

Excel for Hydrology

Section 5



Regression

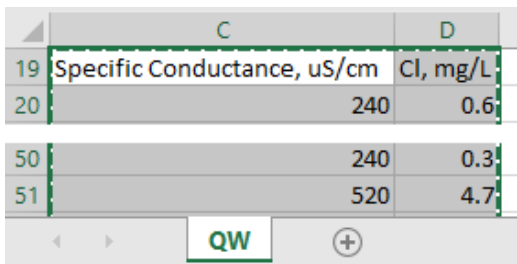
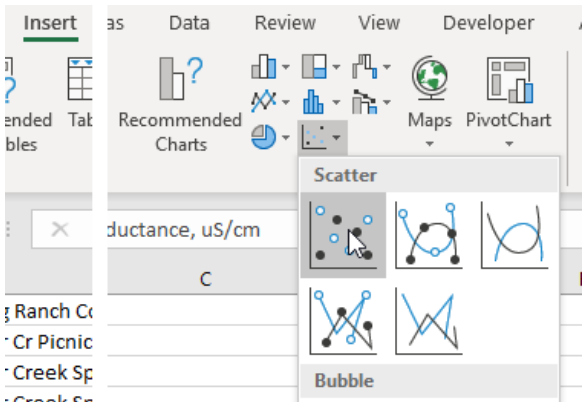
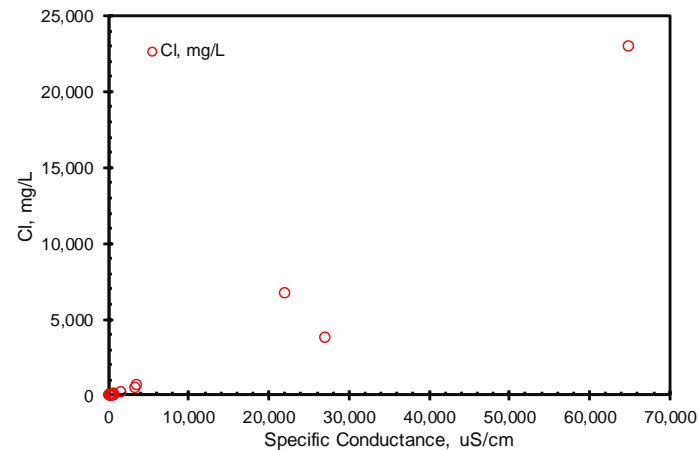
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05_Regression

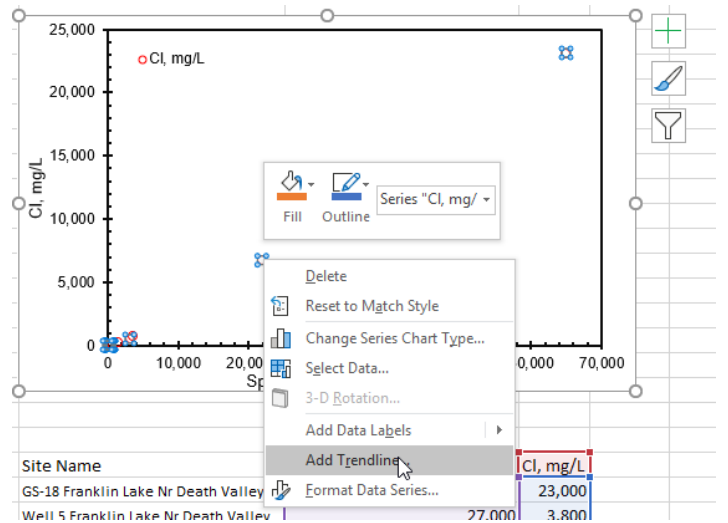
Linear and log-linear regressions are foundations of preliminary interpretations, which are computed quickly by adding trendlines to XY charts. This approach is fast, but estimated slope and intercept are not available for other equations. Alternatively, [SLOPE](#) and [INTERCEPT](#) are functions for linear regression, where estimated slope and intercept are available for other equations.

01_linearQW.xlsx Regression – Specific Conductance and Chloride

Regression by Trendline																
Select range C19: D54 .	 <table><tr><th></th><th>C</th><th>D</th></tr><tr><td>19</td><td>Specific Conductance, uS/cm</td><td>Cl, mg/L</td></tr><tr><td>20</td><td>240</td><td>0.6</td></tr><tr><td>50</td><td>240</td><td>0.3</td></tr><tr><td>51</td><td>520</td><td>4.7</td></tr></table>		C	D	19	Specific Conductance, uS/cm	Cl, mg/L	20	240	0.6	50	240	0.3	51	520	4.7
	C	D														
19	Specific Conductance, uS/cm	Cl, mg/L														
20	240	0.6														
50	240	0.3														
51	520	4.7														
Add XY chart of Specific Conductance and Chloride. Select "Scatter."																
XY chart with formatting for clarity.	 <table><caption>Scatter Plot Data</caption><tr><th>Specific Conductance (uS/cm)</th><th>Chloride (mg/L)</th></tr><tr><td>240</td><td>0.6</td></tr><tr><td>240</td><td>0.3</td></tr><tr><td>520</td><td>4.7</td></tr></table>	Specific Conductance (uS/cm)	Chloride (mg/L)	240	0.6	240	0.3	520	4.7							
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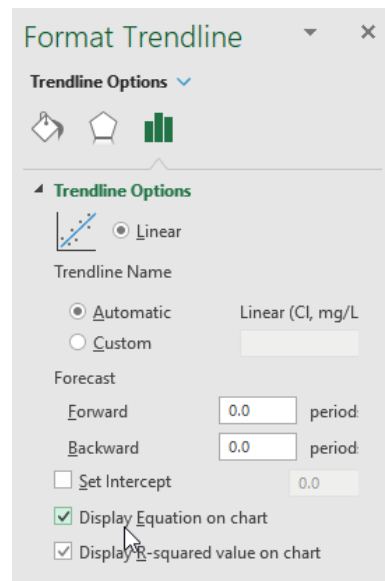
Select series.

Right-click and select “Add Trendline”
from dialog.

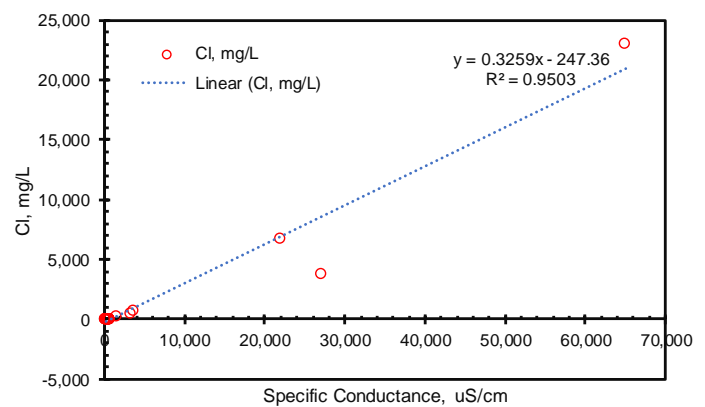


Select Trendline option, **Linear**.

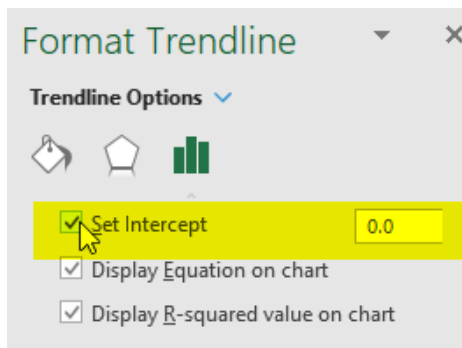
Check options,
“Display Equation on chart”, and
“Display R-squared value on chart”.



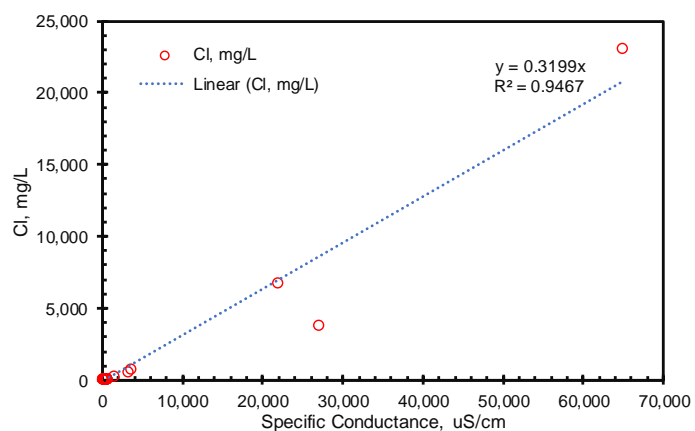
$r^2 > 0.95$, but equation is non-sensical.
Cl = -247 mg/L, negative concentration,
where SC = 0 $\mu\text{S}/\text{cm}$.



Format trendline and set intercept to 0.



r^2 marginally less, but
Results are physically possible.



01_linearQW.xlsx Regression – Specific Conductance and Chloride

Regression by Functions SLOPE+INTERCEPT	
Enter labels “Slope =” and “Intercept =” in cells D17 and D18 .	
Type function =SLOPE(into cell E17 . after typing “(” a reminder appears that First range is Ys and Second range is Xs .	
Complete equation with ranges, \$D\$20:\$D\$54 and \$C\$20:\$C\$54 . Finished formula reads, “=SLOPE(\$D\$20:\$D\$54,\$C\$20:\$C\$54)”	
Copy cell E17 . Paste to cell E18 .	
Open cell E18 for editing with F2. Change SLOPE to INTERCEPT. Finished formula reads, “=INTERCEPT(\$D\$20:\$D\$54,\$C\$20:\$C\$54)”	
PLUS: slope and intercept available. MINUS: Intercept cannot be specified.	
Can control reporting of estimated Cl with a threshold value. Add Threshold Cl =, 100, mg/L to range D16:F16 .	

<p>Add header equation to cell E19, ="Estimated "&D19.</p>	<table><tr><th></th><th>D</th><th>E</th><th>F</th></tr><tr><td>16</td><td>Threshold CI =</td><td>100</td><td>mg/L</td></tr><tr><td>17</td><td>Slope =</td><td>0.325914416</td><td></td></tr><tr><td>18</td><td>Intercept =</td><td>-247.3570052</td><td></td></tr><tr><td>19</td><td>CI, mg/L</td><td colspan="2">="Estimated "&D19</td></tr><tr><td>20</td><td>23,000</td><td>20,937</td><td></td></tr><tr><td>21</td><td>3,800</td><td>8,552</td><td></td></tr></table>		D	E	F	16	Threshold CI =	100	mg/L	17	Slope =	0.325914416		18	Intercept =	-247.3570052		19	CI, mg/L	="Estimated "&D19		20	23,000	20,937		21	3,800	8,552																																													
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<p>Add censored estimate equation cell E20 =IF(C20*\$E\$17+\$E\$18>\$E\$16, C20*\$E\$17+\$E\$18, "< "&TEXT(\$E\$16,"0")).</p>	<table><tr><th></th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th></tr><tr><td>16</td><td></td><td>Threshold CI =</td><td>100</td><td>mg/L</td><td></td><td></td><td></td><td></td></tr><tr><td>17</td><td></td><td>Slope =</td><td>0.325914416</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>18</td><td></td><td>Intercept =</td><td>-247.3570052</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>19</td><td></td><td>Specific Conduc CI, mg/L</td><td>Estimated CI, mg/L</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td>65,000</td><td>23,000</td><td colspan="6">=IF(C20*\$E\$17+\$E\$18>\$E\$16,C20*\$E\$17+\$E\$18,"< "&TEXT(\$E\$16,"0"))</td></tr><tr><td>21</td><td>27,000</td><td>3,800</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>22</td><td>22,000</td><td>6,700</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>		C	D	E	F	G	H	I	J	16		Threshold CI =	100	mg/L					17		Slope =	0.325914416						18		Intercept =	-247.3570052						19		Specific Conduc CI, mg/L	Estimated CI, mg/L						20	65,000	23,000	=IF(C20*\$E\$17+\$E\$18>\$E\$16,C20*\$E\$17+\$E\$18,"< "&TEXT(\$E\$16,"0"))						21	27,000	3,800							22	22,000	6,700						
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<p>Copy cell E20. Paste to range E20:E54. Estimated CI values less than the threshold are censored.</p>	<table><tr><th></th><th>C</th><th>D</th><th>E</th><th></th></tr><tr><td>19</td><td>Specific Conduc</td><td>CI, mg/L</td><td>Estimated CI, mg/L</td><td></td></tr><tr><td>20</td><td>65,000</td><td>23,000</td><td>20,937</td><td></td></tr><tr><td>21</td><td>27,000</td><td>3,800</td><td>8,552</td><td></td></tr><tr><td>22</td><td>22,000</td><td>6,700</td><td>6,923</td><td></td></tr><tr><td>23</td><td>3,600</td><td>690</td><td>926</td><td></td></tr><tr><td>24</td><td>3,300</td><td>480</td><td>828</td><td></td></tr><tr><td>25</td><td>1,570</td><td>200</td><td>264</td><td></td></tr><tr><td>26</td><td>700</td><td>41</td><td>< 100</td><td></td></tr><tr><td>27</td><td>670</td><td>1</td><td>< 100</td><td></td></tr><tr><td>28</td><td>630</td><td>16</td><td>< 100</td><td></td></tr></table>		C	D	E		19	Specific Conduc	CI, mg/L	Estimated CI, mg/L		20	65,000	23,000	20,937		21	27,000	3,800	8,552		22	22,000	6,700	6,923		23	3,600	690	926		24	3,300	480	828		25	1,570	200	264		26	700	41	< 100		27	670	1	< 100		28	630	16	< 100																		
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02_Example_T-SC-DeathValley+OtherSCeqs.xlsx – Log-Log Regression

Log-Log Regression by Functions SLOPE+INTERCEPT

Enter labels “Slope =” and “Intercept =” in cells **G16** and **G17**.

	G	H
16	Slope =	
17	Intercept =	
18	MEASURED	
19	SC, gpm/ft	

Add slope function in cell **H16**.

Note:

Ys in column F and

Xs in column G.

	F	G	H	I	J
16		Slope =	=SLOPE(\$F\$20:\$F\$34,\$G\$20:\$G\$34)		
17		Intercept =			
18		MEASURED			
19	T-ft ² /d	SC, gpm/ft			
20	5	0.04			

Add intercept function in cell **H17**.

Add header, T-estimated, ft²/d to cell **H19**.

	F	G	H	I	J
16		Slope =	1032.793876		
17		Intercept =	=INTERCEPT(\$F\$20:\$F\$34,\$G\$20:\$G\$34)		
18		MEASURED			
19	T-ft ² /d	SC, gpm/ft	T-estimated, ft ² /d		
20	5	0.04			

Estimate T with regression in cell **H20**.

With, =G20*\$H\$16+\$H\$17

Copy cell **H20**.

Paste to range **H20:H34**.

	F	G	H
16		Slope =	1032.793876
17		Intercept =	-4354.02532
18		MEASURED	
19	T-ft ² /d	SC, gpm/ft	T-estimated, ft ² /d
20	5	0.04	=G20*\$H\$16+\$H\$17
21	7	0.24	
22	53	0.18	

Whoa, Negative transmissivities,

Seriously wrong results because regressed SC vs. T rather than log(SC) vs. log(T).

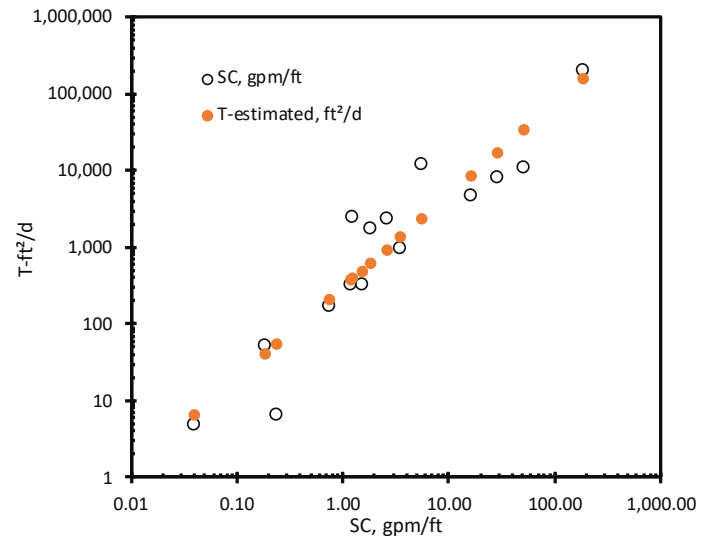
	F	G	H
16		Slope =	1032.793876
17		Intercept =	-4354.02532
18		MEASURED	
19	T-ft ² /d	SC, gpm/ft	T-estimated, ft ² /d
20	5	0.04	-4,313
21	7	0.24	-4,108
22	53	0.18	-4,165
23	173	0.73	-3,603
24	323	1.18	-3,132

Open cell H16 for editing with F2.	<table><tr><td></td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td></tr><tr><td>16</td><td></td><td>Slope =</td><td>=SLOPE(log(\$F\$20:\$F\$34),log(\$G\$20:\$G\$34))</td><td></td><td></td></tr><tr><td>17</td><td></td><td>Intercept =</td><td>SLOPE(known_ys, known_xs)</td><td></td><td></td></tr><tr><td>18</td><td></td><td>MEASURED</td><td></td><td></td><td></td></tr><tr><td>19</td><td>T-ft²/d</td><td>SC, gpm/ft</td><td>T-estimated, ft²/d</td><td></td><td></td></tr></table>		F	G	H	I	J	16		Slope =	=SLOPE(log(\$F\$20:\$F\$34),log(\$G\$20:\$G\$34))			17		Intercept =	SLOPE(known_ys, known_xs)			18		MEASURED				19	T-ft²/d	SC, gpm/ft	T-estimated, ft²/d														
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Encapsulate each range with log, log(range) .																																											
Revised formula reads, "=SLOPE(log(\$F\$20:\$F\$34),log(\$G\$20:\$G\$34))"																																											
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Revise INTERCEPT equation by encapsulating each range with log, log(range) .																																											
Less wrong but still wrong.	<table><tr><td></td><td>G</td><td>H</td></tr><tr><td></td><td>Slope =</td><td>1.198827406</td></tr><tr><td></td><td>Intercept =</td><td>2.485923078</td></tr><tr><td></td><td>MEASURED</td><td></td></tr><tr><td></td><td>SC, gpm/ft</td><td>T-estimated, ft²/d</td></tr><tr><td>5</td><td>0.04</td><td>3</td></tr><tr><td>7</td><td>0.24</td><td>3</td></tr></table>		G	H		Slope =	1.198827406		Intercept =	2.485923078		MEASURED			SC, gpm/ft	T-estimated, ft²/d	5	0.04	3	7	0.24	3																					
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Equation is log(T) = A*log(SC) + B, T = 10^[A*log(SC) + B], or T = 10^B * SC^A																																											
Revise estimate T in cell H20 with T = 10^[A*log(SC) + B]	<table><tr><td></td><td>G</td><td>H</td><td>I</td></tr><tr><td>16</td><td>Slope =</td><td>1.198827406</td><td></td></tr><tr><td>17</td><td>Intercept =</td><td>2.485923078</td><td></td></tr><tr><td>18</td><td>MEASURED</td><td></td><td></td></tr><tr><td>19</td><td>SC, gpm/ft</td><td>T-estimated, ft²/d</td><td></td></tr><tr><td>20</td><td>0.04</td><td>=10^(LOG(G20)*\$H\$16+\$H\$17)</td><td></td></tr><tr><td>21</td><td>0.24</td><td>3</td><td></td></tr><tr><td>22</td><td>0.18</td><td>3</td><td></td></tr></table>		G	H	I	16	Slope =	1.198827406		17	Intercept =	2.485923078		18	MEASURED			19	SC, gpm/ft	T-estimated, ft²/d		20	0.04	=10^(LOG(G20)*\$H\$16+\$H\$17)		21	0.24	3		22	0.18	3											
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Estimated Ts seem plausible.	<table><tr><td></td><td>F</td><td>G</td><td>H</td></tr><tr><td>17</td><td></td><td>Intercept =</td><td>2.485923078</td></tr><tr><td>18</td><td></td><td>MEASURED</td><td></td></tr><tr><td>19</td><td>T-ft²/d</td><td>SC, gpm/ft</td><td>T-estimated, ft²/d</td></tr><tr><td>20</td><td></td><td>5</td><td>0.04</td><td>61</td></tr><tr><td>21</td><td></td><td>7</td><td>0.24</td><td>55</td></tr><tr><td>22</td><td></td><td>53</td><td>0.18</td><td>40</td></tr><tr><td>23</td><td></td><td>173</td><td>0.73</td><td>209</td></tr><tr><td>24</td><td></td><td>323</td><td>1.18</td><td>374</td></tr></table>		F	G	H	17		Intercept =	2.485923078	18		MEASURED		19	T-ft²/d	SC, gpm/ft	T-estimated, ft²/d	20		5	0.04	61	21		7	0.24	55	22		53	0.18	40	23		173	0.73	209	24		323	1.18	374	
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Copy range H19:H34 .																																											

Select XY chart.

Paste special and
add series, **T-estimated, ft²/d**.

Add legend.



Revise series, **T-estimated, ft²/d**, from
markers to a solid line.

