Linear Regression
Standard error of a slope

From RLS to Trumpets

RLS = Robust Least Squares

Trumpets = Calculate Upper and Lower 95% Confidence Limits

There are two regression worksheets: RLS and Trumpets

Week 1 - Introductory Material and Course Logistics

CH452 Zoom meetings link

CH452- Syllabus Fall 2021

Excel Macros sheets

Data Recording AND Reporting

- Find in this book detailed instructions about writing a lab report as well as links to oral presentation and written lab report RUBRICS.

Homework#1- Data Recording AND Reporting- UPLOAD

UPLOAD here your annotated graded sample lab report

Introduction to Statistics, Rounding - the Rule of 2 and 15- AND Propagation of Error

Homework#2 - Rounding - the Rule of 2 and 15 AND Propagation of Error - UPLOAD

8/20 CH452 - Pre-assessment

Introduction to Statistics - (Intro, Error types, Physical measurements and

Calendar

August 2021

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Hide site events
Hide category events
Hide course events
Hide group events
Hide user events
Hide other events

Activities

Assignments
Forums
Quizzes

translate english | Inbox (351) - ste | trumpet excel - f | CH 452 (001) FAL | Post Attendee - | Undergraduate Cour | translate english | My Current Cour

https://moodle-courses2122.wolfware.ncsu.edu/mod/folder/view.php?id=375491

NC STATE Courses 2021-2022

Stefan Franzen

CH 452 (001) Fall 2021 Advanced Measurement Techniques I

WolfWare / Dashboard / My courses / CH 452 (001) FALL 2021 / Week 1 - Introductory Material and Course Logistics / Excel Macros sheets

- CH 452 (001) FALL 2021
- Participants
- Grades
- Week 1 - Introductory Material and Course Logistics
- Week 2 - Practice Lab & Distributions Computer Lab
- Week 3 - Lab Experiment 1
- Week 4 - Computer lab 3
- Week 5 - Lab Experiment 2
- Week 6 - Lab

Excel Macros sheets

- RLSmacro.xls
- SolvStat.xls
- trumpetExcel.xls

Downloads of the Excel Spreadsheets

Download folder | Edit

◄ CH452- Syllabus Fall 2021 | Jump to... | Data Recording AND Reporting ►

Moodle Docs for this page

Type here to search

91°F SWE 4:40 PM 8/27/2021

Let’s follow the download of the trumpets

Airplane mode off

moodle-courses2122.wolfware.ncsu.edu/mod/folder/view.php?id=375491

NC STATE Courses 2021-2022

- CH 452 (001) FALL 2021
- Participants
- Grades
- Week 1 - Introductory Material and Course Logistics
- Week 2 - Practice Lab & Distributions Computer Lab
- Week 3 - Lab Experiment 1
- Week 4 - Computer lab 3
- Week 5 - Lab Experiment 2
- Week 6 - Lab

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Excel Macros sheets

- RLSmacro.xls
- SolvStat.xls
- trumpetExcel.xls

Download folder | Edit

◄ CH452- Syllabus Fall 2021 | Jump to... | Data Recording AND Reporting ►

Moodle Docs for this page

Opening trumpetExcel.xls

You have chosen to open:

trumpetExcel.xls

which is: Microsoft Excel 97-2003 Worksheet (52.5 KB)

from: https://moodle-courses2122.wolfware.ncsu.edu

What should Firefox do with this file?

Open with Excel 2016 (default)

Save File

Do this automatically for files like this from now on.

OK Cancel

Download Trumpet Excel

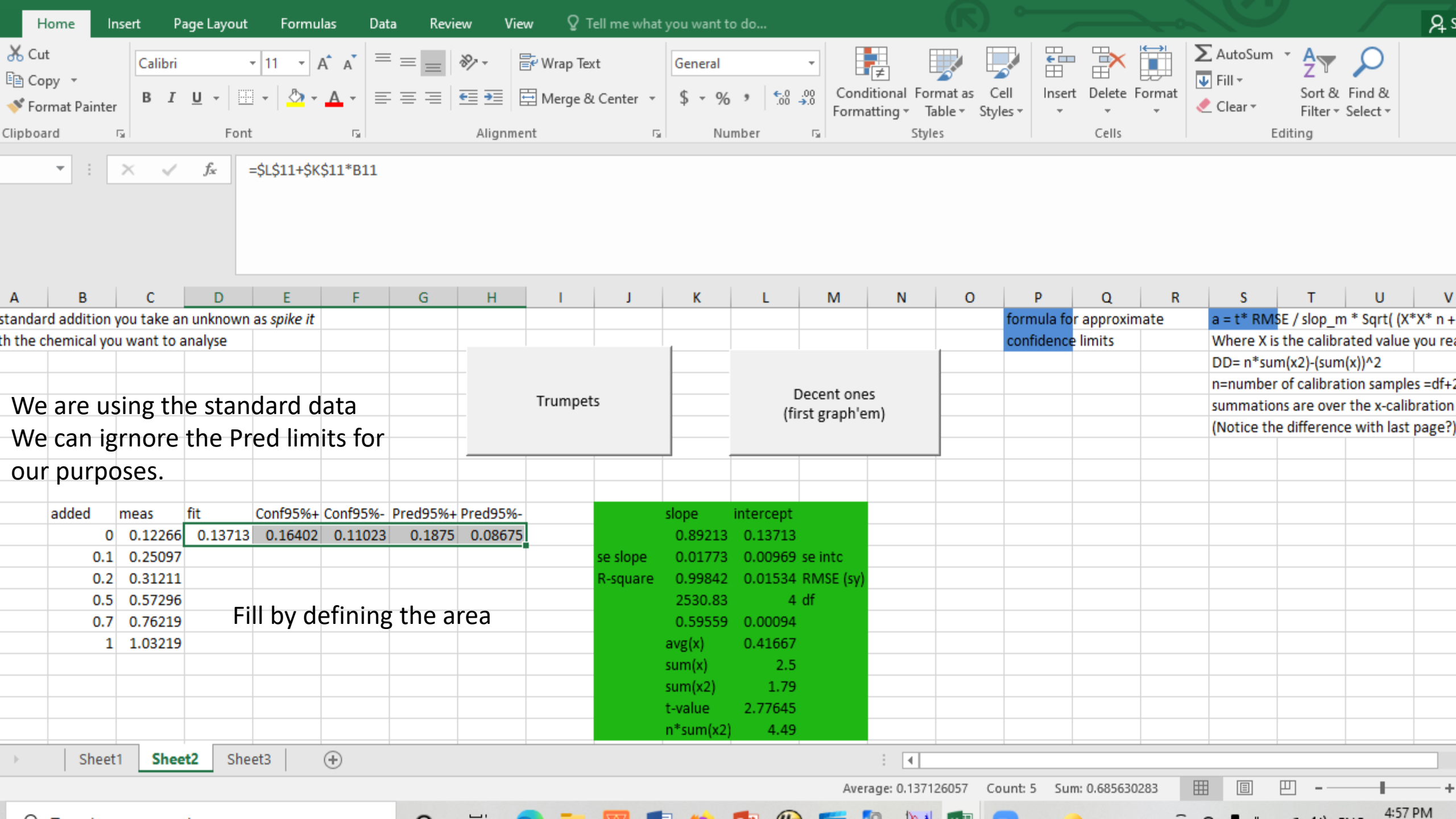
4:43 PM

Trumpets: the confidence limits of a line

The calibration error can statistically be represented by drawing the 95% **confidence** limits around the calibration line. These limits form the two branches of a hyperbolic function. The two sets of hyperbolic branches are given by:

$$Y_{confidence} = sX + b \pm t\ RMSE \sqrt{\frac{1}{N} + \frac{N(X - \bar{X})^2}{N\sum X^2 - (\sum X)^2}}$$

These are the trumpets. The t is determined using the t-test.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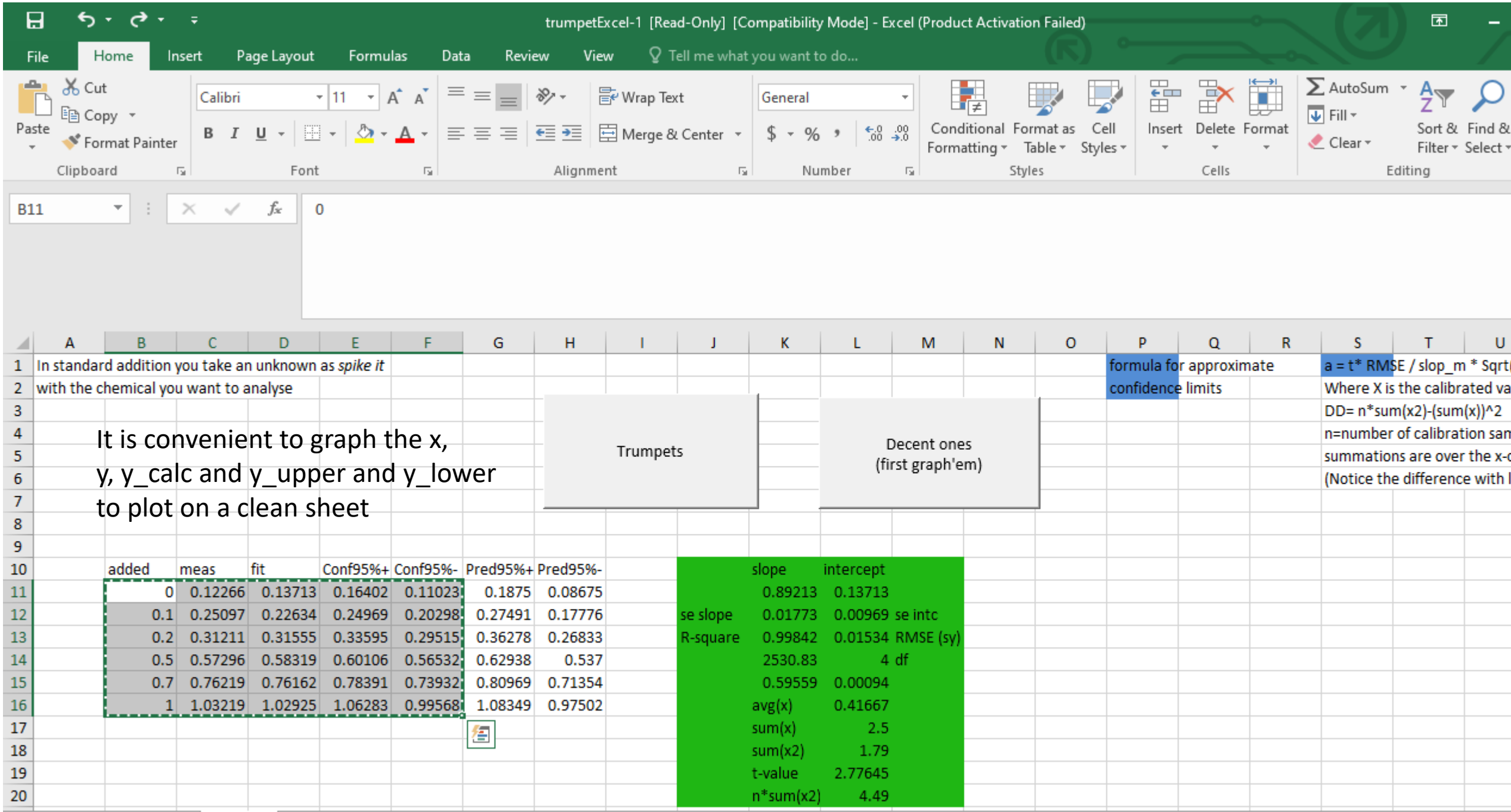
=$L$11+$K$11*B11
standard addition you take an unknown as spike it
th the chemical you want to analyse
formula for approximate confidence limits
a = t* RMSE / slop_m * Sqrt((X*X* n +
Where X is the calibrated value you rea
DD= n*sum(x2)-(sum(x))^2
n=number of calibration samples =df+2
summations are over the x-calibration
(Notice the difference with last page?)
Trumpets
Decent ones (first graph'em)
We are using the standard data
We can igrnore the Pred limits for our purposes.
added meas fit Conf95%+ Conf95%- Pred95%+ Pred95%-
0 0.12266 0.13713 0.16402 0.11023 0.1875 0.08675
0.1 0.25097
0.2 0.31211
0.5 0.57296
0.7 0.76219
1 1.03219
Fill by defining the area
slope intercept
0.89213 0.13713
se slope 0.01773 0.00969 se intc
R-square 0.99842 0.01534 RMSE (sy)
2530.83 4 df
0.59559 0.00094
avg(x) 0.41667
sum(x) 2.5
sum(x2) 1.79
t-value 2.77645
n*sum(x2) 4.49
Sheet1
Sheet2
Sheet3
Average: 0.137126057 Count: 5 Sum: 0.685630283
4:57 PM


trumpetExcel-1 [Read-Only] [Compatibility Mode] - Excel (Product Activation Failed)
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Wrap Text Merge & Center
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Conditional Formatting Format as Table Cell Styles
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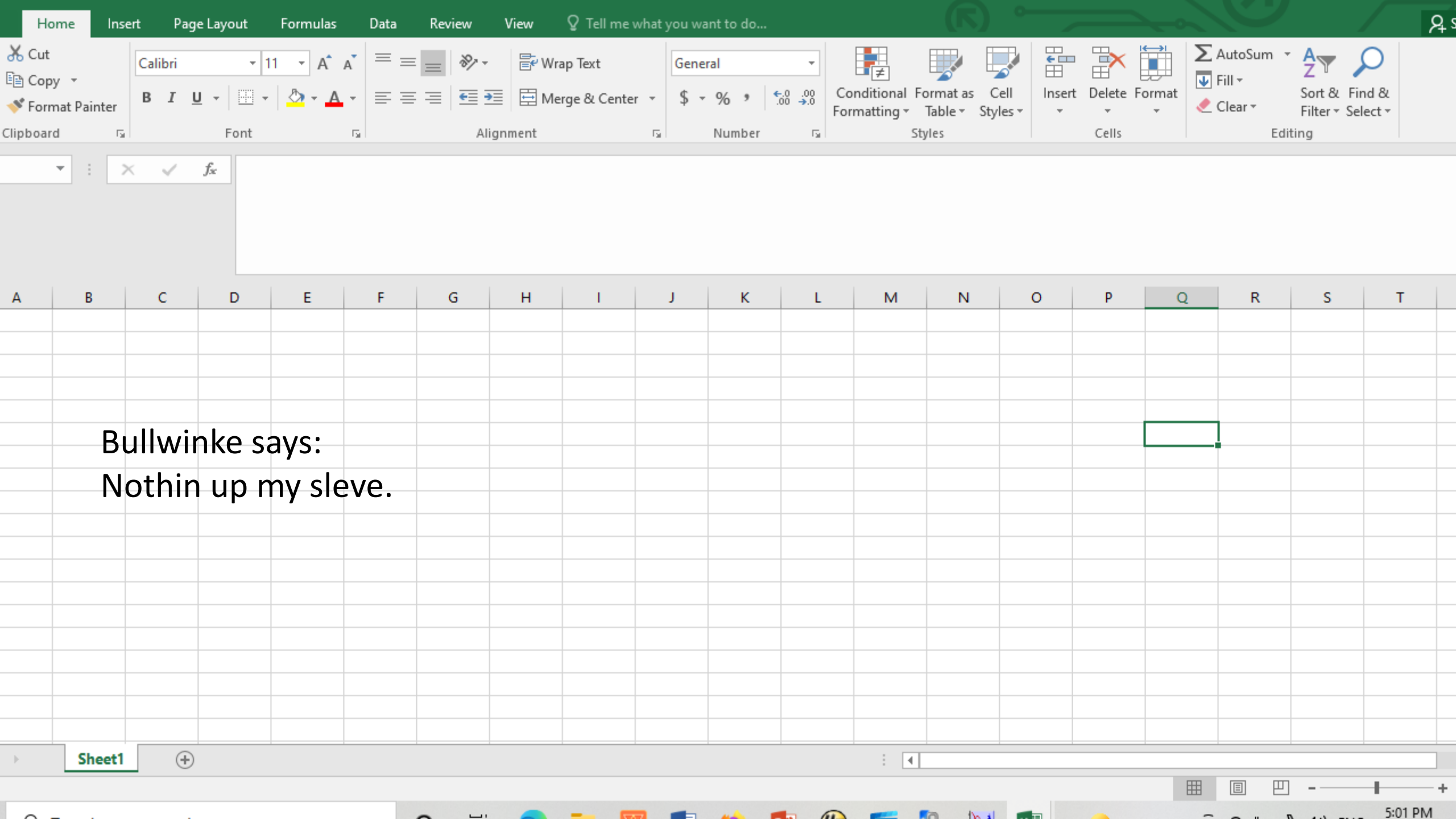
B11
0
In standard addition you take an unknown as spike it
with the chemical you want to analyse
It is convenient to graph the x,
y, y_calc and y_upper and y_lower
to plot on a clean sheet
Trumpets
Decent ones
(first graph'em)
formula for approximate
confidence limits
a = t* RMSE / slop_m * Sqrt(
Where X is the calibrated valu
DD= n*sum(x2)-(sum(x))^2
n=number of calibration sam
summations are over the x-ca
(Notice the difference with la
added meas fit Conf95%+ Conf95%- Pred95%+ Pred95%-
0 0.12266 0.13713 0.16402 0.11023 0.1875 0.08675
0.1 0.25097 0.22634 0.24969 0.20298 0.27491 0.17776
0.2 0.31211 0.31555 0.33595 0.29515 0.36278 0.26833
0.5 0.57296 0.58319 0.60106 0.56532 0.62938 0.537
0.7 0.76219 0.76162 0.78391 0.73932 0.80969 0.71354
1 1.03219 1.02925 1.06283 0.99568 1.08349 0.97502
slope intercept
0.89213 0.13713
se slope 0.01773 0.00969 se intc
R-square 0.99842 0.01534 RMSE (sy)
2530.83 4 df
0.59559 0.00094
avg(x) 0.41667
sum(x) 2.5
sum(x2) 1.79
t-value 2.77645
n*sum(x2) 4.49
Sheet1 Sheet2 Sheet3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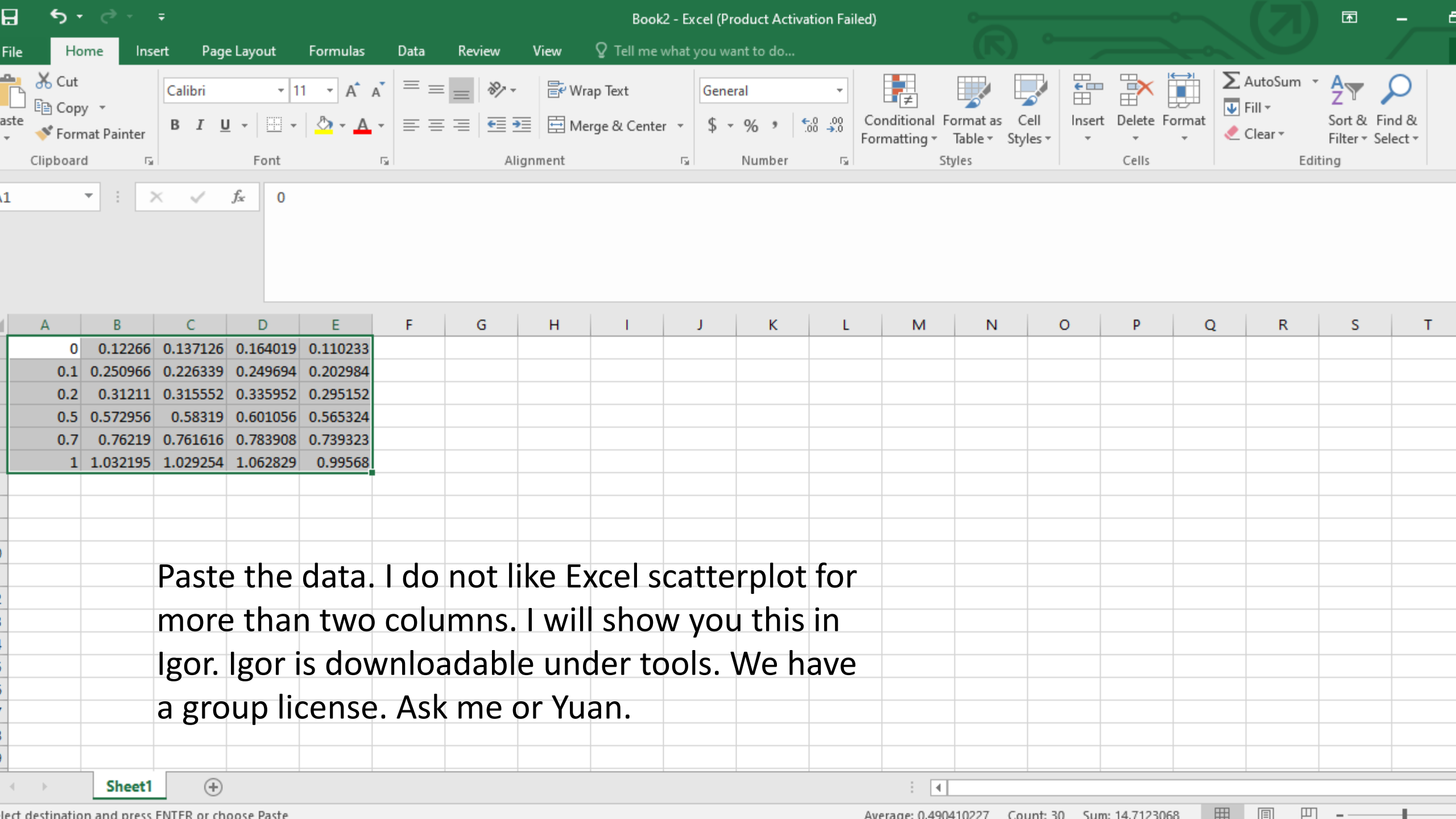
Bullwinke says:
Nothin up my sleve.
Sheet1
5:01 PM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0 0.12266 0.137126 0.164019 0.110233
0.1 0.250966 0.226339 0.249694 0.202984
0.2 0.31211 0.315552 0.335952 0.295152
0.5 0.572956 0.58319 0.601056 0.565324
0.7 0.76219 0.761616 0.783908 0.739323
1 1.032195 1.029254 1.062829 0.99568
Paste the data. I do not like Excel scatterplot for more than two columns. I will show you this in Igor. Igor is downloadable under tools. We have a group license. Ask me or Yuan.
Sheet1
lect destination and press ENTER or choose Paste
Average: 0.490410227
Count: 30
Sum: 14.7123068

Paste the data. I do not like Excel scatterplot f
more than two columns. I will show you this i
Igor. Igor is downloadable under tools. We ha
a group license. Ask me or Yuan.

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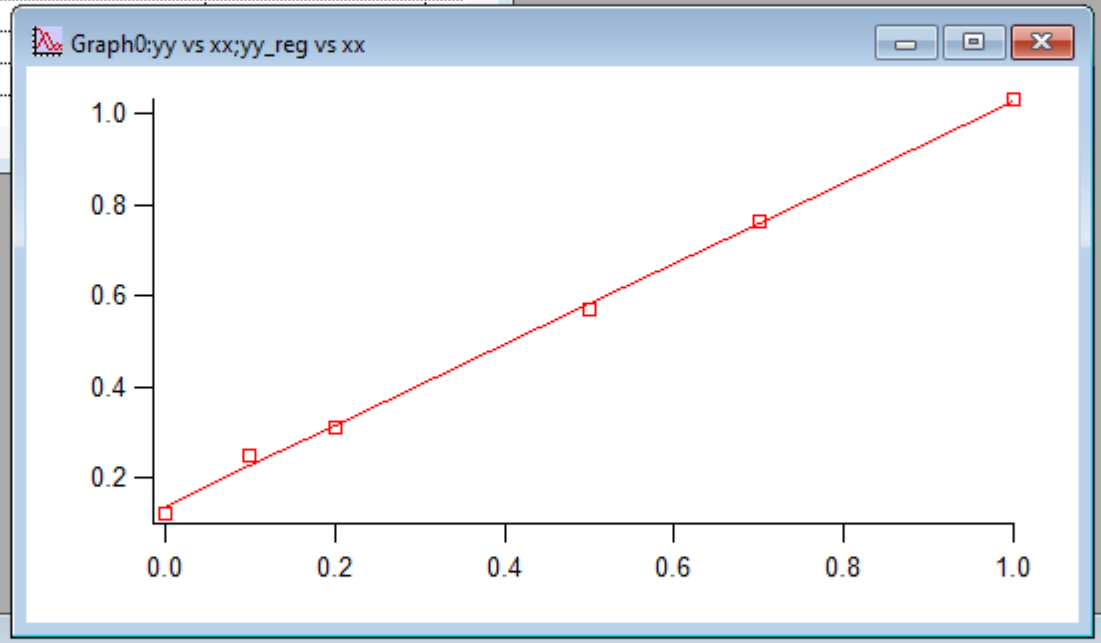
Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					



Untitled

```
•rename wave2 yy_reg
•rename wave3 yy_upp
•rename wave4 yy_low
•display yy vs xx
•ModifyGraph mode=3,marker=5
•appendtograph yy_reg vs xx
```

ady

Type here to search

92°F ENG 5:07 PM 8/27/20

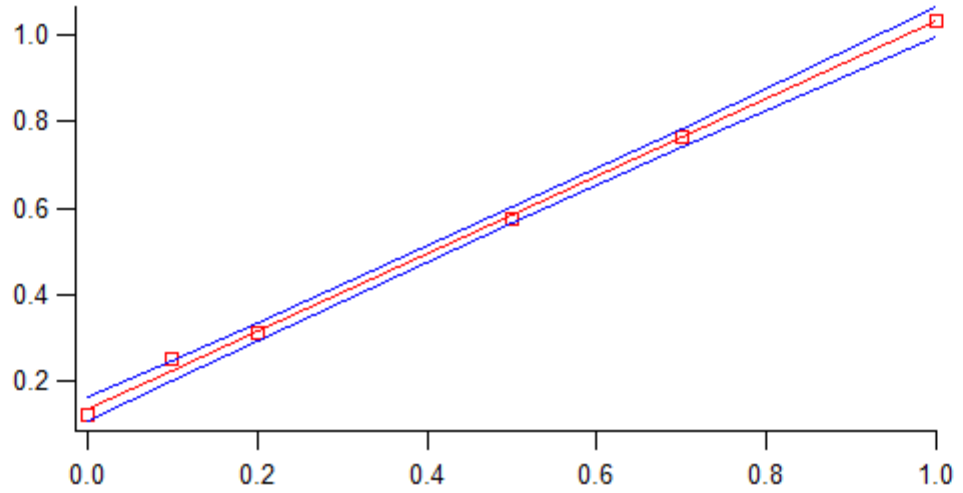
Edit Data Analysis Macros Windows Graph Misc Help

ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Graph0:yy vs xx;yy_reg vs xx;...



ntitled

```
play yy vs xx
difyGraph mode=3,marker=5
pendtograph yy_reg vs xx
pendtograph yy_upp vs xx
pendtograph yy_low vs xx
difyGraph rgb(yy_upp)=(0,0,65280),rgb(yy_low)=(0,0,65280)
```

5:08 PM

Igor Pro 5.00

File Edit Data Analysis Macros Windows Graph Misc Help

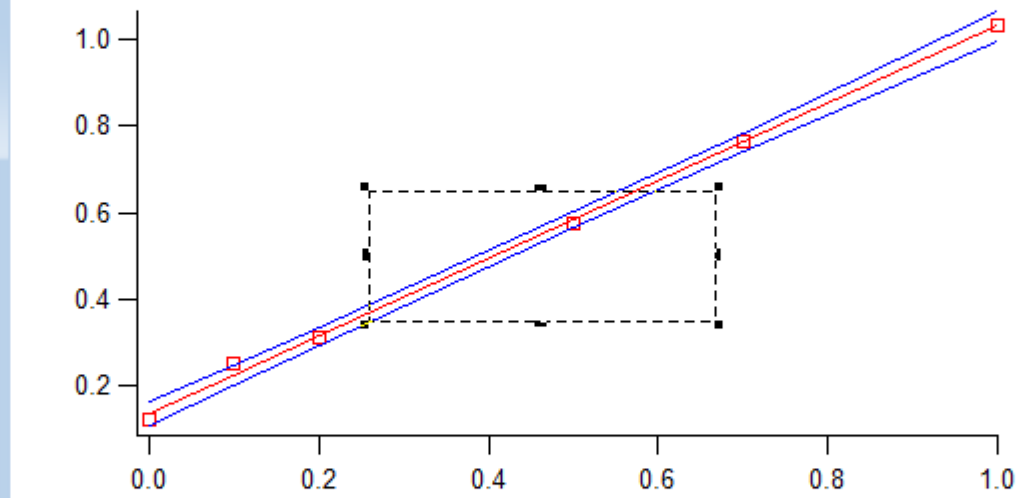
Table0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Expand a selection.

Graph0:yy vs xx;yy_reg vs xx;...



Untitled

```
•display yy vs xx
•ModifyGraph mode=3,marker=5
•appendtograph yy_reg vs xx
•appendtograph yy_upp vs xx
•appendtograph yy_low vs xx
•ModifyGraph rgb(yy_upp)=(0,0,65280),rgb(yy_low)=(0,0,65280)
```

Ready

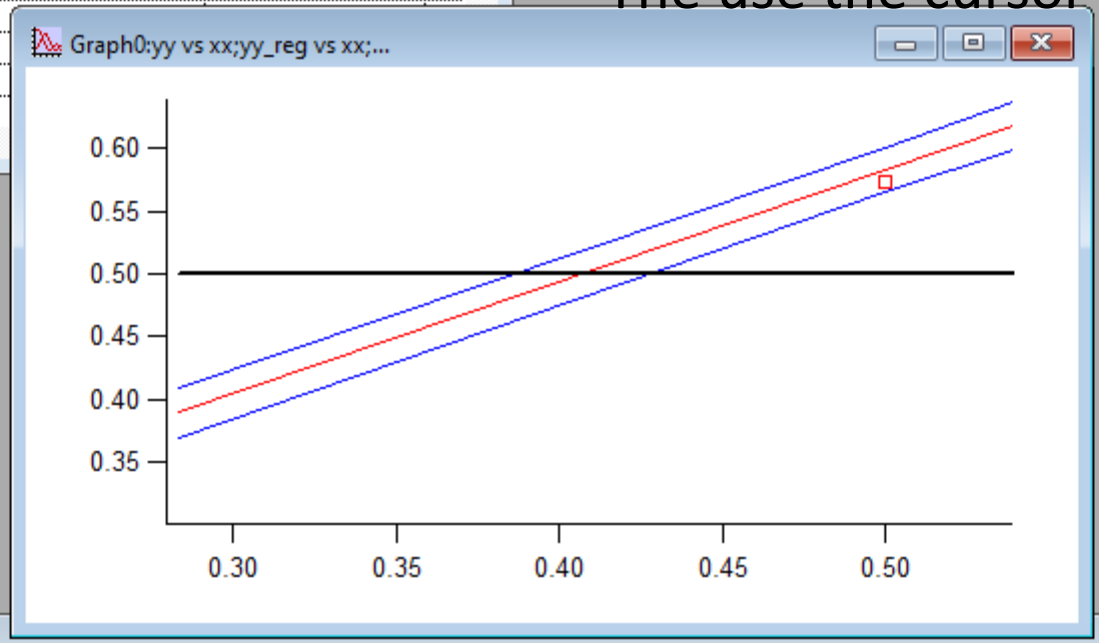
Edit Data Analysis Macros Windows Graph Misc Help

ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Draw a horizontal line.
Use 10000 points or so.
Make /n=10000 yy_cal,xx_cal
xx_cal=x/10000 (so the range is 0 to 1)
The use the cursor (<crtl>I).



ntitled

```
difyGraph rgb(yy_upp)=(0,0,65280),rgb(yy_low)=(0,0,65280)
olicate yy yy_cal
_cal=0.5
pendtograph yy_cal vs xx
difyGraph rgb(yy_cal)=(0,0,0)
difyGraph lsize(yy_cal)=2
```

5:10 PM

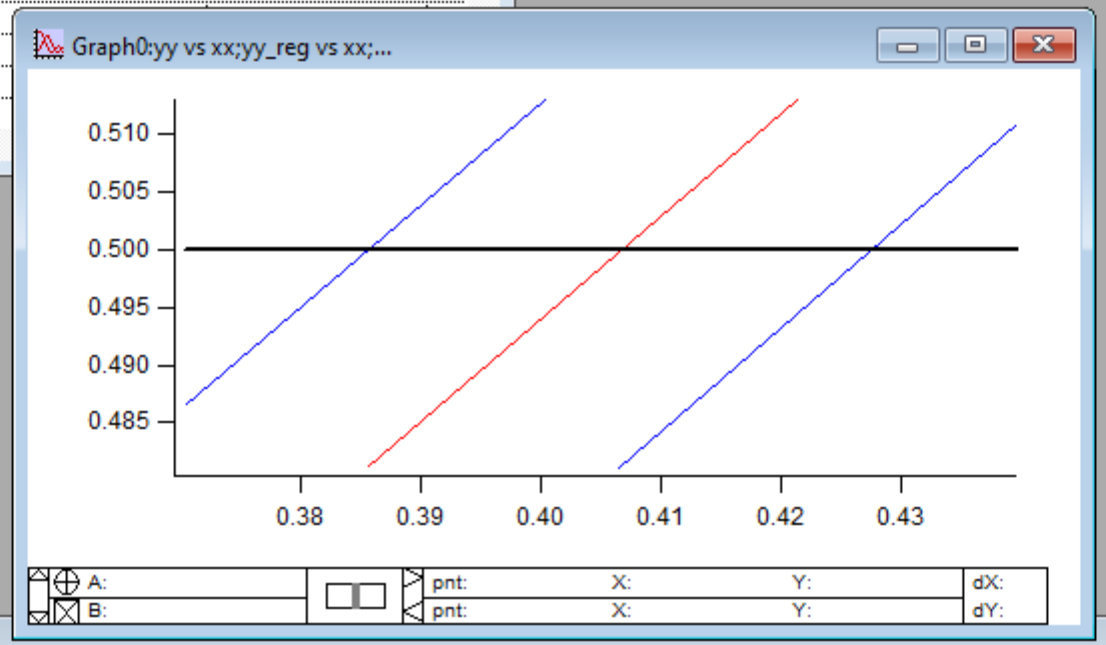
Edit Data Analysis Macros Windows Graph Misc Help

ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Expand a little further to see the intersections. You can also draw vertical lines down to the X-axis, but this is easier



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```
plicate yy yy_cal
_cal=0.5
pendtograph yy_cal vs xx
difyGraph rgb(yy_cal)=(0,0,0)
difyGraph lsize(yy_cal)=2
owInfo
```

5:11 PM

Edit Data Analysis Macros Windows Graph Misc Help

ble0:xx,yy,yy_reg,yy_upp,yy_low

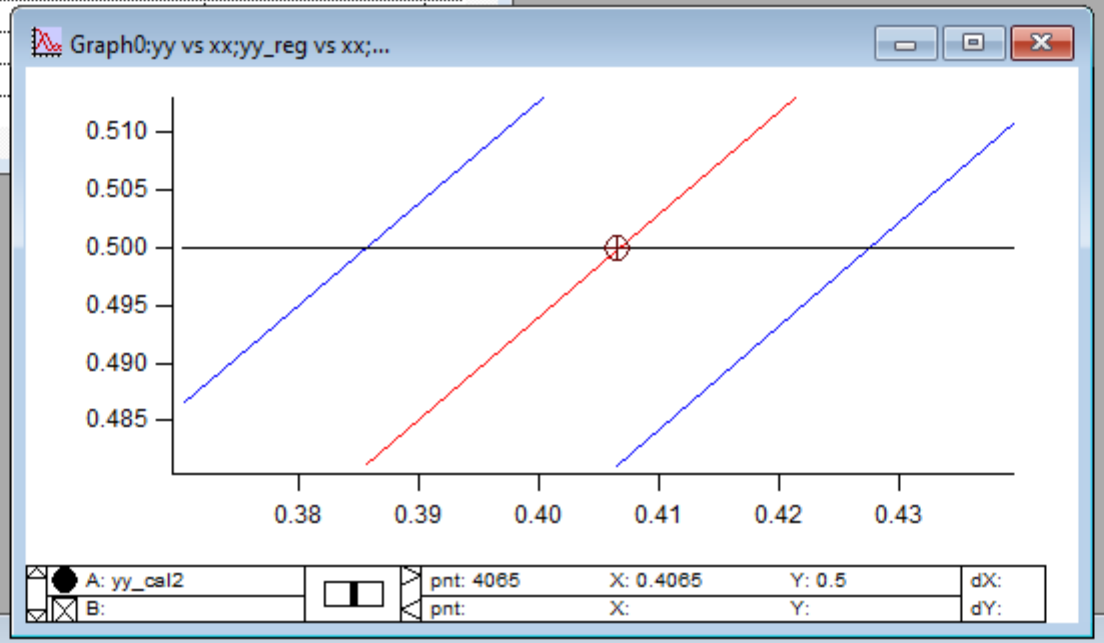
R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Read off the mean to 4 sig figs.

Mean: 0.4065

Graph0:yy vs xx;yy_reg vs xx;...



ntitled

```
pendtograph yy_cal2 vs xx2
moveFromGraph yy_cal
_cal2=0.5
difyGraph rgb(yy_cal2)=(0,0,0)
leInfo
owInfo
```

popup menu to control resolution of data.

5:13 PM

Edit Data Analysis Macros Windows Graph Misc Help

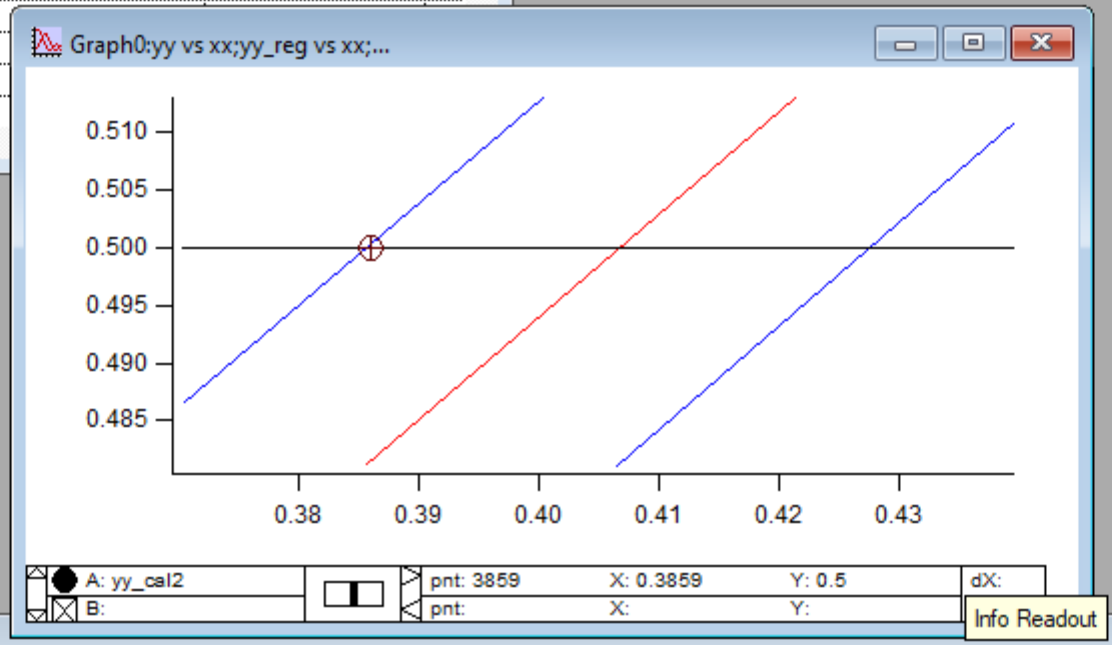
ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Read off the upper 95% to 4 sig figs.

Upper 95%: 0.3895



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pendtograph yy_cal2 vs xx2
moveFromGraph yy_cal
_cal2=0.5
difyGraph rgb(yy_cal2)=(0,0,0)
leInfo
owInfo

popup menu to control resolution of data.

5:14 PM

Edit Data Analysis Macros Windows Graph Misc Help

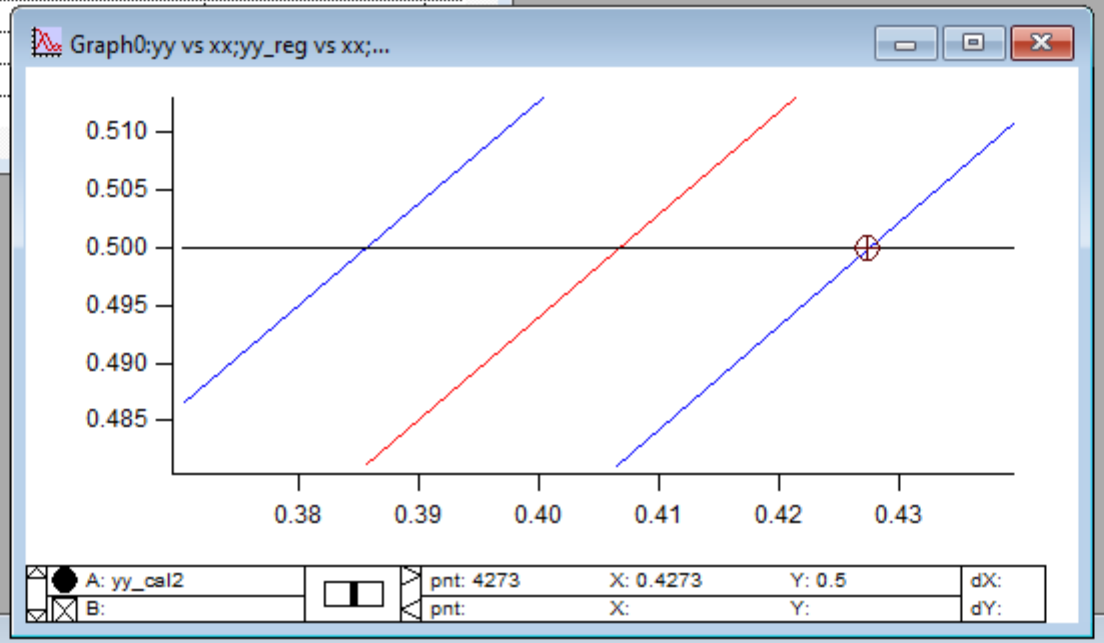
ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Read off the lower 95% to 4 sig figs.

Upper 95%: 0.4273



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```
pendtograph yy_cal2 vs xx2
moveFromGraph yy_cal
_cal2=0.5
difyGraph rgb(yy_cal2)=(0,0,0)
leInfo
owInfo
```

5:19 PM

The mean is the value of interest and upper – lower = 95% Confidence Limit

In the previous example it was 0.0208.

If you can plot this more easily on Excel, then please use it. I use Igor and make it Available under tools.

It is normally the case that the limit of detection (LOD) is larger than the error in the mid-regression. The errors in the ends are not as well determined since there are fewer data points.

Read off the upper and lower 95% to 4 sig figs.
Calculate the difference and this is the 95% Confidence interval for the calibration at this value.

Igor Pro 5.00

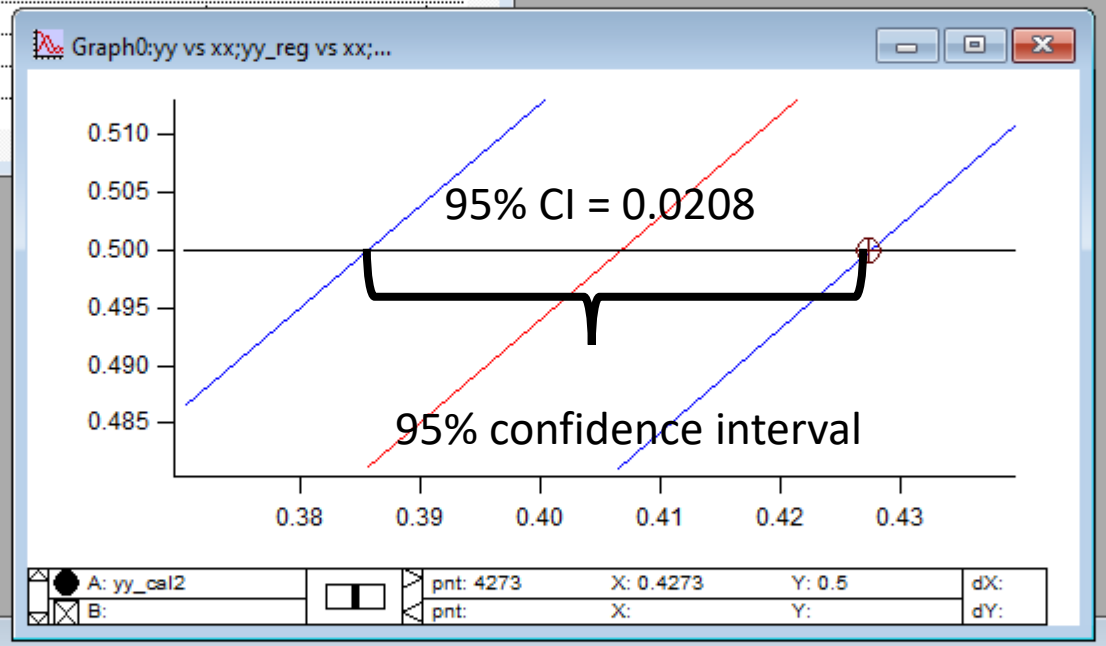
File Edit Data Analysis Macros Windows Graph Misc Help

Table0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Graph0:yy vs xx;yy_reg vs xx;...



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```
•appendtograph yy_cal2 vs xx2
•RemoveFromGraph yy_cal
•yy_cal2=0.5
•ModifyGraph rgb(yy_cal2)=(0,0,0)
```

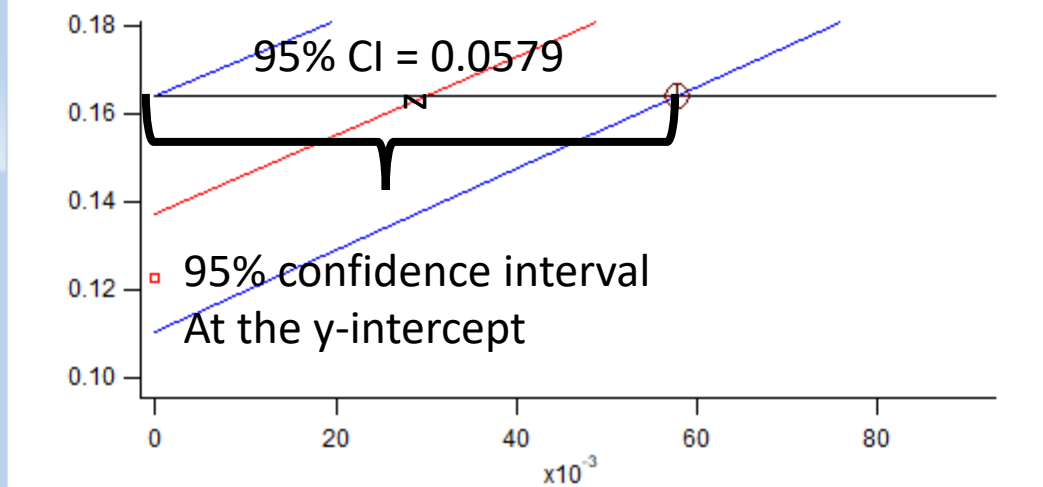
Edit Data Analysis Macros Windows Graph Misc Help

ble0:xx,yy,yy_reg,yy_upp,yy_low

R0C0 | 0

Point	xx	yy	yy_reg	yy_upp	yy_low
0	0	0.12266	0.137126	0.164019	0.110233
1	0.1	0.250966	0.226339	0.249694	0.202984
2	0.2	0.31211	0.315552	0.335952	0.295152
3	0.5	0.572956	0.58319	0.601056	0.565324
4	0.7	0.76219	0.761616	0.783908	0.739323
5	1	1.03219	1.02925	1.06283	0.99568
6					

Graph0:yy vs xx;yy_reg vs xx;...



ntitled

```
leInfo
owInfo
t yy_lod
pendtograph yy_lod vs xx2
difyGraph rgb(yy_lod#1)=(0,0,0)
moveFromGraph yy_lod
```

9:08 PM

Igor is available under Tools.