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Simultaneous fitting of sigmoid curves in Excel (Excel Solver Add-in)

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Works for me

[dx.doi.org/10.17504/protocols.io.8g9htz6](https://doi.org/10.17504/protocols.io.8g9htz6)**Kenji Ohgane**

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ABSTRACT

Sometimes it is desirable to fit sigmoid curves with shared parameters against several data sets. Such simultaneous fitting procedure is available in most of the specialized statistical softwares (R, Prism etc.), but also possible with Excel. Here, this protocol explains how to perform simultaneous fitting using Excel Solver plug-in against a pair of data set. For more basic protocol to fit sigmoid curve, see Kenji Ohgane (2019) Sigmoid fitting in Excel (Excel Solver Add-In). [protocols.io dx.doi.org/10.17504/protocols.io.78ihru6](https://doi.org/10.17504/protocols.io.78ihru6). See Gerdi Kemmer & Sandro Keller (2010) **Nat. Protocols** 5: 267–281 for more detail on the use of Excel Solver in nonlinear least square fitting.

GUIDELINES

Although this protocol explains how to set up simultaneous fitting of two curves, you can easily accommodate this protocol to more complex data sets. However, for more sophisticated analysis, the use of Prism (commercial software) or R (open source software) is recommended for more clear analytical workflow and reproducibility. To perform simultaneous fitting of dose-response curves in R, the use of *drc* package would be a convenient option.

BEFORE STARTING

Excel Solver Add-In is currently bundled with Excel by default, but you need to load the add-in for the first time. To load the add-in, select "Excel Add-Ins" from "Tools" menu, check the Solver Add-In, and click OK.

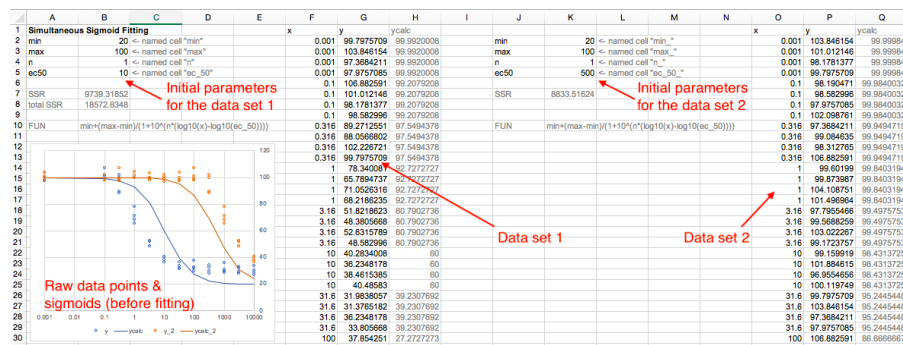
- 1 Download the following excel file.
The file contains a sheet set up for simultaneous sigmoidal fitting with two set of example data, for which you can test the fitting procedure.

☐ [ExcelSolver_SimultaneousFitting.xlsx](#)

- Open the excel file, and enter your data set in the two set of "x" and "y" columns. Delete unnecessary data.



The data in the "x" column should be in decreasing or increasing order. Otherwise, the plot will not be correctly displayed.

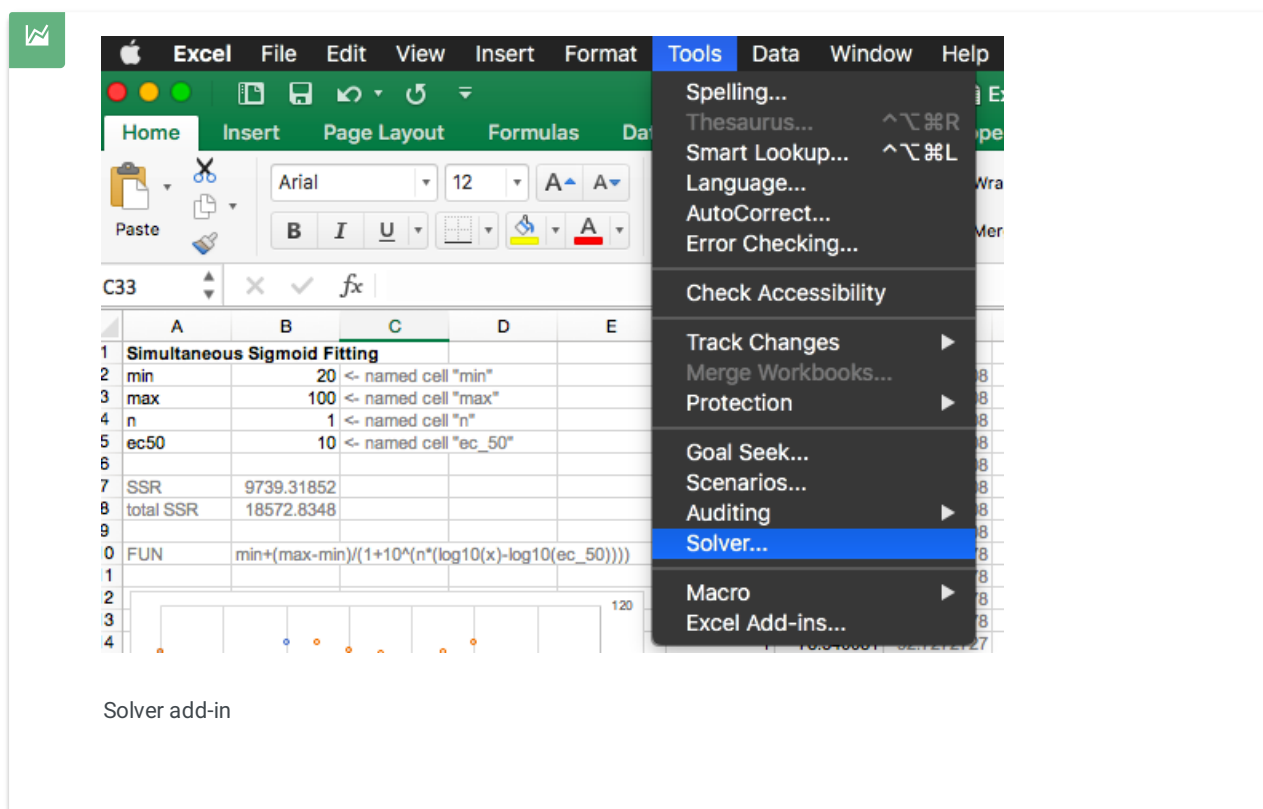


- Guess initial parameters for the sigmoids (minimum, max, n, and ec_50), which can be easily guessed from the plot, and enter the estimated initial values into the cells (B2, B3, B4, and B5 for the first data set, and K2, K3, K4, and K5 for the second data set).



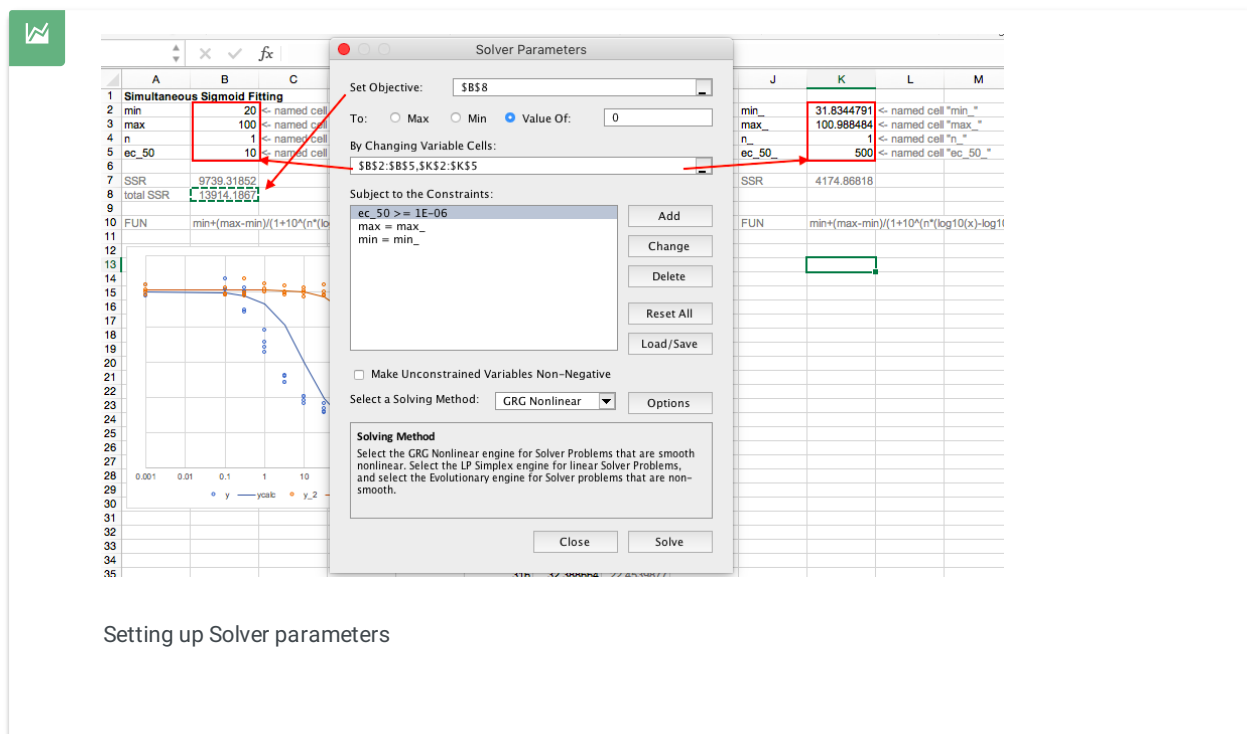
Note that these cells for parameters are "named cells". So you can reference these cells from within equations by using "=min" (first data set) or "=min_" (second data set), where an underbar denotes parameters for the second data set. If you want to modify the equation for the curves, please modify equations within the cells in the "ycalc" columns.

- 4 Start the Excel Solver add-in from Tool > Solver on the menu bar.



Solver add-in


- 4.1 Set "Objective / Target cells" to "\$B\$8", which contains the sum of SSR (Sum of Squared Residuals) calculated for the two data sets.



The screenshot shows the Excel Solver Parameters dialog box. The "Set Objective" field is set to "\$B\$8". The "To" section has "Value Of" set to 0. The "By Changing Variable Cells" field is set to "\$B\$2:\$B\$5, \$K\$2:\$K\$5". The "Subject to the Constraints" section has a constraint "ec_50 >= 1E-06". The "Solving Method" section is set to "GRG Nonlinear". The worksheet in the background shows a graph of two sigmoid curves and a table of values.

Setting up Solver parameters

- 4.2 Set "equal to" section to "Value of 0".

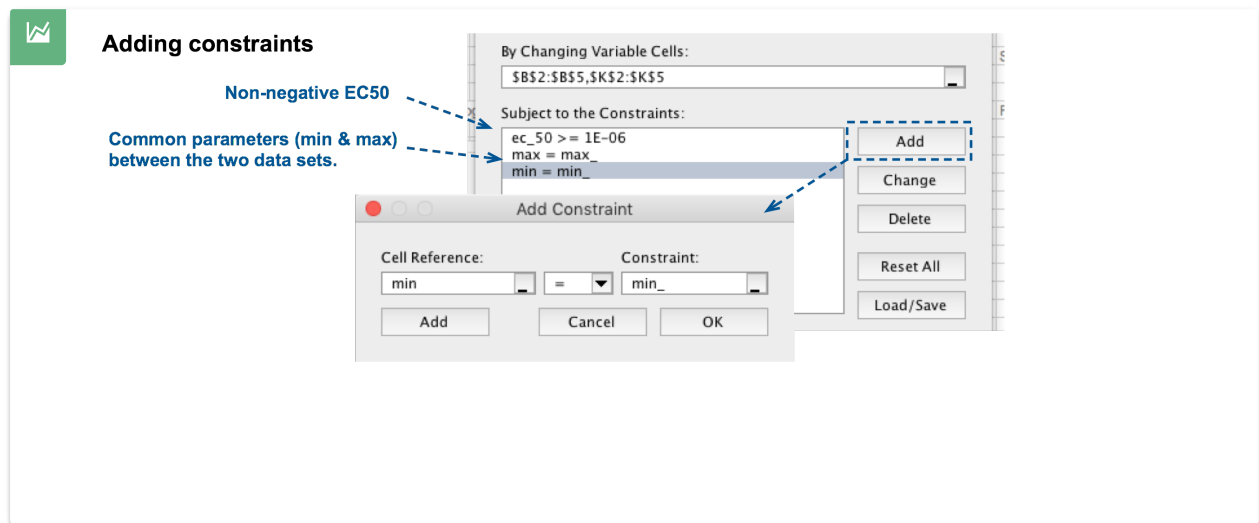


This results in a warning saying "unable to find solution", but you can ignore it.

- 4.3 Set "Changing variable cells" to the cells that contains initial values for the two sigmoid curves ("B2:B5, K2:K5").

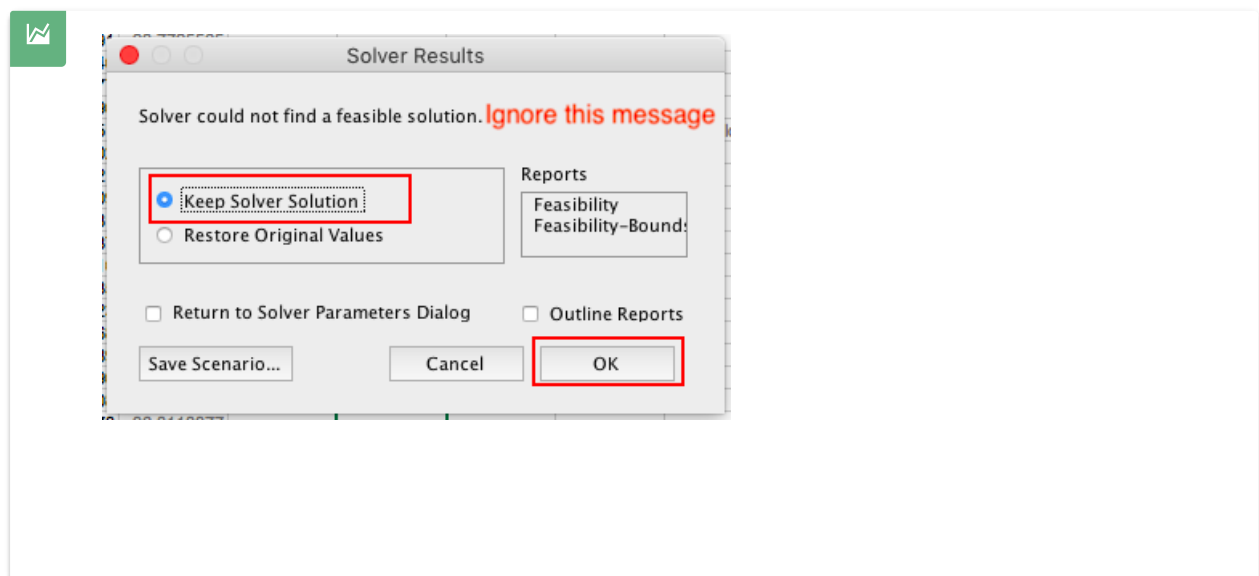
4.4 Add constraints.

- (1) We recommend to add "ec_50 >= 0.000001" etc., to avoid EC50 becoming negative values or zero.
- (2) In this example, we fit two sigmoid curves that share minimum and maximum values against the pair of data set. So add two constraints as shown in the figure ("min = min_" and "max=max_").



4.5 Confirm that "Assume non-negative" is unchecked, and click "Solve" to run the Solver.

Close the Solver window when the calculation finished. Then you can get fitted parameters and a curve overlaid over the raw data points. Check if the sigmoid curve is reasonably fitted over the data.



- 5 Then you can get fitted parameters and curves overlaid over the raw data points. Check if the sigmoid curve is reasonably fitted over the data.

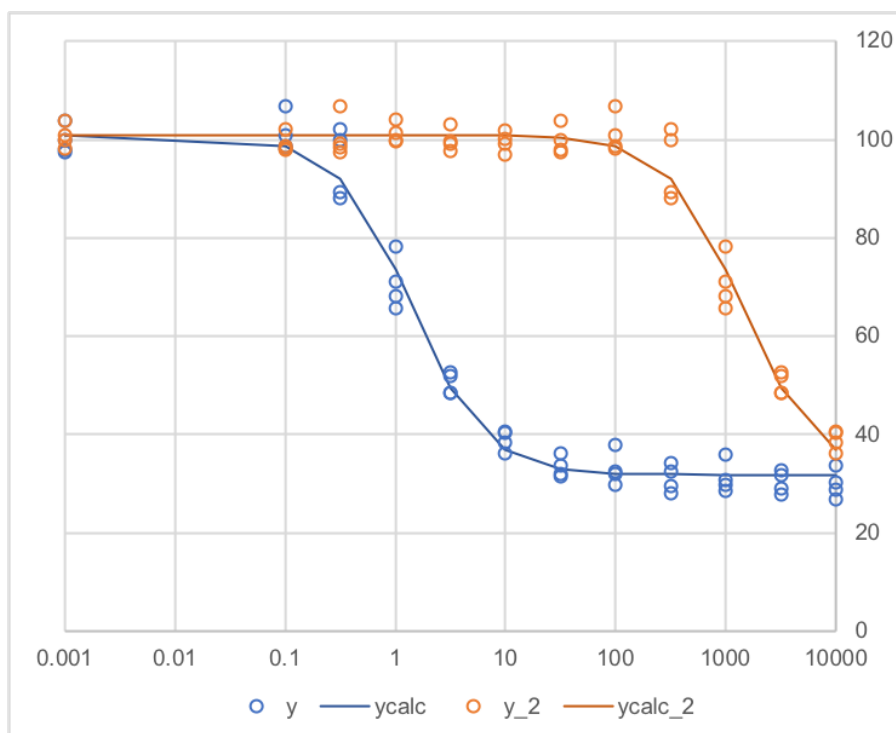


Fitted results

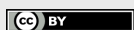
Common values (min & max)

	A	B	C	D		J	K	L	M
Simultaneous Sigmoid Fitting									
min		31.8344791	<- named cell "min"			min	31.8344791	<- named cell "min_"	
max		100.988484	<- named cell "max"			max	100.988484	<- named cell "max_"	
n		1.29524551	<- named cell "n"			n	1.29458783	<- named cell "n_"	
ec50		1.38909303	<- named cell "ec_50"			ec50	1386.91223	<- named cell "ec_50_"	
SSR		633.50413				SSR	602.644218		
total SSR		1236.14835							

Determined for each data set (n & EC50)



The result of simultaneous sigmoid curve fitting.



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