Curve Fitting in Microsoft Excel By William Lee

This document is here to guide you through the steps needed to do curve fitting in Microsoft Excel using the least-squares method.

In mathematical equations you will encounter in this course, there will be a dependent variable and an independent variable. Identifying the dependent and independent variables in a mathematical equation will help you identify what you are solving for in the equation. The *independent variable* is a variable whose value determines the value of the *dependent variables*. Independent variable is plotted on the Xaxis, and the dependent variable is plotted on the Y-axis. Other variables may also be present in equations. These may be constants or other variables. They may be given to you or you may be required to obtain them by performing curve fitting. The example below illustrates this point.

Equation 1: y = mx + C

y = dependent variable x = independent variable m and C = constants

Data set:

X – independent variable	Y – dependent variable
0	50
10	70
20	90
30	110
40	130
50	150

Graph 1:



When the dependent and independent variables are plotted as shown in graph 1, m and C values are obtained by adding a best fit line through the data points. m is the slope of the equation, and C is the y-intercept. Adding a best-fit line in Excel can be done by using the Add Trendline.

1	•	Ad	d	Data	Set	in	Exce	1
---	---	----	---	------	-----	----	------	---

X N	🔀 Microsoft Excel - Book1									
	<u>F</u> ile <u>E</u> dit	<u>V</u> iew <u>I</u> nse	ert F <u>o</u> rmat	<u>T</u> ools <u>D</u> a	ata <u>W</u> indov	v <u>H</u> elp				
D	🖻 🖪 🔒) 🎒 🖻	🗠 🖌 🍓	Σ • <u>2</u> ↓	7. I III I	🖓 🏆 Aria	l			
	C6	•	fx X							
	Α	В	С	D	E	F	G			
1										
2										
3										
4										
5										
6			X	Y						
7			0	50						
8			10	70						
9			20	90						
10			30	110						
11			40	130						
12			50	150						
13										
14										
15										
10										
1/										
10										

2. To graph it click on **Chart Wizard button.**

🔀 Microsoft Excel - Book1													
8	<u>F</u> ile ļ	<u>E</u> dit	⊻iew	Inse	ert F <u>o</u> r	mat	<u>T</u> ools	Da	ita	<u>W</u> indow	<u>H</u> elp		
D	🛩 🖕	1 🔒	6	B	ю. ,		Σ•	₽↓	Z↓	1) *	Arial	
	C6		-		fx X					1			
	A		В		С		D			E Chart	Wizard		G
1													
2													
3													
4													
5													
6					Х		Y						
7					0		50						
8					10		70						
9					20		90						
10					- 30		110						
11					40		130						
12					50		150						
13									·				
14													
15													
16													
17													



3. Plot the graph as XY (Scatter) with data points only. Click Finish when done.

4. To add a trendline, right-click on one of the data points, then select Add Trendline...



5. Select Linear Trend\Regression type.

🔀 M	icrosoft E	xcel - Book	1									
	<u>Eile E</u> dit	⊻iew Inse	ert Format	<u>⊺</u> ools ⊆	hart <u>W</u> indo	ow <u>H</u> elp						
D	൙ 🖬 🖨	alain	N-10	Σ - AL	Z1 00 0	?) »		÷	- B I	UE		\$ %
Se	eries "Y"	•	& =SERIE	S(Sheet1)	5D\$6 Shee	11\$C\$7.\$C\$	12 Sheet19		12 1)			
	A	В	С	D	E	F	G	Н		J	K	L
1							-					
2												
3												
4									1		· · · · · · · · · · · · · · · · · · ·	
5												
6			Х	Υ								
7			0	50								
8			10	70		Add Trendli	ine				?	<
9			20	90								1
10			30	110	- 10	Type O	ptions					
11			40	130	16	Trend/Regre	ession type —					
12			50	150	14				2 2			
13					12	in the			Orde	r:		
14						1		11	₩ 2	<u></u>		
15					14	Linear	Logarithr	nic <u>P</u> oly	/nomial			
16					8			7 [● Y
17									······································	0:		
10					- 1				× 2			
19				2	- 1	Power	Exponen	tial <u>M</u> ov	/ing Average			
20				-	- 2	Based on seri	es:					
21						Y		A				
22												
20								-				
24						1						
26												
27					-							
28					-					OF	Cancel	1
29					-					UK I	Cancel	
30												

6. Click on the Options tab. Put a check on **Display equation on chart** and **Display R-squared value on chart boxes.** Click **OK** when done.

	Microsoft Ex	kcel - Bool	<1										
	<u>Eile E</u> dit	⊻iew Ins	ert F <u>o</u> rmat	<u>⊺</u> ools ⊆h	nart <u>W</u> indo	w <u>H</u> elp							Туре
D			N- Q	Σ - Al	ZI 100 C	2 »		+	- B /	UE	= = =	\$%,	*.0 .00 0.+ 00.
S	Series "Y"	+	fx =SERIE	S(Sheet1!\$	D\$6,Sheet	1!\$C\$7:\$C	\$12,Sheet1	\$D\$7:\$D\$1	12,1)				
	A	В	С	D	E	F	G	Н	1	J	K	L	М
1 2 3 4 5 6 7 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22		B	C X 0 10 20 30 40 50	D Y 50 70 90 110 130 150	E 16 12 12 12 12 12 12 12 12 12 12 12 12 12	F Add Trend Type Trendline r © gustor Forecast Eorward Eorward Set inter V Display	G Coptions Coptions atic: Linear n: □ Coptions Co	H (Y) Units Units Units D units D units			к ?	X •Y	M
23 24 25 26 27 28										ок	Cancel		
29 30							1						



7. The equation for the function will be displayed on the chart as shown below.

The equation displayed for the best-fit line shows m (slope) to be 2 and C (y-intercept) to be 50. The method shown here works well when Excel already has the built-in function, such as the function for a linear regression shown above. When the function to be used is not present in Excel (as is the case for most functions you will encounter in the sciences), the method shown below should be used.

Curve fitting for the Strength-Duration Data

The equation used to fit the strength-duration data is shown below:

$$V = V_{Rh} \left(\frac{1}{1 - e^{\frac{-t}{k}}} \right)$$

- V = stimulus strength (dependent variable). Plot the stimulus strength on the y-axis.
- $V_{\rm Rh}$ = Rheobase. The rheobase is a constant, whose value depends on the nerve studied. You will obtain this parameter from the fit.
- t =duration (independent variable). Plot the duration on the x-axis.
- k = constant. This is also a constant. You will obtain this parameter from the fit as well.
- 1. Input your data set as shown below.

R 19	dicro	soft E	xcel -	Sciatio	_Nerve_I	Lab_Fa	ill_100	303		
8	Eile	<u>E</u> dit	⊻iew	Insert	F <u>o</u> rmat	<u>T</u> ools	<u>D</u> ata	<u>W</u> indow	<u>H</u> elp	
	2	8) 6	Ē	v • 🍓	Σ -		11 🕄	🌺 Arial	
	A1		-	fx	duration	(ms)				
		A			В		С		D	E
1	dura	tion ((ms)	stren	gth (V) 👘					
2	0.02			0.97						
3	0.03			0.7						
4	0.04			0.58						
5	0.05			0.495						
6	0.06			0.42						
7	0.07			0.37						
8	0.08			0.33						
9	0.09			0.3						
10	0.1			0.28						
11	0.11			0.26						
12	0.13			0.24						
13	0.15			0.24						
14	0.17			0.225						
15										
16										

2. Create names for k and V_{Rh} . Input the initial values for V_{Rh} and k (e.g., 1 for both Vrh and k). Then click on **Insert**, **Name**, **Create**. Then a new window will pop up and just click ok.

N	Wicrosoft Excel - 1	Scia	tic_Nerve_I	Lab_	_Fall_100303				
	Eile Edit ⊻iew	Inse	ert F <u>o</u> rmat	Ţo	ols <u>D</u> ata <u>W</u> indow <u>H</u>	<u>t</u> elp			
D	🖻 🖪 🔒 🍯		Rows			Arial		• 10 •	E
	A17 -		⊆olumns						
	A		Worksheet		C	D	E	F	
1	duration (ms)	1	C <u>h</u> art						-
2	0.02		<u>S</u> ymbol						+
4	0.04	fx	Function						1
5	0.05		Name	•	Dofino				
6	0.06		Tamo		Denne				-
1	0.07		Picture	•	Paste				+
8	0.08	0.0	¥	_	Create				+
9	0.09	0.3			Applu				+
10	0.1	0.28	1	_	Epply				-
11	0.11	U.2t	j	_	Label				-
12	0.13	0.24	1	_					-
13	0.15	0.24	1	_					+
14	U.17	0.22	25	_					-
15									-
16		_		-					-
17	Vrh	1							_
18	k	1							+
19				_					-
20									
21									

3. Now you have created names for k and V_{Rh} . You can predict the strength using these constants in the equation shown below.

Kicrosoft Excel - Sciatic_Nerve_Lab_Fall_100303											
8	<u>File E</u> dit <u>V</u> iew	Insert Format	<u>T</u> ools <u>D</u> ata <u>W</u> indow <u>H</u> elp								
	🖆 🖪 🔒 🎒	🗈 🗤 🐁	Σ - 2 Z I III ? . Arial -								
	AVERAGE 👻 🗙	✓ f _* =∨rh*(1/	(1-EXP(-A2/k)))								
	A	В	C D E								
1	duration (ms)	strength (V)	Predicted Strength (V)								
2	0.02	0.97	=Vrh*(1/(1-EXP(-A2/k)))								
3	0.03	0.7									
4	0.04	0.58									
5	0.05	0.495									
6	0.06	0.42									
7	0.07	0.37									
8	0.08	0.33									
9	0.09	0.3									
10	0.1	0.28									
11	0.11	0.26									
12	0.13	0.24									
13	0.15	0.24									
14	0.17	0.225									
15											
16											
17	Vrh	1									
18	k	1									
19											
20											

4. Once you have one predicted value for the first duration, double left click on the bottom right corner of your first predicted strength cell as shown below. This will predict the strength for all the durations. See the two figures shown below for what to expect before and after.

_								
2	Microsoft Excel	- Sciatic_Ne	rve_Lab_Fall_1003	03				
R	Eile Edit <u>V</u> ie	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>V</u>	<u>W</u> indow	<u>H</u> elp			
	- 🗲 🖪 🔒 🛔	5 🖻 🗠 🗸	$\left \begin{array}{c} & \Sigma \\ \end{array} \right = \left \begin{array}{c} \Sigma \\ \end{array} \right = \left \begin{array}{c} \Delta \\ \Delta \\ \end{array} \right = \left \begin{array}{c} \Delta \\ \Delta \\ \end{array} \right = \left \begin{array}{c} \Delta \\ \Delta \\ \end{array} \right $	11 🤉	Arial		- 10) -
-	C2 ▼	fx =∨t	h*(1/(1-EXP(-A2/k)))		•			
	A	B	С		D	E	F	
1	duration (ms)	strength (V)	Predicted Strength	(V)		_		
2	0.02	0.97	50.50166666					
3	0.03	0.7			$\langle \rangle$			
4	0.04	0.58			$\overline{\}$			
5	0.05	0.495						
6	0.06	0.42		Г	aubla	laft clic	ŀ	
7	0.07	0.37			ouoic		ĸ	
8	0.08	0.33		tł	nere.			
9	0.09	0.3						
10	0.1	0.28						
11	0.11	0.26						
12	0.13	0.24						
13	0.15	0.24						
14	0.17	0.225						
15								
16	Vrh	1						
17	k	1						
18								
N	Wicrosoft Excel -	Sciatic_Nerve	_Lab_Fall_100303					
8	<u>File E</u> dit <u>V</u> iew	Insert Forma	at <u>T</u> ools <u>D</u> ata <u>W</u> indo	ow <u>H</u> elp				
	🖻 🖪 🔒 🍯	B (🔒 Σ - 🤶 ΖΙ 📶	?	Arial	- 1	0 - 3	8 .
	C2 🗸	<i>f</i> ∗ =∨rh*	(1/(1-EXP(-A2/k)))					
	A	P	<u> </u>	1	ר ר	- F		G

			74 11					
		A	В	С	D	E	F	G
	1	duration (ms)	strength (V)	Predicted Strength (V)				
	2	0.02	0.97	50.50166666				
	3	0.03	0.7	33.8358333				
	4	0.04	0.58	25.50333324				
	5	0.05	0.495	20.50416649				
	6	0.06	0.42	17.17166637				
	7	0.07	0.37	14.79154714				
	8	0.08	0.33	13.00666596				
	9	0.09	0.3	11.6186101				
	10	0.1	0.28	10.50833194				
	11	0.11	0.26	9.600073909				
	12	0.13	0.24	8.203137975				
	13	0.15	0.24	7.179161982				
	14	0.17	0.225	6.396512789				
	15				.			
	16	∨rh	1					
	17	k	1					
	18							
Į	10							

5. Now we have predicted the strength for all the durations. We can take the difference between the actual data and the predicted value, and calculate the square of the differenced all the predicted data points (e.g., strengths).

R 1	Microsoft Excel - Sciatic_Nerve_Lab_Fall_100303										
8	<u>File E</u> dit <u>V</u> ie	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>W</u> indow	<u>H</u> elp							
	📽 🖪 🔒 🔮	5 🖻 🗠 -	🕘 Σ - Δ. Ζ. Δ. 🛍 🕄	P Arial		- 10					
	AVERAGE 🚽	X √ fx =(C	2-B2)^2								
	A	В	С	D	E	F					
1	duration (ms)	strength (V)	Predicted Strength (V)	Diff^2							
2	0.02	1 <u>0.97</u>	50.50166666	l=(<mark>C2</mark> -B2)^2							
3	0.03	0.7	33.8358333								
4	0.04	0.58	25.50333324								
5	0.05	0.495	20.50416649								
6	0.06	0.42	17.17166637								
7	0.07	0.37	14.79154714								
8	0.08	0.33	13.00666596								
9	0.09	0.3	11.6186101								
10	0.1	0.28	10.50833194								
11	0.11	0.26	9.600073909								
12	0.13	0.24	8.203137975								
13	0.15	0.24	7.179161982								
14	0.17	0.225	6.396512789								
15											
16	Vrh	1									
17	k	1									
18											
19											
20											

6. Now we have calculated the square of the differences. We can then sum the square of the differences by using the **AutoSum** button as shown below.

R 1	Microsoft Excel	- Sciatic_Ne	rve_Lab_Fall_100303			
	<u>File E</u> dit <u>V</u> iev	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>W</u> indow	<u>H</u> elp		
D	🖻 🔚 🔒 🔮	j 🗈 🗠 •		Arial		• 10 •
	D15 🛛 👻	fx				
	A	В	AutoSum	D	E	F
1	duration (ms)	strength (V)	Predicted Strength (V)	Diff^2		
2	0.02	0.97	50.50166666	2453.386		
3	0.03	0.7	33.8358333	1097.983		
4	0.04	0.58	25.50333324	621.1725		
5	0.05	0.495	20.50416649	400.3667		
6	0.06	0.42	17.17166637	280.6183		
7	0.07	0.37	14.79154714	207.981		
8	0.08	0.33	13.00666596	160.6979		
9	0.09	0.3	11.6186101	128.1109		
10	0.1	0.28	10.50833194	104.6188		
11	0.11	0.26	9.600073909	87.23698		
12	0.13	0.24	8.203137975	63.41157		
13	0.15	0.24	7.179161982	48.15197		
14	0.17	0.225	6.396512789	38.08757		
15						
16	Vrh	1				
17	k	1				
18						
10						

	🔀 V	Aicrosoft Exce	el - Sciatic_Ne	rve_l	.ab_	Fall_100303					
	8	<u>File E</u> dit <u>V</u> i	ew <u>I</u> nsert Fo	rmat	<u>T</u> oo	ls <u>D</u> ata <u>W</u> indow	<u>H</u> elp	_			
	D	🛩 🖪 🔒	a 🖻 🗠 -		ABC.	Spelling	F7	ial		↓ 10	в
		D17 -	fx	1	-	Error Checking					
I		A	В			Share Workbook			E	F	
	1	duration (ms	strength (V)	Pred							
	2	0.02	0.97	50.5		Protection	•	86			
	3	0.03	0.7	33.8		O <u>n</u> line Collaboration	•	83			
	4	0.04	0.58	25.5		The second as the second se		25			
	5	0.05	0.495	20.5		Formula Aggliong	•	67			
	6	0.06	0.42	17.1		Sol <u>v</u> er		83			
	7	0.07	0.37	14.7		Tools on the Web		1			
	8	0.08	0.33	13.0				79			
	9	0.09	0.3	11.6	33	<u>AutoCorrect</u> Options.		09			
	10	0.1	0.28	10.5		<u>C</u> ustomize		88			
	11	0.11	0.26	9.60		Options		98			
	12	0.13	0.24	8.20		<u>o</u> p		57			
	13	0.15	0.24	7.17	9161	982	48.151	97			
	14	0.17	0.225	6.39	6512	789	38.087	57			
	15			sum	of c	liff^2	5691.8	324			
	16	∨rh	1								
	17	k	1								
	18										
	19										
	20										
1	04										

7. Now you have all the data for the analysis. Now click on **Tools**, **Solver**.

8. A new window will open as shown below. Set the sum of diff² cell as your Target Cell.

	Microsoft Excel - Sciatic_Nerve_Lab_Fall_100303												
	<u>Eile E</u> dit <u>V</u> iev	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>W</u> indow	Help							Type a qu	estion for help	1
		1 b 0 +	🕘 Σ - Ž↓ Ž↓ 🕍 🕽	≫ ∏Arial		+ 10 +	BI	1 = =		\$%,	8 .08 €	t= 🖂 • 🕹	3
	D15 👻	fx =SI	JM(D2:D14)		·					ci			
	A	В	C	D	E	F	G	Н		J	K	L	
1	duration (ms)	strength (V)	Predicted Strength (V)	Diff^2									
2	0.02	0.97	50.50166666	2453.386									_
3	0.03	0.7	33.8358333	1097.983									
4	0.04	0.58	25.50333324	621.1725									
5	0.05	0.495	20.50416649	400.3667									
6	0.06	0.42	17.17166637	280.6183									
7	0.07	0.37	14.79154714	207.981	Sab	er Darame	iore				6		
8	0.08	0.33	13.00666596	160.6979	300		1910						
9	0.09	0.3	11.6186101	128.1109	S <u>e</u> t	Target Cell:	\$D\$15				Solv	e	
10	0.1	0.28	10.50833194	104.6188	Eau	ual To: C	May G		lue of 0	1			
11	0.11	0.26	9.600073909	87.23698	BV	Changing Cell		1.111 · / 7.6	ide or . je		Clos	e	
12	0.13	0.24	8.203137975	63.41157		changing coil	21						
13	0.15	0.24	7.179161982	48.15197	\$1	B\$16:\$B\$17				Guess			
14	0.17	0.225	6.396512789	38.08757	Su	biect to the Co	onstraints:				0.1		_
15			sum of diff^2	5691.824				01 .		11		. 11	
16	Vrh	1						Clic	k to se	elect th	ie targ	et cell	
17	k	1								Change			_
18										<u></u>	Rese	All	
19									-	Delete			
20											Hel	2	_
21													
22													_

N	Microsoft Excel - Sciatic_Nerve_Lab_Fall_100303											
	<u>File E</u> dit <u>V</u> iev	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata y	<u>M</u> indow	Help							
		5 B + +	$\left \begin{array}{c} & \Sigma \\ & \bullet \end{array} \right \left \begin{array}{c} & \Sigma \\ & \bullet \end{array} \right \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left \left \left \begin{array}{c} & Z \\ & Z \end{array} \right \left \left $	2	≫ Arial		+ 10 ·	BI	u 🗐 🖷			
	D15 👻	f _x										
	A	В	C		D	E	F	G	Н			
1	duration (ms)	strength (V)	Predicted Strength	(V)	Diff^2							
2	0.02	0.97	50.50166666		2453.386							
3	0.03	0.7	Solver Darametere					0				
4	0.04	0.58	solver Parameters					£				
5	0.05	0.495	\$D\$15									
6	0.06	0.42	17.17166637		280.6183			/				
7	0.07	0.37	14.79154714		207.981							
8	0.08	0.33	13.00666596		160.6979							
9	0.09	0.3	11.6186101		400 4400							
10	0.1	0.28	10.50833194 C	lick l	iere aft	er you	have se	elected	the			
11	0.11	0.26	9.600073909	um of	f diff^2							
12	0.13	0.24	8.203137975 St			Cell						
13	0.15	0.24	7.179161982									
14	0.17	0.225	6.396512789		30,00737							
15			sum of diff^2		5691.824							
16	Vrh	1				3						
17	k	1										

9. Now make the target cell Equal to Min. Under By Changing Cells, select the cells where the numeric values of V_{Rh} and k are located as shown below.

	Aicrosoft Excel	- Sciatic_Ne	rve_Lab_Fall_10030	3	Microsoft Excel - Sciatic_Nerve_Lab_Fall_100303											
	<u>File Edit Viev</u>	v <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>W</u>	<u>'indow H</u> elp	Type a question for help											
10) B N +	$\left \begin{array}{c} & \Sigma \\ & \bullet \end{array} \right \left \begin{array}{c} \Sigma \\ & \bullet \end{array} \right \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left \left \begin{array}{c} Z \\ & \bullet \end{array} \right \left \left $	Arial	▼10 ▼ B I U ■ 書 書 圉 \$ % , ‰ ☆ 倖 倖 ⊞・											
	B16 -	fx =S	UM(D2:D14)													
	A	В	0.11		F G H I J K L											
1	duration (ms)	strength (V)	Predicted Set ta	arget cell to Min												
2	0.02	0.97	50.501668	-	solver Parameters											
3	0.03	0.7	33.8358333	1097.983	Set Target Celly											
4	0.04	0.58	25.50333324	621.1725												
5	0.05	0.495	20.50416649	400.3667	Equal To: C Max Min C Value of: 0 Close											
6	0.06	0.42	17.17166637	280.6183	By Changing Cells:											
7	0.07	0.37	14.79154714	207.981	\$B\$16:\$B\$17 Guess											
8	0.08	0.33	13.00666596	160.6979												
9	0.09	0.3	11.6186101	128.1109	-Subject to the Constraints: Options											
10	0.1	0.28	10.50833194	104.6188	Add											
11	0.11	0.26	9.600073909	87.23698												
12	0.13	0.24	8.203137975	63.41157	Change											
13	0.15	0.24	7.179161982	48.1 01: 1 1	Leset All											
14	0.17	0.225	6.396512789	38.0 Click the	ere to select Vrh & K											
15			sum of diff^2	569												
16	Vrh	1														
17	k	1														
18	· · · · · · · · · · · · · · · · · · ·															

10. Now you can click on **Solve** and Excel will minimize the difference between the predicted strength and actual strength by changing the values of V_{Rh} and k. A new window will popup after you click solve, just click **OK**.

	Microsoft Exce	l - Sciatic_Ne	rve_Lab_Fall_100303									
8	Eile Edit <u>V</u> ie	w <u>I</u> nsert Fo	rmat <u>T</u> ools <u>D</u> ata <u>W</u> indow	Help							Type a c	uestion for help
	i 🖻 🖬 🔒 🤞	5 B 0 -	🔹 z - 21 Z1 🛍 🤉	≫ Arial		+ 10 +	BZ	u = =	=	\$%,	*.0 .00 ∉	= f= 🗐 • 👌
	B18 👻	fx										
	A	В	С	D	E	F	G	Н	l II	J	K	L
1	duration (ms)	strength (V)	Predicted Strength (V)	Diff^2								
2	0.02	0.97	1.10274818	0.017622							2	1
3	0.03	0.7	0.727823061	0.000774								
4	0.04	0.58	0.540397651	0.001568		Solver F	esults					2
5	0.05	0.495	0.427972116	0.004493		SSAVET 1						
6	0.06	0.42	0.353046511	0.004483		Solver ha	as converged	to the curren	t solution. A	All .		
7	0.07	0.37	0.299549428	0.004963		constrain	its are satisf	ied.		B	eports	
8	0.08	0.33	0.25944516	0.004978						F	Inswer	A
9	0.09	0.3	0.228269428	0.005145		• <u>K</u> ee	p Solver Sol	ution		9	iensitivity	
10	0.1	0.28	0.203343659	0.005876		CRe	tore Origina	l Values		Ľ	IIIIICS	-
11	0.11	0.26	0.182963309	0.005935						,		_
12	0.13	0.24	0.151643054	0.007807			к	Cancel	Save	Scenario	H	elp
13	0.15	0.24	0.128714243	0.012385				-				
14	0.17	0.225	0.111215112	0.012947								
15			sum of diff^2	0.088976								
16	Vrh	-0.04479756										
17	k	-0.50225872										
18										1		
19												
20												

11. Now plot both the actual and predicted values in Excel. You can do this by highlighting the duration, strength and predicted strength columns as shown below. Then click on the **Chart Wizard** button.

🔀 A	Kicrosoft Excel - Sciatic_Nerve_Lab_Fall_100303											
8	<u>Eile E</u> dit <u>V</u> ie	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools <u>D</u> ata <u>W</u> ir	ndow <u>H</u> elp								
D	🖻 🖬 🔒 🤞	s 🖻 🗠 -	🗟 Σ 🗕 🤶 🕺	👔 🏆 Arial								
	A2 🗸	<i>f</i> ≈ 0.02	2									
	А	В	С	Chart Wizard	E							
1	duration (ms)	strength (V)	Predicted Strength (V) Diff^2								
2	0.02	0.97	1.10274818	0.017622								
3	0.03	0.7	0.727823061	0.000774								
4	0.04	0.58	0.540397651	0.001568								
5	0.05	0.495	0.427972116	0.004493								
6	0.06	0.42	0.353046511	0.004483								
7	0.07	0.37	0.299549428	0.004963								
8	0.08	0.33	0.25944516	0.004978								
9	0.09	0.3	0.228269428	0.005145								
10	0.1	0.28	0.203343659	0.005876								
11	0.11	0.26	0.182963309	0.005935								
12	0.13	0.24	0.151643054	0.007807								
13	0.15	0.24	0.128714243	0.012385								
14	0.17	0.225	0.111215112	0.012947								
15			sum of diff^2	0.088976								
16	Vrh	-0.04479756										
17	k	-0.50225872										
18												
19												

12. Select XY scatter as the chart type and click finish.

	Aicrosoft E	xcel - Sciatic_Ne	erve_Lab_Fall_100	303									
8	<u>Eile E</u> dit	View Insert F	ormat <u>T</u> ools <u>D</u> ata	Window	Help								T
n		ABO	Δ. Σ - ΔΙ ΖΙ	11 2	» Arial	• 10	- B	7 U	EE		\$ %		+.0
	A2	▼ fv ∩ ſ	12		• (=) (100
	A	B	C		6								
1	duration (ms) strength (V)	Predicted Streng	th (V)	D Chart Wizard -	Step 1 of 4	- Char	rt Type					
2	0.02	0.97	1.10274818			Custom Tur							1
3	0.03	0.7	0.727823061		0	Custom typ	ies				1		
4	0.04	0.58	0.540397651		0 Chart type:		Char	t sub- <u>t</u> ype	:				
5	0.05	0.495	0.427972116			_	-					L	
6	0.06	0.42	0.353046511		0 🖪 Bar			•				L	-
7	0.07	0.37	0.299549428					•					-
8	0.08	0.33	0.25944516							-			
9	0.09	0.3	0.228269428		U XY (Scatter)			\sim	IN			-	
10	0.1	0.28	0.203343659		Area				N				_
11	0.11	0.26	0.152963309		Doughnut			•				-	-
12	0.15	0.24	0.101040004			_			b.			E-	-
14	0.15	0.24	0.120714243	-	0 0 Bubble			\mathcal{A}	XX			-	-
15	0.17	0.225	sum of diff^2		O Itti Stock	-	1	- J	1 A				-
16	Vrh	-0.04479758	i i i i i i i i i i i i i i i i i i i										
17	k	-0.50225872	2		-		Scati	ter. Compa	ares pairs of	values.			
18													
19		1											
20								Press an	d Hold to Vie	w Sample			
21							-						1
22			4		0	Cancel	(er	Back	Next >	Тей	nish		-
23						Cancor		constr.	Toves	J			-
24						3	3	3			3		3

13. Now your predicted points are shown in pink and your actual values are shown in blue. Notice the predicted values do not fall exactly on top of the actual strength. This means the predicted values are not good.

N	Microsoft Excel	- Sciatic_Ne	ve_Lab_Fall	100303							
8	<u>File E</u> dit <u>V</u> ier	w <u>I</u> nsert F <u>o</u>	rmat <u>T</u> ools (<u>-</u> hart <u>W</u> indow	<u>H</u> elp						
D	൙ 🖪 🔒 é) 🖻 🗠 -	Q Σ - <u>2</u> ,	ZI 🛍 🕐	Arial		• 10 •	BI	<u>u</u> = =	三國 9	в%, [*]
C	hart Area 🚽	fx		1							
	A	B		С	D	E	F	G	Н		J
1	duration (ms)	strength (V)	Predicted St	rength (V)	Diff^2						_
2	0.02	0.97	1.10274818		0.017622						
3	0.03	0.7	0.727823061		0.000774						
4	0.04	0.58	0.540397651		0.001568						
5	0.05	0.495	0.427972116		0.004493						
6	0.06	0.42	0.353046511		0.004483						
7	0.07	0.37	0.299549428		0.004963						
8	0.08	0.33	0.25944516		0.004978						
9	0.09	0.3	0.228269428		0.005145						
10	0.1	0.28	0.203343659	4.2							
11	0.11	0.26	0.182963309	1.2					Chart Are	a	
12	0.13	0.24	0.151643054								
13	0.15	0.24	0.128714243	1							
14	0.17	0.225	0.111215112								
15			sum of diff^	0.8							
16	Vrh	-0.04479756			+					• Corico1	
17	k	-0.50225872		0.6	•					• Series I	
18				•	• •					Series2	
19				0.4							
20					•	· • • •					
21				0.2			* * *	+ •	•		
22				0.2			· · ·	1 1 1 1			
23											
24				U 	0.05		4	0.45			
25				U	0.05	U	.1	0.15	0.2		
26											
27											
28											
1 20											

14. To allow solver to minimize the sum of square of differences, the initial values for V_{Rh} and k have to be close to the final predicted values. So change V_{Rh} to 0.5 and k to 0.02.



15. Use solver again to solve. This is what you will get.

R 1	Microsoft Excel - Sciatic_Nerve_Lab_Fall_100303												
	<u>File E</u> dit <u>V</u> iev	w <u>I</u> nsert Fo	rmat <u>T</u> ools [ata <u>W</u> indow	Help								
D	🖻 🖪 🔒 🔮) b 10 +	🔒 Σ 🗕 🛓	👬 🛍 🕄	Arial		- 10	- B Z	u ≣≣		\$ %		
	B18 -	fx											
	A	В	(>	D	E	F	G	Н	1	J		
1	duration (ms)	strength (V)	Predicted St	rength (V)	Diff^2								
2	0.02	0.97	0.99635733		0.000695								
3	0.03	0.7	0.698601175		1.96E-06								
4	0.04	0.58	0.550547974		0.000867								
5	0.05	0.495	0.462370848		0.001065								
6	0.06	0.42	0.404126345		0.000252								
7	0.07	0.37	0.362980602		4.93E-05								
8	0.08	0.33	0.332515884		6.33E-06								
9	0.09	0.3	0.309166113		18 / E-US						<u> </u>		
10	0.1	0.20	0.290791072	1.2 -									
12	0.11	0.20	0.276026326										
13	0.15	0.24	0.238557103	1									
14	0.13	0.24	0.227373735	•									
15	0.11	0.220	sum of diff^	0.8									
16	√rh	0.18955131											
17	k	0.09477654		0.6						 Series 	\$1		
18					•••					Series	\$2		
19				n4									
20				0.4		1 							
21				0.2		· · ·	* + - +	ا <mark>ب</mark> ا					
22				0.2									
23													
24				0	0.05	0	1	0.15					
25				U	0.05	U	. 1	0.13	U.2				
20													
27			1										

Now you can use the predicted values to calculate the Chronaxie. This is the end of the tutorial.