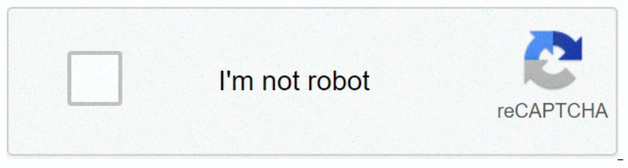

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Least squares regression line excel

In the previous two Excel tutorials, we discovered two ways to obtain the least square estimates of the slope and intercept from a best fit line: use the slope() and intercept() functions adding a trendline to a distributed both of these methods is quick and useful, but they are mere toys compared to the method outlined in this tutorial : using Excel's Analysis ToolPak add-on. Here's a screenshot of the calibration data (click to download the file): First, let's see that the add-in is installed. Go to the | Add-ins sub-menu; you need to see the next screen. Make sure the Analysis ToolPak is checked. Doing so will add a data analysis item to the Tools menu. Select the Data Analysis item, and then scroll down, and select Regression a Dialog box will appear. Select the ranges of the X and Y data; you can click on the funny little icons to select these series. It is also often a good idea to look at one of the remaining erven. After you click 'OK', a page will be created with statistical information about the linear regression. Click the above image to download the Excel file. If you chose that particular option, a plot of the remains would appear to help identify outliers and evaluate the appropriateness of the chosen regression model. Look at the sequence of events leading up to these last screen-shots If you're an engineer (as I used to be in a previous life), you've probably done your bit of experimenting. Usually, you need a way to match your measurement results with a curve. If you're a proper engineer, you also have an idea what type of comparison should theoretically fit your data. Maybe you did some metings with results like this: Match data with a comparison. A known way to match data to a comparison is by using the least square method (LS). I won't repeat the theory behind the method here, just read up the case by clicking on the link to Wikipedia. Fitting simple linear comparisons Excel provides us with some tools to perform the least square calculations, but they're all centered around the simpler features: simple Linear functions of the form y=a.x+b, y-a.exp (b.x), y=a.x^b etc. With a few tricks, you can also perform LS on polynomium using Excel. Regression tools in the Analysis Toolpak Insertion Enable the Analysis Toolpak in your list of add-ins (File button or Office button, Excel Options, Add-ins tab, click Go): The add-in list of Excel with the Analysis Toolfack enabled It adds the Data Analysis button to your ribbon, on the Data tab, Analysis group (this is also the location where you have the : Ribbon with Data Analysis Click that button to explore which regression tools are available. Worksheet Features There are a number of worksheet features that you can also use to do regression analytics. To quickly access them, select an empty blank and click Shift+F3 to open the function wizard. In the search box, enter Regression (without the quotes of course). Excel will list the relevant functions: Function wizard showing Regression Functions Select one and click the Help on this feature link at the bottom of the function wizard to find out more about their use. Match more complex functions That if you want to match a more complex function, such as y = exp (a.x).sentence(x) + b ? How can this be done using Excel? I devised a way to do this what the following steps entail: Create a table with x and y values Add a column with the model function formula, which indicates your x-es and to some cells for the constant(s) Has a column that calculates the Sum of Square Use Solver to find the constants that produce the lowest sum of squares. Explaining the Sample file I created an example file that you can use directly. Here you will find a link to the file and an explanation about how the file is compiled. Download this file: Neither linear least square example How the file works Data The calculations and the data is concentrated on Sheet1 of the file. The main area is the table that starts in cell A1: Data table in LS file Column A holds your x values and column B holds the y values. The third column holds the formula that calculates the result of the fitted equation using the constants and the x values. The sample file has this formula in column C: = EXP (Const_a * xValues)*SIN(xValues)+Const_b The fourth column of the table is used to calculate the sum of squares. Formula: =(B2-C2)^2 As you've probably already noticed, I've used some serial names. I explain those below. Series of names To ease up works with the file I created some serial names. Instead of using the table references that use Excel 2007, 2010, and 2013 offering, I included some dynamic range names that point to the data. This means the workbook also works in Excel 2003 and previously. Serial name refers to description Const_a=Sheet1!$G $2 Model Constant Const_b=Sheet1!$G $3 Model Constant Const_c = Sheet1!$G $4 Model Constant Const_d = Sheet1!$G $5 Model Constant Const_e = Sheet1!$G $6 Model Constant Const_f=Sheet1!$G $7 Model Constant Const_g=Sheet1!$G $8 Model Constant Const_h=Sheet1!$G $9 Model Constant Constants=Sheet1!$G $2 :$G $9 constants comparison xValues = OFFSET(Sheet1!$A $2, 0, 0, COUNT (Sheet1!$A $1: $A $65551), 1) Column with x values yDelta = OFFSET(xValues,0,3) Column with Square Differences yhat = OFFSET(xValues,0,2) Column with model matching results yValues = OFFSET(xValues,0,1) Column with y values Constants of the equation The const series names point to a second table in the file : Constants table This table is where you enter your first initial guesses the resulting constants and where the Resolver add-in also returns the results. As you can see, the remaining Sum of Square is shown under that table. Formula: =SUM(yDelta) This is cell G11 that we are trying to reduce using the Solver add-in. By using solvent first, you must install the Solvent add-in. Use the Add-ins dialog box that I showed at the top of this article and check the box next to Solver Add-in. It adds the Solver button in the same place on the ribbon as the Data Analysis button I showed before. After ensuring that the model formula is entered correctly into column C and the calculations work, click the Solvent button. The dialog box below is shown: The Solvent dialog Box Ensures that the Set objective box points to the cell that contains the sum of squares. Select Few next to On. The By changing variable cells box should only point to the cells used by your model, otherwise the degrees of freedom calculation (on the ANOVA page) will be incorrect. Also, make sure that any unused constant cells are empty by selecting them and hitting the del key. Note that depending on your model type, you may need to change the resolver settings. A little experimentation may be necessary for best results. You can save and load Solvent settings using the appropriate button. So be prudent and critical about whether you've actually achieved a best fit, the Resolver can come with non-optimal results depending on your model comparison and solver settings. If you're satisfied with the current Resolver settings, click Resolve. After some time the Solver Results dialog box opens, give you some options on how to proceed. Note that it also allows you to ask for a few reports. The example file shows the end result: The end result analysis of variance on the ANOVA tab, you can find the ANalysis of VAriance table, which looks like this: The ANOVA table The main cell here is cell F2. If the value in that cell is less than 0.05, there is a probability of 95% that correctly matches your model with the data. So less is more for this cell, you want it to stay below 0.05. The cell will red for values over 0.05. Please check if the value in cell B2 is exactly one less than the number of constants you used for the model. If not, go back to Sheet1 and empty the cells not used by your model. So if you used const_a and const_b, the value of B2 (model grades of freedom) should be 1. Conclusion As you've seen that custom-complex features to your data aren't very difficult to do. A combination of some relatively simple formulas and the Solver Add-in comes here to the rescue. Some advice as one engineer to another; Be critical please. Don't believe everything Excel tells you! Analyze the results it gives back carefully, as Solver can get things wrong and not get you the best result! To use Excel to match a comparison by Linear Least Square Regression: Y = A+BX+CX^ 2+DX^ 3+... Have your Y values in a vertical column (column B), the X values in the following column on the right (column C), the X^ 2 values on the right side of the X values values D), etc. Under this block of numbers, a block selects just as wide as one and 2 to 4 rows are high — so if you only have Y and X values (linear comparison), the new marked block is 2 columns with 2 to 4 rows. Type = lines (and then drag down to hilite your column Y values - it must now look like = lineups (B2:B12 . Enter a comma, and then drag across all the X, X^2, X^3, ... values from top left to bottom right to hylimate the entire block - this is just one column if you have a linear equation - and now the text should look like = lineups (B2:B12, C2:C12 or = lineups (B2:B12, C2:E12 if you have cubic terms. Now type ,1,1) and hold down the open-apple key (next to the Spacebar) while you hit Enter. If you type 0 in place of the first 1 it forces A to be zero. 0 in place of the second 1 cutting insecurities in A, B, C, ... Dragging over the values to include them in the formula is just a convenience, you can simply type the lineup declaration if you wish. The comparison you fit doesn't have to be a power range. You can be appropriate Y to any set of variables (X, V, W): Y = A+ BX + CV + DW. Just put your X values in column C, V values in column D, and W values in column E In the new block, the top row is the coefficients in reverse order — the one on the right is A, then B to the left of it, etc. Among each of these is an estimated uncertainty or standard deviation in the value. The left entry in the third row is the correlation coefficient (R^2) which should be close to 1,000. The second item is the standard deviation (the scattering) of the Y values across the calculated line. The fourth rule is other statistical things.

|___B____|___C___|____D____|__ E ___|___F___|

2 |___Y1___|___X1__|__X1^2__|__X1^3_|__ 3 |___Y2___|___X2__|__X2^2__|__X2^3_|__ 4 |___Y3___|___X3__|__X3^2__|__X3^3_|__ 5 |___Y4___|___X4__|__X4^2__|__X4^3_|__ 6 |___Y5___|___X5__|__X5^2__|__X5^3_|__ 7 |___Y6___|___X6__|__X6^2__|__X6^3_|__ 8 |________|________|________|_______|__ 9 |________|________|________|_______|__ 10 |________|________|________|_______|__ 11 |________|________|________|_______|__ Hilite this whole block by dragging the mouse from cell B8 to cell E11 Type = linest(B2:B7,C2:E7,1,1) and open-apple ENTER Gives Y = A + BX + CX^2 + DX^3 8 |____D___|____C___|____B___|___A___| 9.9 Self |___dD___|___dC___|___dB___|__dA___| 10 |__R^2___|___dY___|_|_|_ 11 |__?___|___dF___|_| | dF = degrees of Freedom = (# of Y values) - (# of parameters) The # of Y values must be at least the square of the number of parameters. Line Chart with Excel (and later) 1. Select data to be graphed, usually in (a) column(s). The name of the column for the Legend can be included as the top entry. If only one column is selected, it is usually the Y values, and the X values are equally spaced (1,2,3,...). If two more columns are selected, you'll be able to name one as the X values - the other columns will be photographed on different lines. It is best to have the X column on the left side of the Y column(s). This is OK if some Y values are missing from some of the columns. 2. Drag under INSERT on the menu bar to CHART. Choose whether you want the chart to be on the same page as the data or on another page. You can cut and paste later, so it's not critical. 3. Hold down the mousebutton and drag over the area where the graph will appear. You can reform it later and move it if you want. A dialog box appears. 4. Make sure that the indicated range is the data you want to chart. Click NEXT. 5. Select a STRAW PLOT or a LINE Plot (IF you haven't entered X values). Click NEXT. 6. Select the format you want for the chart. Click NEXT. 7. Check the entries that appear, and then click FINISH. Edit: 1. Click the chart to select it for moving or recreating. Double-click to produce a thick border to make internal changes. 2. Drag down under FORMAT to CHART TYPE to change the basic type of plot (as in 5 above). Drag to AUTOFORMAT to change the format (as in 6 above). Drag to OBJECT to fonts, colors, line types, etc. 3. Double-click an axle to edit it. You can use the scale, tick marks, font, etc. It's also where you have symbols, line colors, shattered lines, etc. 4. Click the CHART WIZARD icon on the Toolbar to change the data selection and other properties. Properties.

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