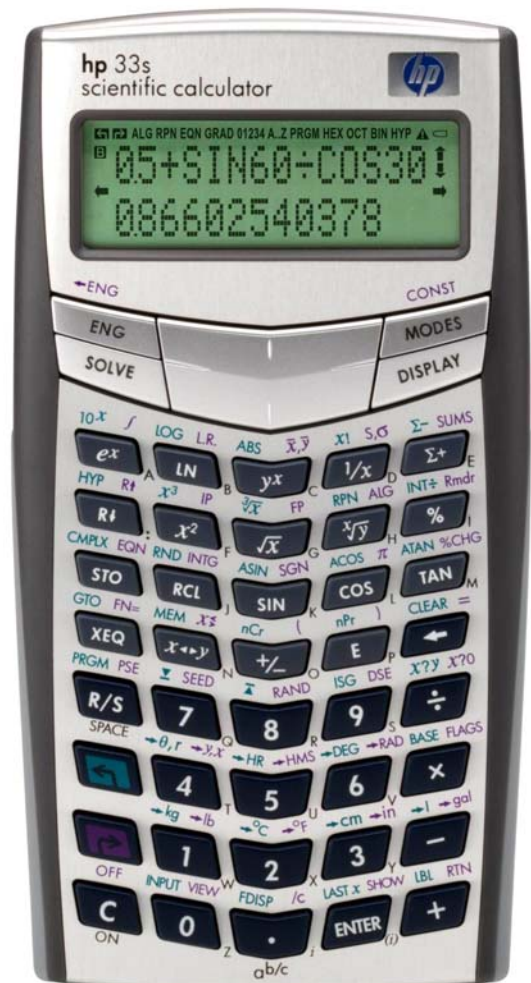


hp calculators

HP 33S Trend Lines

Trend Lines

Practice predicting the future using trend lines



Trend Lines

A trend line is actually an equation of a line in the form $Y = mX + b$, where m is the slope of the line and b is the Y-intercept. Linear regression calculates the equation for this line by minimizing the sum of the squared residuals between the actual data points and the predicted data points using the estimated line's slope and intercept. Once the slope and intercept have been calculated, it is fairly easy to substitute other values for X and predict a corresponding value for Y , or to substitute a value for Y and predict a value for X . When the X value is a measure of time (months or years, for example), the equation is specifically referred to as a trend line. These are often used to predict future sales growth given past sales data. Be aware, however, that it is rarely a good idea to use such an equation to predict too far into the future from the actual data used, since circumstances can change rather quickly. Also be aware that these predictions are linear in nature and make no adjustment for any seasonality that may exist.

On the HP 33S, values are entered into the statistical / summation registers by keying in the number (or pair of numbers) desired and pressing $\Sigma+$. This process is repeated for all numbers or pair of numbers. When entering a pair of numbers in RPN mode, key the Y value, press ENTER , then key the X value and press $\Sigma+$. When entering a pair of numbers in algebraic mode, key the Y value, press $x \leftrightarrow y$, then key the X value and press $\Sigma+$.

To view the linear regression results, press F2 L.R. . The HP 33S displays a menu of possible values. Items on this menu are viewed by pressing the \leftarrow or \rightarrow parts of the cursor key at the top of the HP 33S, as shown in Figure 1 below.

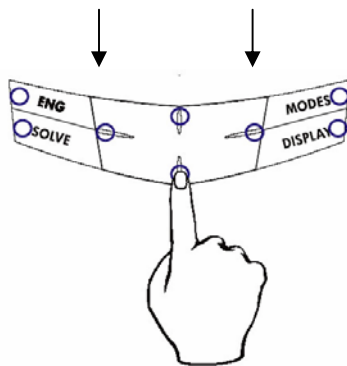


Figure 1

The position of the arrows point to the portion of the cursor key to be pressed to move the selection of the menu left or right. In the practice problems below, this will be indicated by using the \leftarrow or \rightarrow symbols to reflect pushing the proper portion of the cursor key.

This menu allows you to predict a value for X given a Y value, or predict a value for Y given an X value. It also displays the linear regression line's correlation, slope, and y-intercept. The correlation will always be between -1 and $+1$, where values closer to -1 and $+1$ indicating a good "fit" of the line to the data. Values nearer to zero indicate little to no "fit." Little reliance should be placed upon predictions made where the correlation is not near -1 or $+1$. Exactly how far away from these values the correlation can be and the equation still be considered a good predictor is a matter of debate. To use a value displayed on the menu, press the ENTER button and the value will be copied for further use. This is illustrated in the problems below.

Practice predicting the future using trend lines

Example 1: John's store has had sales for the last 5 months of \$150, \$165, \$160, \$175, and \$170. Use a trend line to predict sales for months 6 and 7 and also predict when estimated sales would reach \$200. What is the correlation of the regression line?































Solution: Be sure to clear the statistics / summation memories before starting the problem.

 CLEAR 

In RPN mode:

   ENTER      ENTER      ENTER  
   ENTER      ENTER  

In Algebraic mode:

To view the linear regression results, press  L.R.. Figure 2 displays the menu shown.

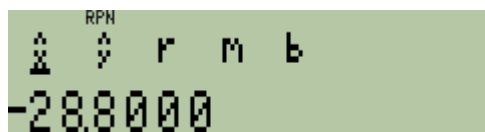


Figure 2

In either RPN or algebraic mode, press:   to view the correlation.

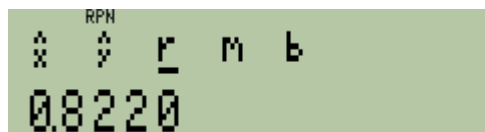



Figure 3

In either RPN or algebraic mode, press:  to view the slope of the linear regression / trend line.

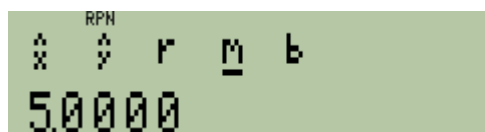


Figure 4

In either RPN or algebraic mode, press  to view the y-intercept of the linear regression / trend line.

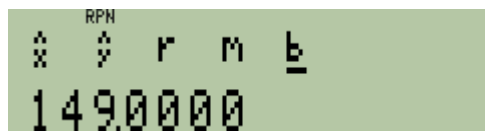


Figure 5

To estimate sales for month 6, do the following:

In either RPN or algebraic mode, press:    

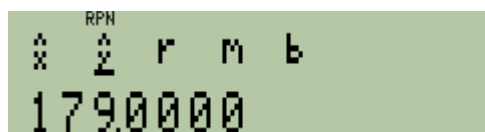


Figure 6

To estimate sales for month 7, do the following:

In either RPN or algebraic mode, press: **C** **7** **▸** **L.R.** **→**

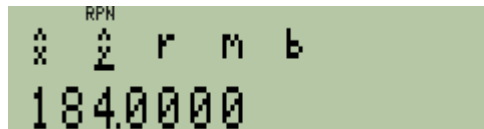


Figure 7

To estimate the month during which sales would reach \$200, do the following:

In either RPN or algebraic mode, press: **C** **2** **0** **0** **▸** **L.R.**

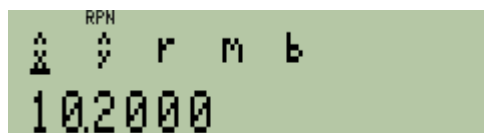


Figure 8

Answer: Sales in month 6 are predicted to be \$179 and in month 7 \$184. Sales are predicted to reach \$200 between months 10 and 11. The correlation is 0.82, which indicates a fairly strong relationship and predictive ability.

Example 2: A store's quarterly sales for the last 2 years have been \$30,000, \$31,200, \$30,500, \$32,400, \$32,200, \$33,100, \$32,600 and \$33,250. Use a trend line to predict sales for the next year and also predict when estimated sales would reach \$38,000. What is the correlation of the linear regression line?

Solution: The X values will be the quarters of 1 through 8. The Y values will be the existing sales numbers. Predictions will be made for quarters 9, 10, 11, and 12. Be sure to clear the statistics / summation memories before starting the problem.

◀ **CLEAR** **4**

In RPN mode:

3 **0** **0** **0** **0** **ENTER** **1** **Σ+** **3** **1** **2** **0** **0** **ENTER** **2** **Σ+**
3 **0** **5** **0** **0** **ENTER** **3** **Σ+** **3** **2** **4** **0** **0** **ENTER** **4** **Σ+**
3 **2** **2** **0** **0** **ENTER** **5** **Σ+** **3** **3** **1** **0** **0** **ENTER** **6** **Σ+**
3 **2** **6** **0** **0** **ENTER** **7** **Σ+** **3** **3** **2** **5** **0** **ENTER** **8** **Σ+**

In Algebraic mode:

3 **0** **0** **0** **0** **x↔y** **1** **Σ+** **3** **1** **2** **0** **0** **x↔y** **2** **Σ+**
3 **0** **5** **0** **0** **x↔y** **3** **Σ+** **3** **2** **4** **0** **0** **x↔y** **4** **Σ+**
3 **2** **2** **0** **0** **x↔y** **5** **Σ+** **3** **3** **1** **0** **0** **x↔y** **6** **Σ+**
3 **2** **6** **0** **0** **x↔y** **7** **Σ+** **3** **3** **2** **5** **0** **x↔y** **8** **Σ+**

To view the linear regression results, press **▸** **L.R.**. Figure 9 displays the menu shown.

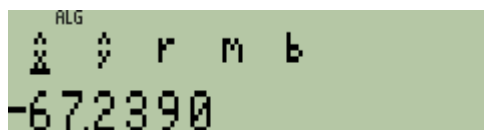


Figure 9

In either RPN or algebraic mode, press: $\boxed{\rightarrow} \boxed{\rightarrow}$ to view the correlation.

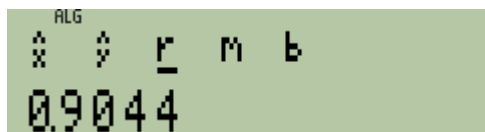


Figure 10

In either RPN or algebraic mode, press: $\boxed{\rightarrow}$ to view the slope of the linear regression / trend line.

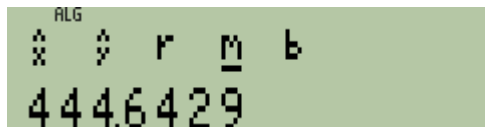


Figure 11

In either RPN or algebraic mode, press $\boxed{\rightarrow}$ to view the y-intercept of the linear regression / trend line.

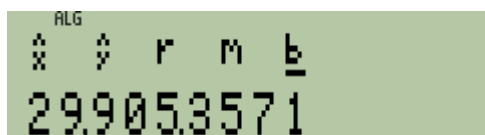


Figure 12

To estimate sales for the first quarter of the next year (quarter 9), do the following:

In either RPN or algebraic mode, press: $\boxed{C} \boxed{9} \boxed{\rightarrow} \boxed{L.R.} \boxed{\rightarrow}$

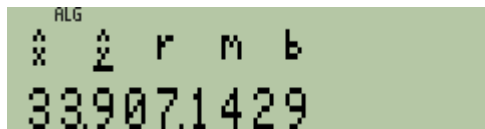


Figure 13

To estimate sales for the second quarter of next year (quarter 10), do the following:

In either RPN or algebraic mode, press: $\boxed{C} \boxed{1} \boxed{0} \boxed{\rightarrow} \boxed{L.R.} \boxed{\rightarrow}$

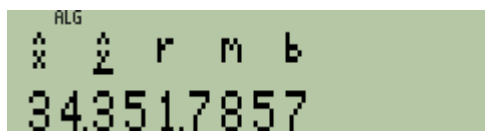


Figure 14

To estimate sales for the third quarter of the next year (quarter 11), do the following:

In either RPN or algebraic mode, press: $\boxed{C} \boxed{1} \boxed{1} \boxed{\rightarrow} \boxed{L.R.} \boxed{\rightarrow}$

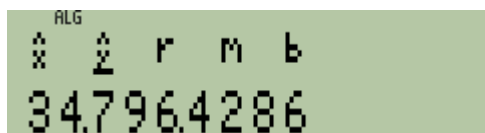


Figure 15

To estimate sales for the fourth quarter of next year (quarter 12), do the following:

In either RPN or algebraic mode, press: **C** **1** **2** **▸** **L.R.** **→**

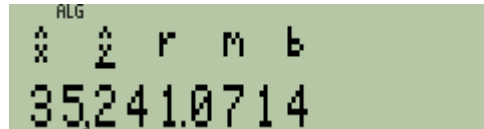


Figure 16

To estimate the month during which sales would reach \$38,000, do the following:

In either RPN or algebraic mode, press: **C** **3** **8** **0** **0** **0** **▸** **L.R.**

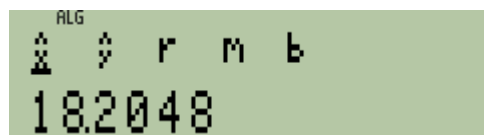


Figure 17

Answer:

Sales for quarters 9 through 12 are predicted to be \$33,907, \$34,351, \$34,796 and \$35,241. Sales are predicted to reach \$38,000 between months 18 and 19. The correlation is 0.90, which indicates a fairly strong relationship and predictive ability.