

## Excel Bootcamps 1, 2, 3 and 4

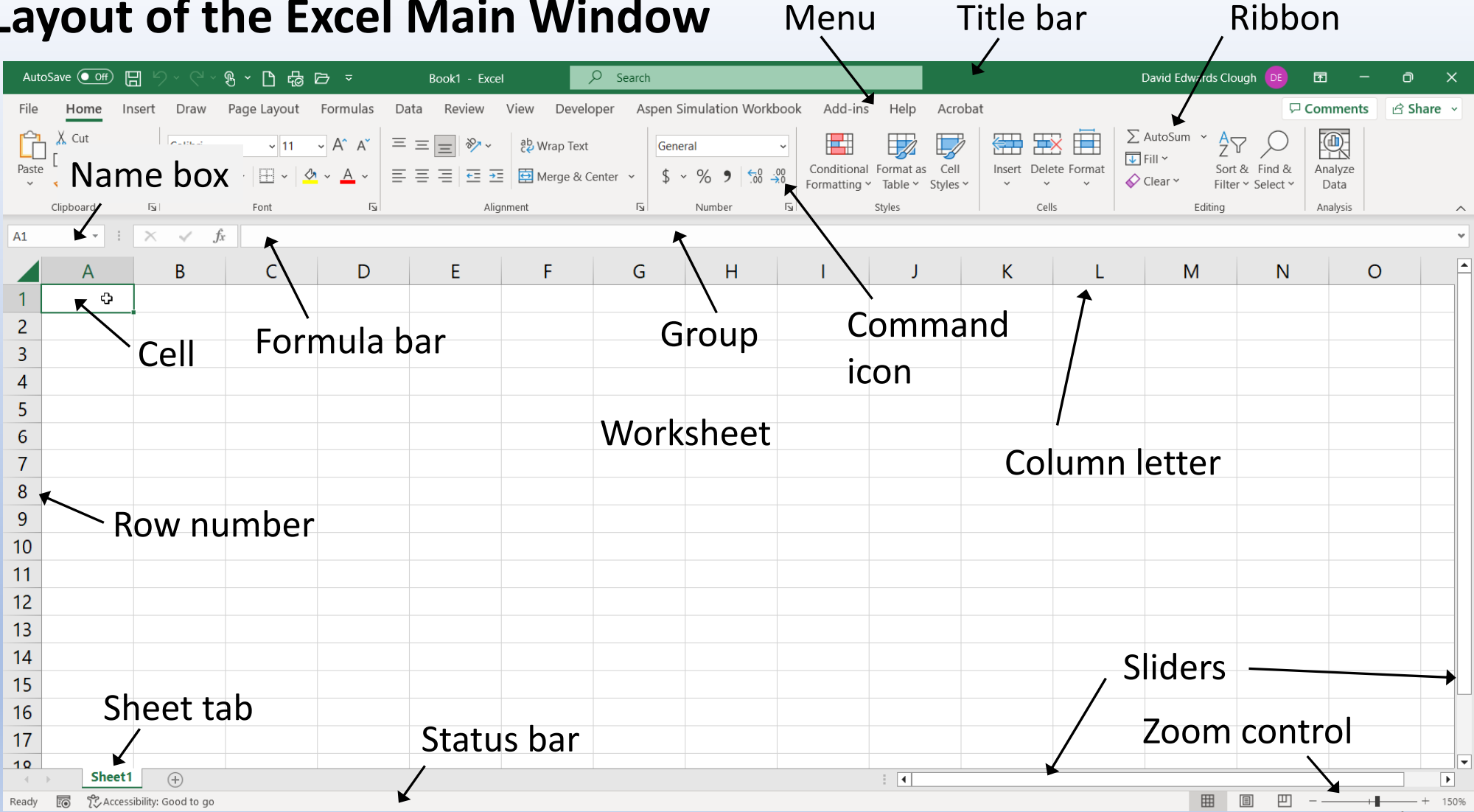
- 1: Getting up to speed with Excel
- 2: Introducing VBA
- 3: Learning to use Excel to solve typical problem scenarios
- 4: Detailed modeling of packed-bed and plug-flow reactors

### Bootcamp 1 Outline

#### Slide Number

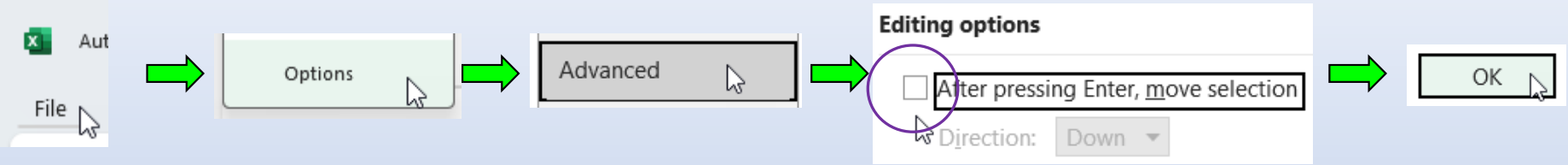
- |  |    |
|--|----|
| • Layout of the Excel main window            | 2  |
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# Layout of the Excel Main Window

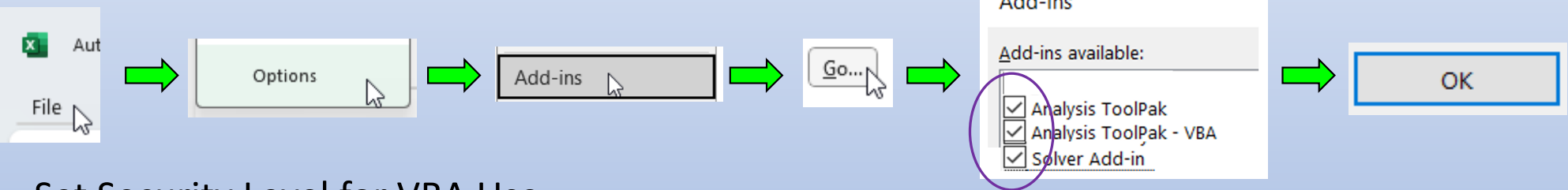


# Preferred Settings

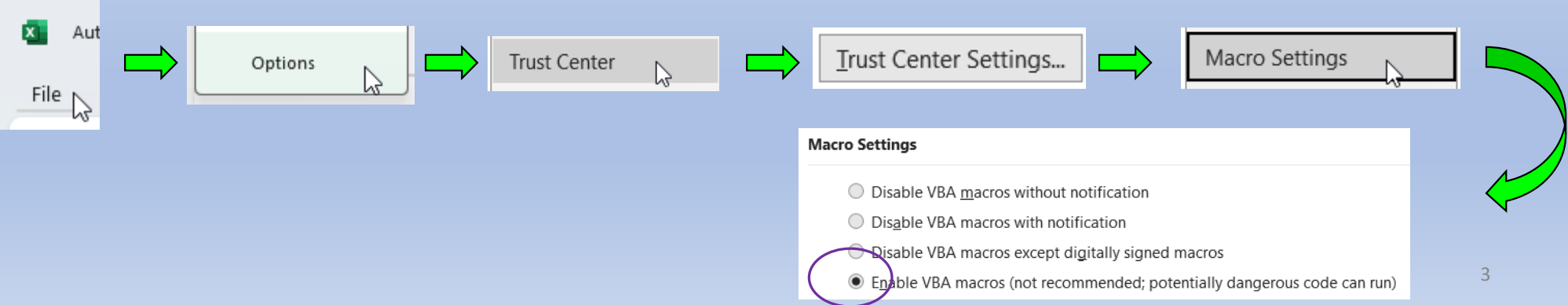
## No Move After Enter



## Enable Solver and Data Analysis

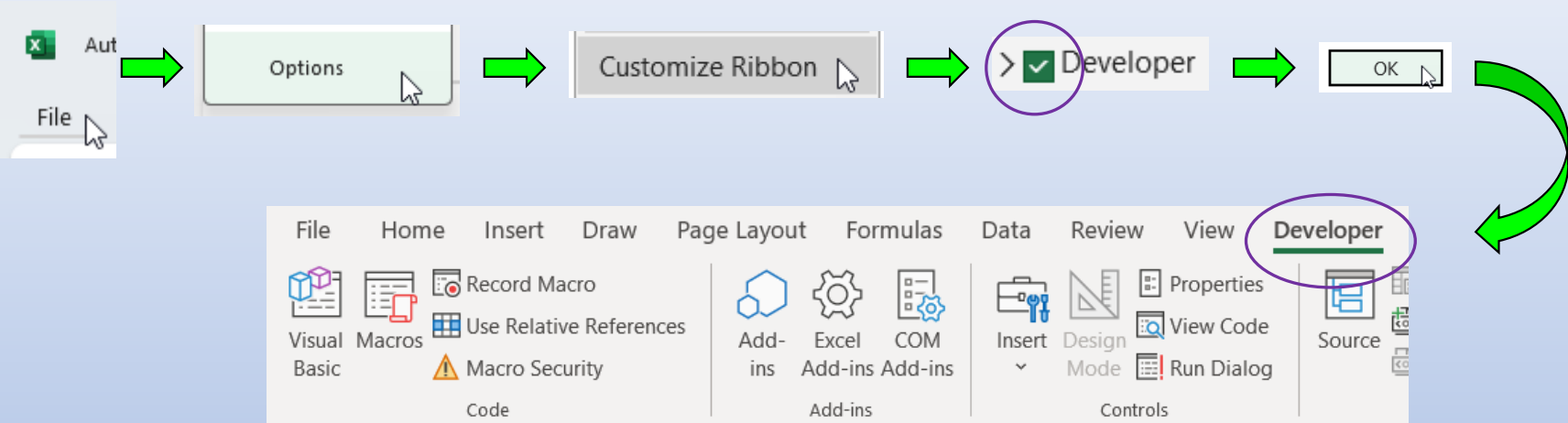


## Set Security Level for VBA Use



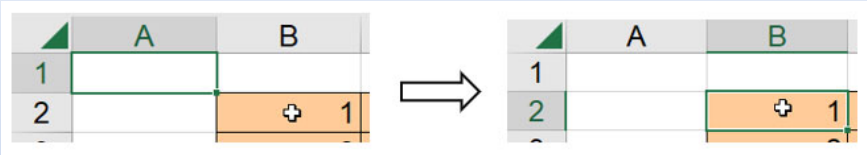
# Preferred Settings

Enable the Developer Tab on the Ribbon

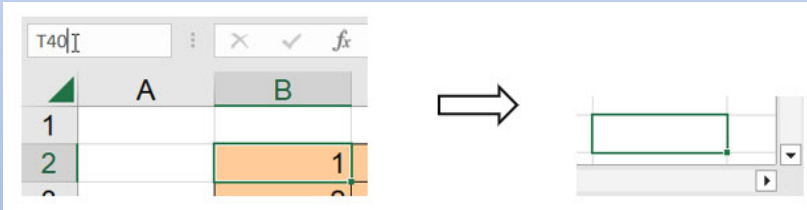


# Efficient Spreadsheet Manipulations

## Moving the ActiveCell



Click on the new cell or use the ↓ → keys



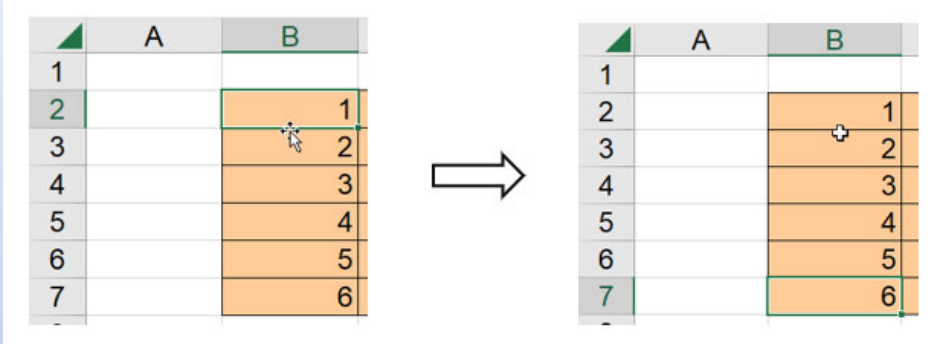
Enter the cell address in the Name Box  
(can also use F5 GoTo)

SelectionPractice.xlsx

	A	B	C	D	E
1					
2		1	0.243		
3		2	0.755		
4		3	0.047		
5		4	0.745		
6		5	0.254		
7		6	0.864		
8					
9					
10		39.93	39.71	40.06	40.29
11		40.28	40.40	39.50	39.95
12		40.25	39.75	39.84	39.61
13		39.58	39.78	39.82	39.51

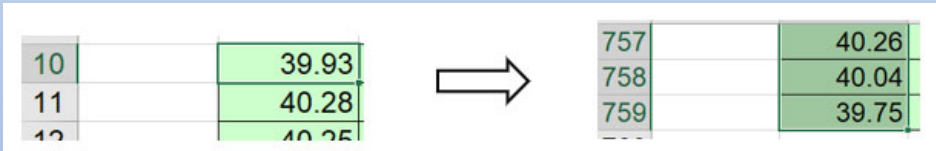
# Efficient Spreadsheet Manipulations

Jumps within filled cell ranges



Double-click boundary of the ActiveCell or  
Ctrl-↓

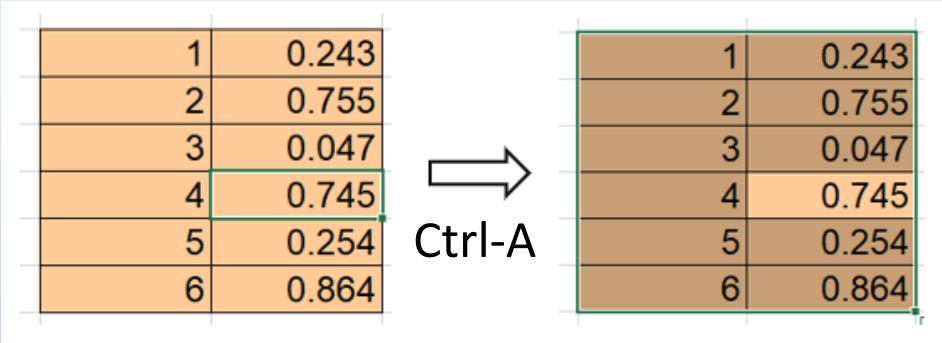
Selections within filled cell ranges



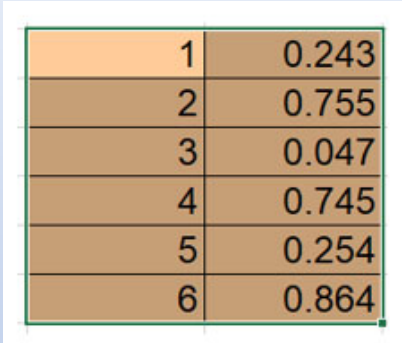
Adjoin the Shift key  
to the above

# Efficient Spreadsheet Manipulations

## Selecting blocks of cells



or  
Ctrl-\*



Moves the  
ActiveCell to  
the origin

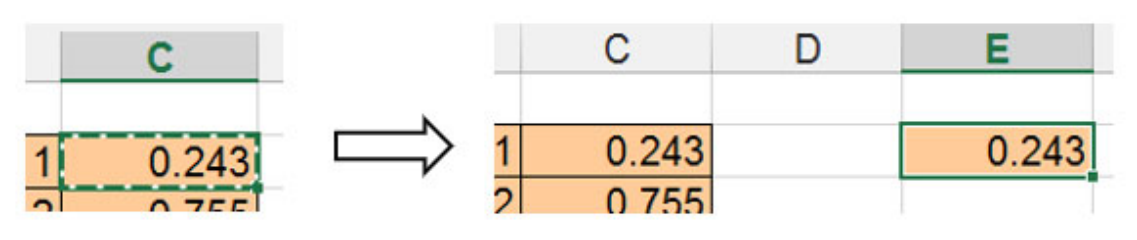
## Selecting discontinuous blocks of cells

753		40.24	40.43	39.69	39.85
754		40.35	39.99	39.62	39.94
755		40.13	40.26	39.74	39.97
756		40.11	39.92	40.15	39.82
757		40.26	39.96	40.02	39.71
758		40.04	40.49	40.36	40.41
759		39.75	40.09	39.88	40.00

Select B10, Ctrl-Shift-↓  
Tab, Back-Tab, Ctrl-click on D10  
Ctrl-Shift-↓

# Efficient Spreadsheet Manipulations

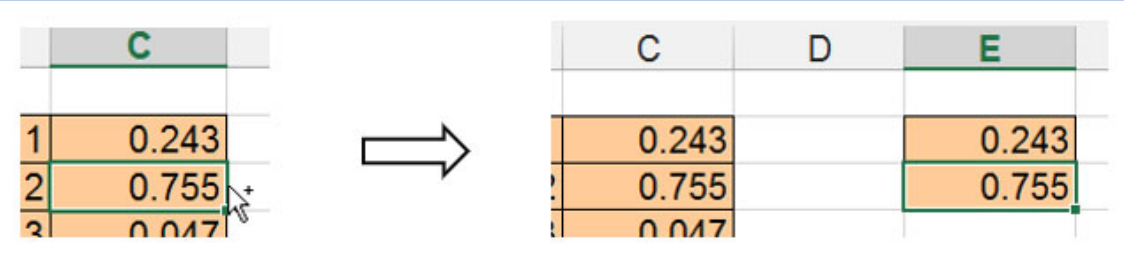
## Copying cells



Ctrl-C  
Select destination cell  
Enter

Use Paste (Ctrl-V) for multiple copies

## Drag copy

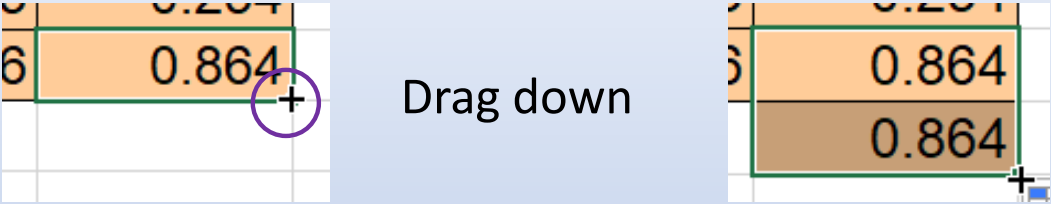


Hold down Ctrl  
Drag to new location  
Release Ctrl

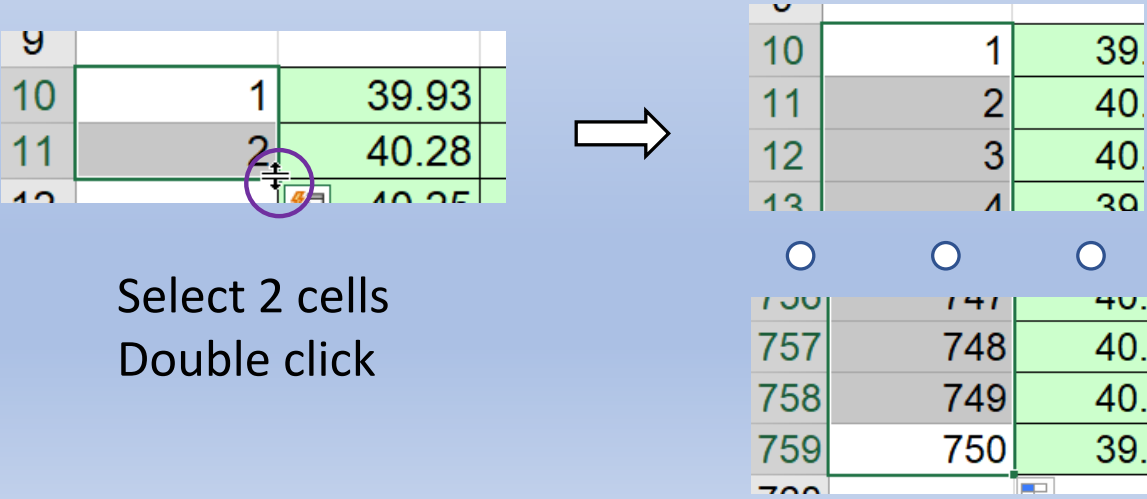


# Efficient Spreadsheet Manipulations

Copying cells using the Fill Handle



Extending a pattern adjacent to a filled column using the Fill Handle



# Efficient Spreadsheet Manipulations

## Moving cells

	B	C	D	E
	1			
	2	0.755		0.243
	3	0.047		
	4	0.745		

Ctrl-X, Select destination, Enter  
or  
Drag cell with mouse

Drag block of cells one column to the right

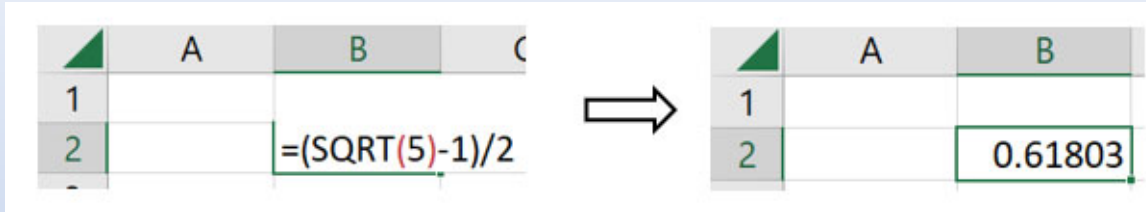
	B	C	D	E
10	39.93	39.71	40.06	40.29
11	40.28	40.40	39.50	39.95
12	40.25	39.75	39.84	39.61
13	39.58	39.78	39.82	39.51
14	39.87	39.91	40.03	39.92
15	39.92	39.91	40.31	39.98
16	39.96	39.88	40.45	40.20

	B	C	D	E	F
10					
11		39.93	39.71	40.06	40.29
12		40.28	40.40	39.50	39.95
13		40.25	39.75	39.84	39.61
14		39.58	39.78	39.82	39.51
15		39.87	39.91	40.03	39.92
16		39.92	39.91	40.31	39.98

# Formulas, Cell Addresses, and Range Names

## Calculator formulas

$$\frac{\sqrt{5}-1}{2}$$



	A	B	C
1			
2		=SQRT(5)-1)/2	

→

	A	B
1		
2		0.61803

- evaluate any functions, like SQRT above
- evaluate parentheses groupings
- negation or unary minus (–) (this is not subtraction)
- exponentiation (^) left to right
- multiplication (\*) and division (/) left to right
- addition (+) and subtraction (–) left to right

# Formulas, Cell Addresses, and Range Names

## Calculator formulas

$$\frac{12}{(1 + e^{-1}) \cdot 7^{1.5}}$$

```
=12/(1+EXP(-1))/7^1.5
```

or



```
0.47368
```

```
=12/((1+EXP(-1))*7^1.5)
```

## Watch out for these

```
=-3^2
```



```
9
```

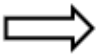
or

```
=(3^2)
```



```
-9
```

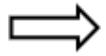
```
=3^2^1.6
```



```
33.63
```

or

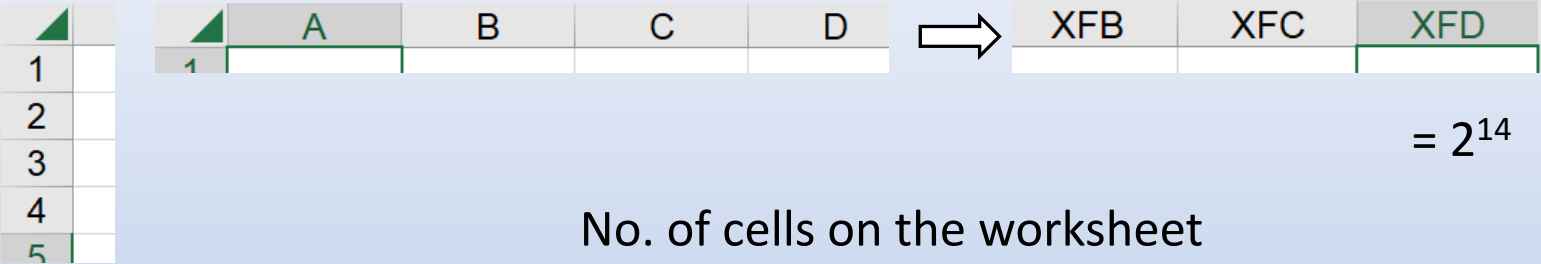
```
=3^(2^1.6)
```



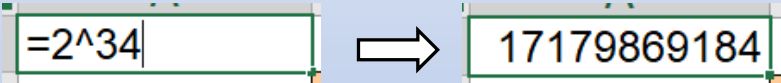
```
27.95
```

# Formulas, Cell Addresses, and Range Names

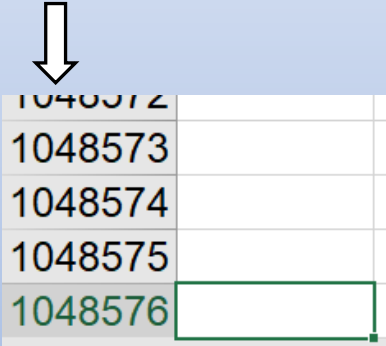
## Cell Addresses



No. of cells on the worksheet



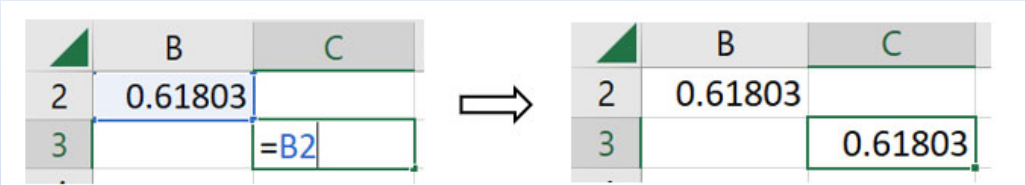
Number stored in 8 bytes (64 bits).  
Capacity of worksheet = 128 Gb



$= 2^{20}$

# Formulas, Cell Addresses, and Range Names

## Cell Addresses



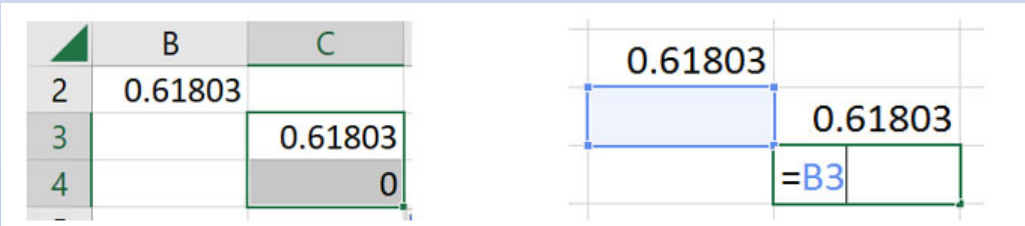
The diagram shows two states of a spreadsheet. On the left, cell B2 contains the value 0.61803, and cell C3 contains the formula =B2. An arrow points to the right, where cell C3 now displays the value 0.61803, indicating that the formula has been evaluated.

	B	C
2	0.61803	
3		=B2

	B	C
2	0.61803	
3		0.61803

Pointer formula




The diagram shows a spreadsheet with cell B2 containing 0.61803. Cell C3 contains 0.61803, and cell C4 contains 0. A blue selection box is shown around cell C3, and a smaller blue box is shown around cell C4, indicating that the formula from C3 is being copied to C4. The formula in C4 is shown as =B3.

	B	C
2	0.61803	
3		0.61803
4		0

	0.61803	
		0.61803
		=B3

Drag-copy the formula down  
Relative reference moves with copy



The diagram shows a spreadsheet with cell B2 containing 0.61803 and cell C3 containing 0.61803. An arrow points to the right, where cell C4 now contains 0.61803. This indicates that the formula from C3 was moved to C4, and the cell reference was retained as =B3.

	B	C
2	0.61803	
3		0.61803
4		

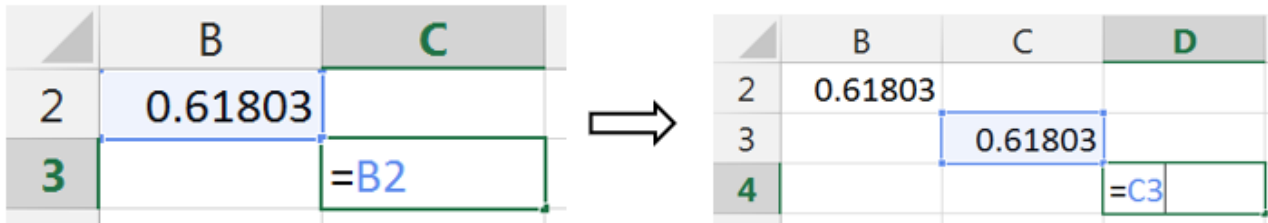
	B	C
2	0.61803	
3		
4		0.61803

Drag-move the formula down  
Cell reference is retained

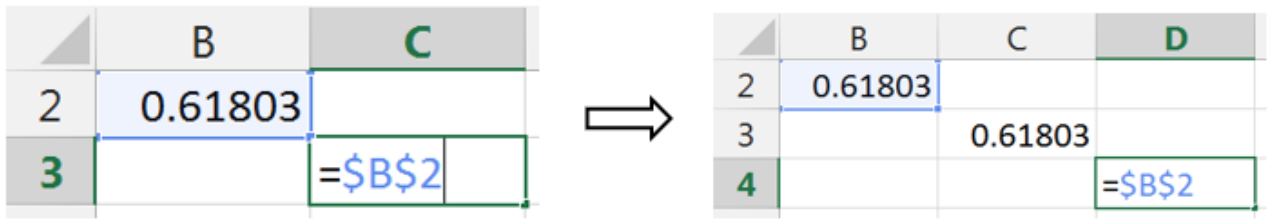
# Formulas, Cell Addresses, and Range Names

## Relative and Absolute Cell Addresses

Relative copy



Absolute copy

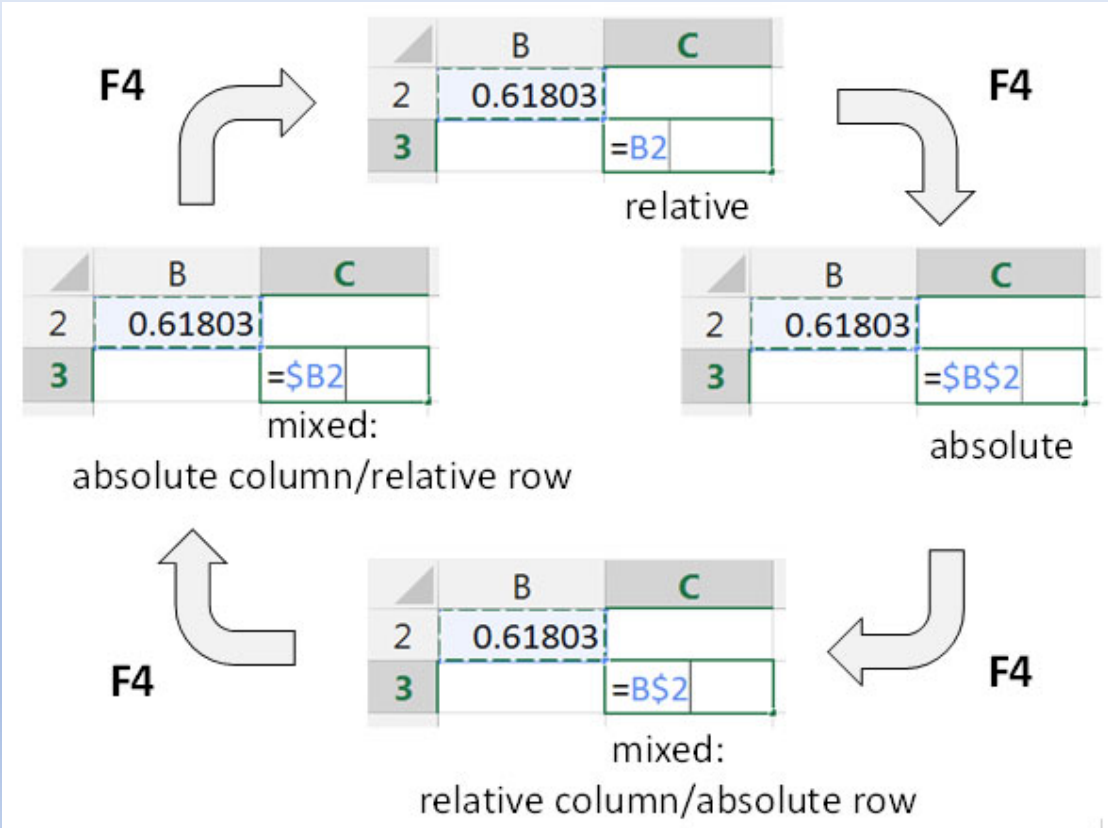


Copy from B2 to C3

# Formulas, Cell Addresses, and Range Names

## Relative, Mixed, and Absolute Cell Addresses

Using the F4 Key





# Formulas, Cell Addresses, and Range Names

## Relative, Mixed, and Absolute Cell Addresses

Relative column/absolute row copy

	B	C
2	0.61803	
3		=B\$2

	B	C	D
2	0.61803		
3		0.61803	
4			=C\$2

Absolute column/relative row copy

	B	C
2	0.61803	
3		=\$B2

	B	C	D
2	0.61803		
3		0.61803	
4			=\$B3

# Formulas, Cell Addresses, and Range Names

## Mixed Cell Addresses Example

	A	B	C	D	E	F	G	H	I
1			Relative Roughness						
2			0.0001	0.0005	0.001	0.005	0.01	0.02	0.05
3	Reynolds Number	4000							
4		10000							
5		20000							
6		50000							
7		100000							
8		200000							
9		500000							
10		1000000							

$$f_M = \frac{1}{\left\{ -1.8 \cdot \log_{10} \left[ \left( \frac{\varepsilon/D}{3.7} \right)^{1.1} + \frac{6.9}{Re} \right] \right\}^2}$$

Haaland equation for friction factor in pipe flow

	A	B	C	D	E	F	G
1			Relative Roughness				
2			0.0001	0.0005	0.001	0.005	0.01
3	Reynolds Number	4000	=1/(-1.8*LOG10((C\$2/3.7)^1.1+6.9/\$B3))^2				
4		10000					
5		20000					
6		50000					

	A	B	C	D	E	F	G	H	I
1			Relative Roughness						
2			0.0001	0.0005	0.001	0.005	0.01	0.02	0.05
3	Reynolds Number	4000	0.0405	0.0408	0.0413	0.0451	0.0497	0.0580	0.0789
4		10000	0.0310	0.0316	0.0323	0.0378	0.0436	0.0532	0.0754
5		20000	0.0259	0.0267	0.0278	0.0347	0.0413	0.0514	0.0742
6		50000	0.0210	0.0224	0.0239	0.0326	0.0397	0.0504	0.0735
7		100000	0.0183	0.0202	0.0222	0.0318	0.0392	0.0500	0.0732
8		200000	0.0163	0.0189	0.0212	0.0314	0.0389	0.0498	0.0731
9		500000	0.0144	0.0178	0.0205	0.0312	0.0388	0.0497	0.0731
10		1000000	0.0135	0.0175	0.0203	0.0311	0.0387	0.0497	0.0730

HaalandMoodyStarter.xlsx

# Formulas, Cell Addresses, and Range Names

## Creating Cell Names

- names cannot be cell addresses, TMP1 cannot be a name
- R and C cannot be names
- R and C followed by any numeral cannot be names

	A	B
1		
2	eps	
3	D	
4	Re	
5		
6	fM	

Or transfer adjacent labels

	A	B
3	D	
4	Re	

Enter name in the Name Box

A screenshot of the Excel Name Box and grid. The Name Box at the top left contains the text 'eps' and is circled in purple. A purple arrow points from the Name Box to cell B2 in the grid, which also contains the text 'eps'. The grid shows columns A and B, and rows 1 through 3.

A screenshot of the Excel 'Formulas' ribbon. The 'Name Manager' group is visible, with the 'Create from Selection' button circled in purple. Other buttons like 'Define Name' and 'Use in Formula' are also present.

A screenshot of the 'Create Names from Selection' dialog box. The dialog has a title bar 'Create Names from Sele...' and a close button. Under 'Create names from values in the:', the 'Left column' checkbox is checked, while 'Top row', 'Bottom row', and 'Right column' are unchecked. The 'OK' button is circled in purple.

# Formulas, Cell Addresses, and Range Names

## Using Cell Names in Formulas

	A	B	
2	eps	4.50E-05	m
3	D	0.0525	m
4	Re	10000	

fM = 1/(-1.8\*LOG10((eps/D/3.7)^1.1+6.9/Re))^2

	A	B	
2	eps	4.50E-05	m
3	D	0.0525	m
4	Re	10000	
5			
6	fM	0.0323	
7			

# Formulas, Cell Addresses, and Range Names

## Using Range Names in Formulas

The screenshot shows an Excel spreadsheet with a range named 'Pdata' highlighted in blue. The range is located in columns B through F and rows 2 through 11. The formula bar shows the formula '=AVERAGE(Pdata)' and the result '14.79' is displayed in the active cell.

	A	B	C	D	E	F
1						
2		17.25	11.38	22.33	15.49	17.13
3		14.30	18.33	14.07	17.25	11.38
4		16.61	15.40	16.47	14.30	18.33
5		13.57	14.27	14.21	14.07	16.61
6		12.88	15.42	15.85	16.47	17.50
7		17.48	15.13	16.22	17.92	17.92
8		9.91	17.13	8.54	12.72	8.37
9		13.69	17.08	14.78	19.06	19.06
10		12.94	15.61	17.26	12.08	11.46
11		13.81	15.10	18.37	20.43	14.56

14.79

=AVERAGE(Pdata)

BlockData.xlsx


# Formulas, Cell Addresses, and Range Names

## The IF Function and Logical Expressions

Syntax: =IF(logical expression,true option,false option)

Example: Square a value and retain the sign in the result

	B	C	D
2	-3	=IF(B2<0,-(B2^2),B2^2)	



	B	C
2	-3	-9
3	3	9
4	0	0

Logical expression here is relational

# Relational Operators and Logical Functions

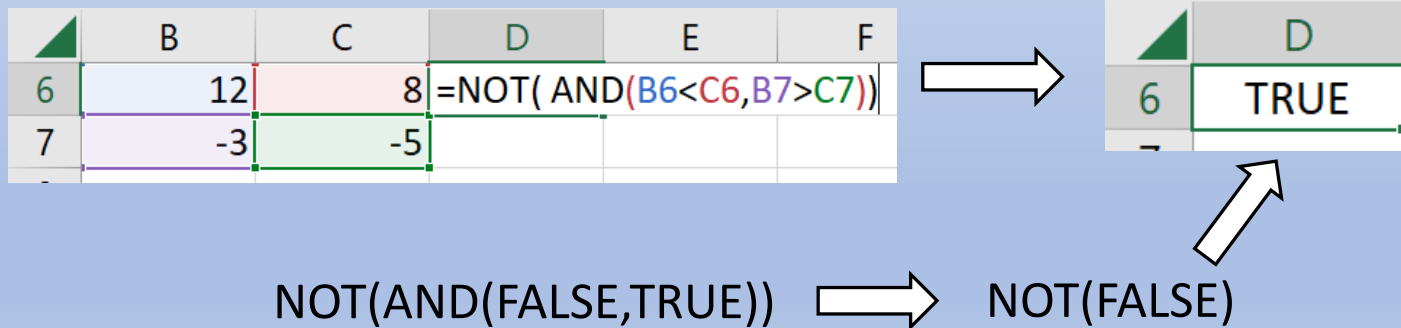
## Relational Operators

=	equal to
<>	not equal to
>	greater than
<	less than
>=	greater than or equal to
<=	less than or equal to

## Logical Functions

NOT	logical negation
AND	logical and
OR	logical or
XOR	exclusive or

## Example logical expression



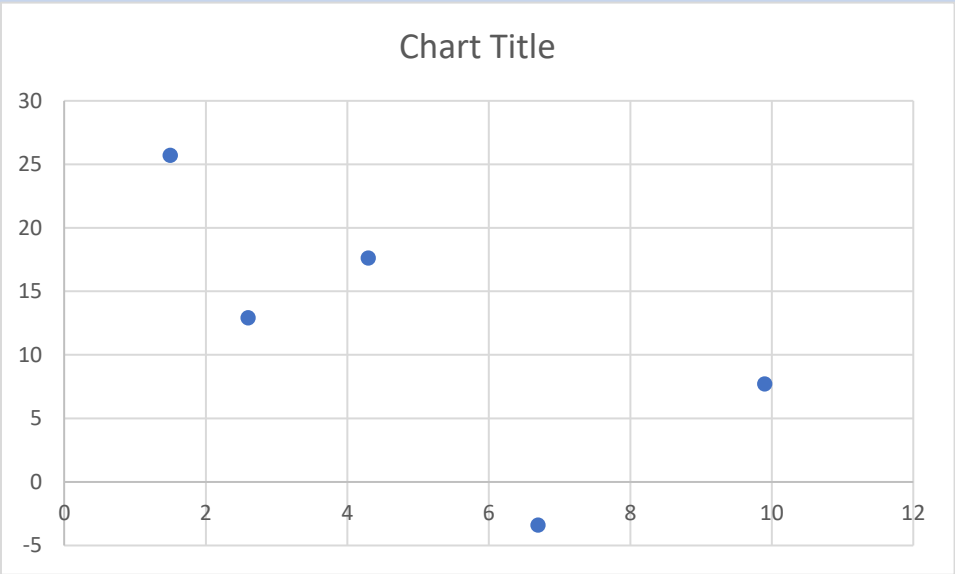
# Creating Simple Plots

## XY Charts

	B	C
2	x	y
3	1.5	25.7
4	2.6	12.9
5	4.3	17.6
6	6.7	-3.4
7	9.9	7.7

Create a scatter plot of y versus x

The screenshot shows the 'Insert' tab on the Excel ribbon. The 'Charts' group is expanded, showing 'Recommended Charts' and 'Charts'. The 'Scatter' icon is selected, and a dropdown menu is open, displaying several scatter plot styles. An arrow points from the 'Insert' tab to the 'Charts' group, and another arrow points from the 'Scatter' dropdown to the final chart.





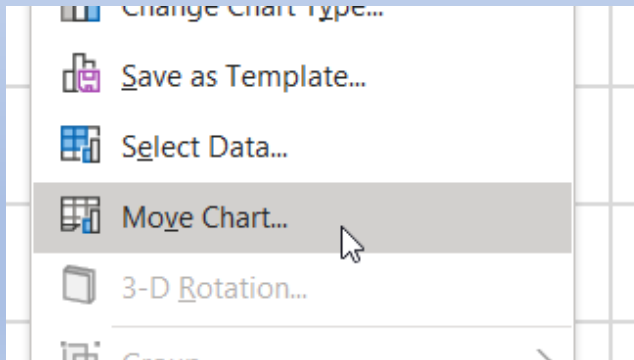
# Creating Simple Plots

## Customizing the scatter plot

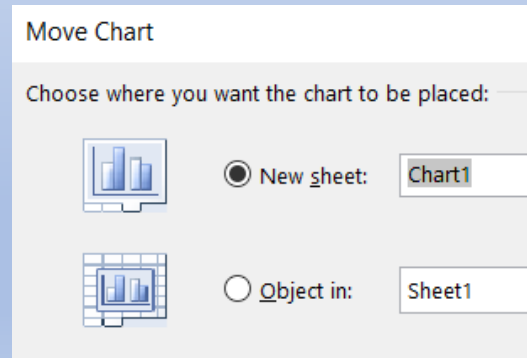
Typical steps:

- Move the plot to its own chart sheet
- Align and format the axes
- Adjust markers and lines
- Add axis titles and chart title

## Move the plot to its own chart sheet



right-click the chart

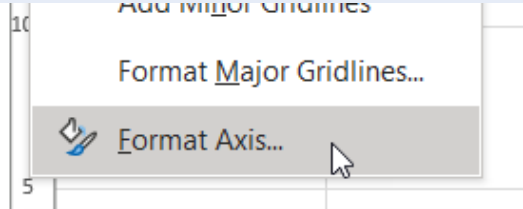


click OK

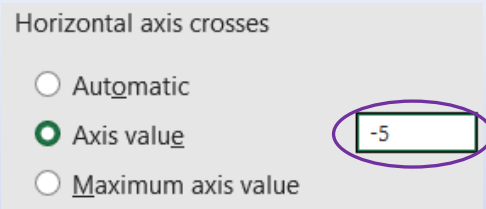
Formatting is best with the chart on its own sheet. Reasons to keep the chart on the worksheet include when multiple charts need to be visible and when it is advantageous to see plot responses to worksheet changes.

# Creating Simple Plots

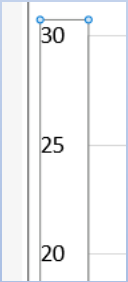
## Align and format the axes



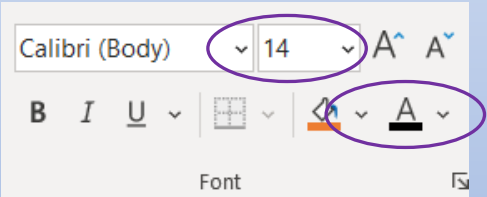
right-click vertical axis  
select Format Axis...



lower where the  
horizontal axis crosses



select each  
axis

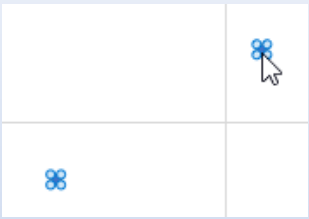


change font  
size(14pt) and  
color (black)

Note: Can change font  
style, if desired.

# Creating Simple Plots




## Adjust markers and lines



select the series  
(not an individual  
marker)

Format Data Series

Series Options ▾


Line  Marker

Marker Options

Automatic

None

Built-in

Type  ▾

Size




Marker Options

Automatic

None

Built-in

Type  ▾

Size

Fill

No fill

enlarge marker  
choose no fill




Border

No line

Solid line

Gradient line

Automatic

Color 

Transparency

Width

change border color  
increase line width

# Creating Simple Plots

Adjust markers and lines – possibly add interconnecting lines

Series Options

Line

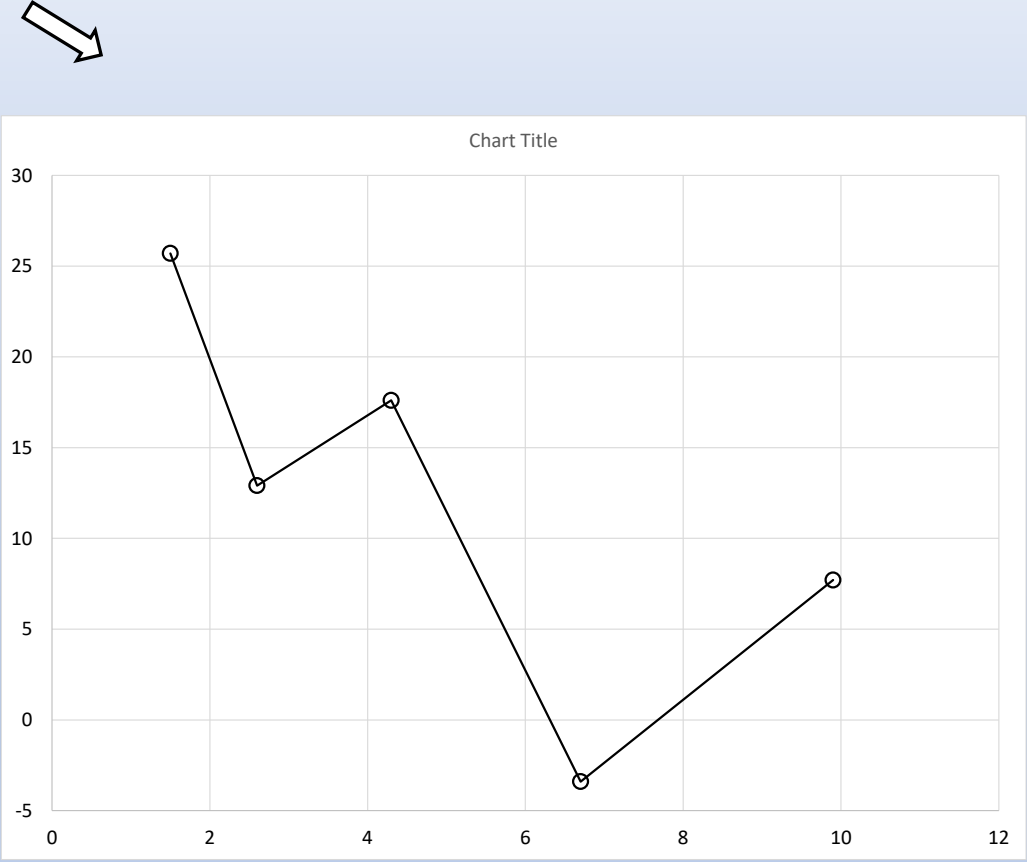
Line

- No line
- Solid line
- Gradient line
- Automatic

Color

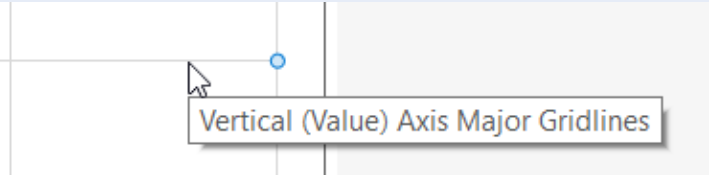
Transparency 0%

Width 1.5 pt

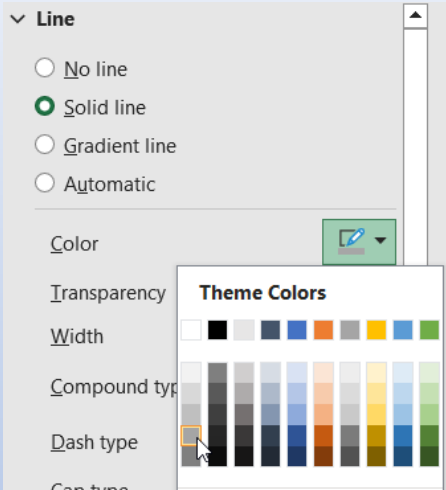


# Creating Simple Plots

Adjust markers and lines – increase intensity of gridlines



select horizontal gridlines

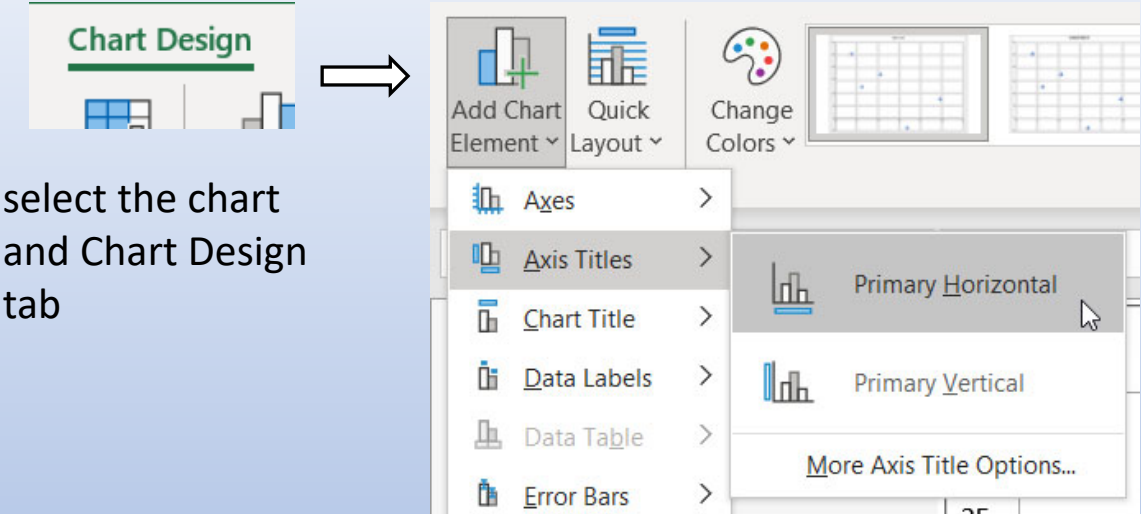


select solid line and adjust intensity to suit

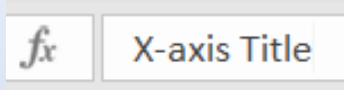
Format the vertical gridlines similarly, the plot outline, and the axes borders.

# Creating Simple Plots

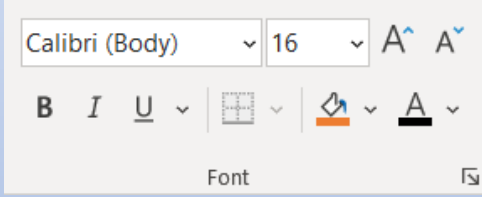
Add axis titles and chart title



select the chart and Chart Design tab

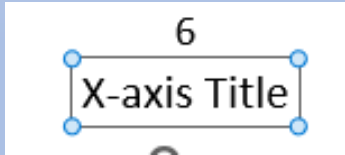


enter title in the Formula Bar or in place



adjust font size and color

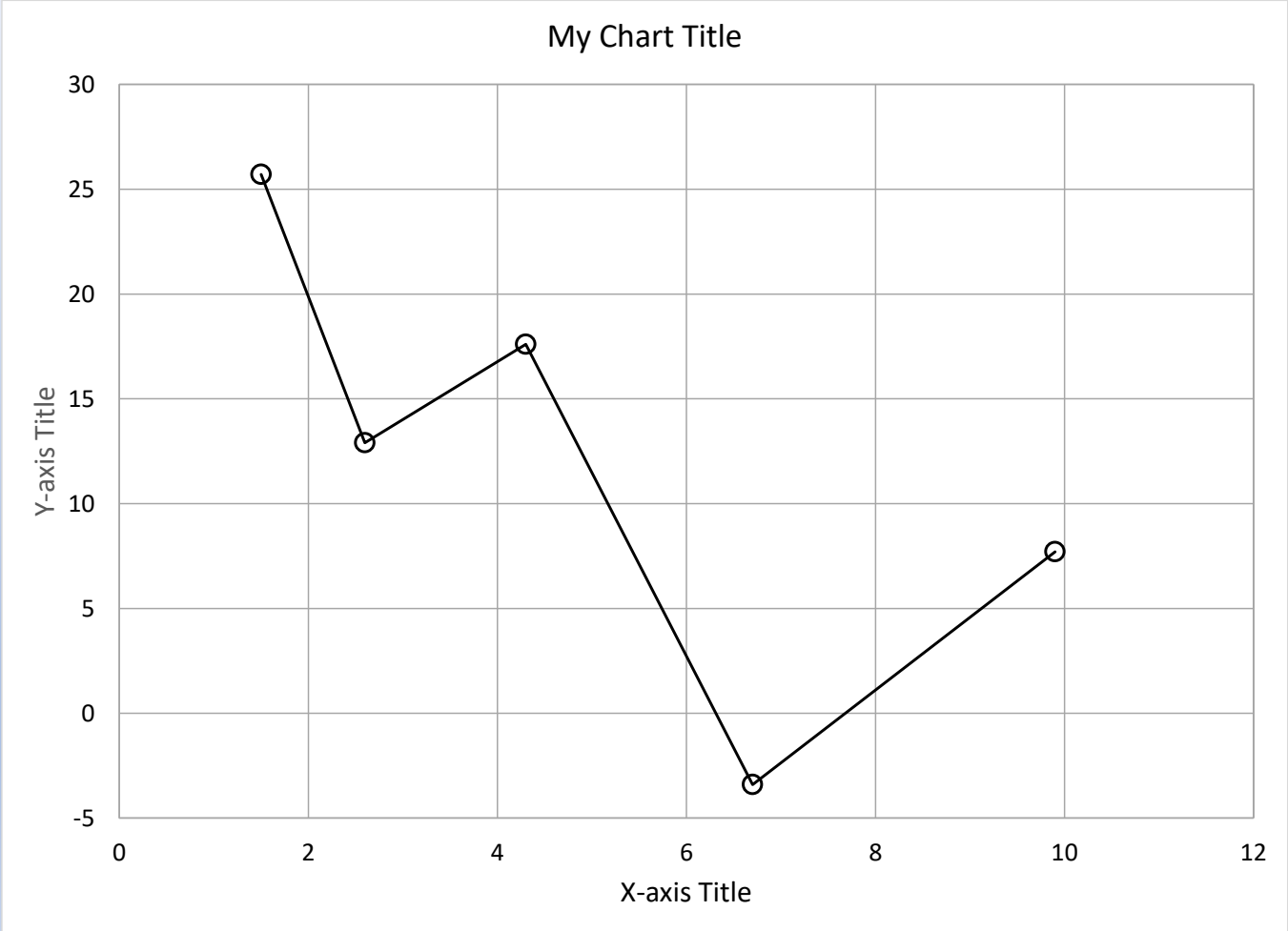
Carry out similar entry and formatting of Primary Vertical Axis Title and Chart Title



Note: Can change font style, if desired.

# Creating Simple Plots

## Example Formatted Plot



## Creating Plots with Multiple Series

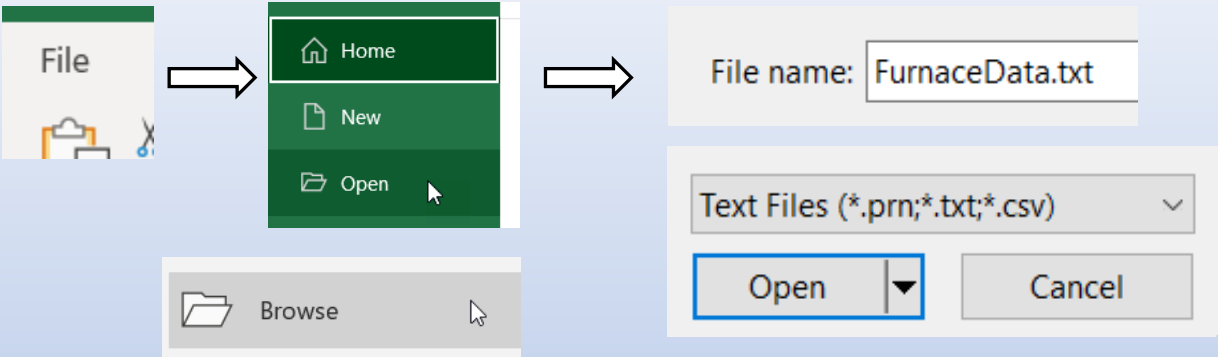
Possible features:

- Acquiring data from a text (.txt or .csv) file
- Distinguishing markers and/or line styles
- Legend to identify series
- Lines only for large data series or analytical functions



# Creating Plots with Multiple Series

## Acquiring data from a text (.txt or .csv) file



change file type to Text Files and locate file click Open



### Text Import Wizard - Step 1 of 3

Choose the file type that best describes your data:

- Delimited - Characters such as commas or tabs separate each field.
- Fixed width - Fields are aligned in columns with spaces between each field.

**FurnaceData.txt**

Preview of file C:\Users\d

1	0-0.10953.8
2	9053.6
3	180.17853.5
4	270.33953.5
5	360.37353.4
6	450.44153.1



Next >



Data preview

0	-0.109	53.8
9	0	53.6
18	0.178	53.5
27	0.339	53.5
36	0.373	53.4
45	0.441	53.1



Next >



Finish

# Creating Plots with Multiple Series

Acquiring data from a text (.txt or .csv) file

	A	B	C
1	0	-0.109	53.8
2	9	0	53.6
3	18	0.178	53.5
4	27	0.339	53.5
5	36	0.373	53.4
6	45	0.411	53.1

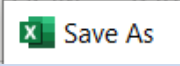


	A	B	C
292	2619	0.195	58.5
293	2628	0.131	58.3
294	2637	0.017	57.8
295	2646	-0.182	57.3
296	2655	-0.262	57

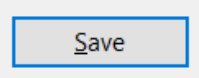
296 data entries  
time, y1, and y2

Save As  
Excel Workbook

F12



File name: FurnaceData.xlsx  
Save as type: Excel Workbook (\*.xlsx)

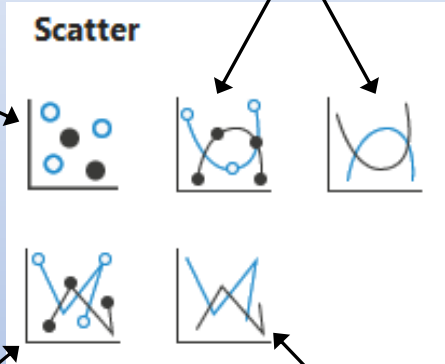


# Creating Plots with Multiple Series

## Different X-Y Scatter Plot Styles

artificial smoothing  
recommend against

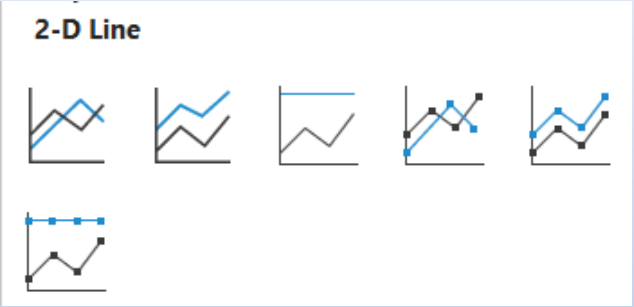
experimental data  
small sample  
(n < 50-to-100)



experimental data  
small sample (n < 50-to-100)  
interconnecting lines  
for pattern recognition

experimental data  
large sample (n < 50-to-100)  
markers would clutter  
interconnecting lines  
or analytical functions

recommend against using  
Line plot which are intended  
for categorical x-axis



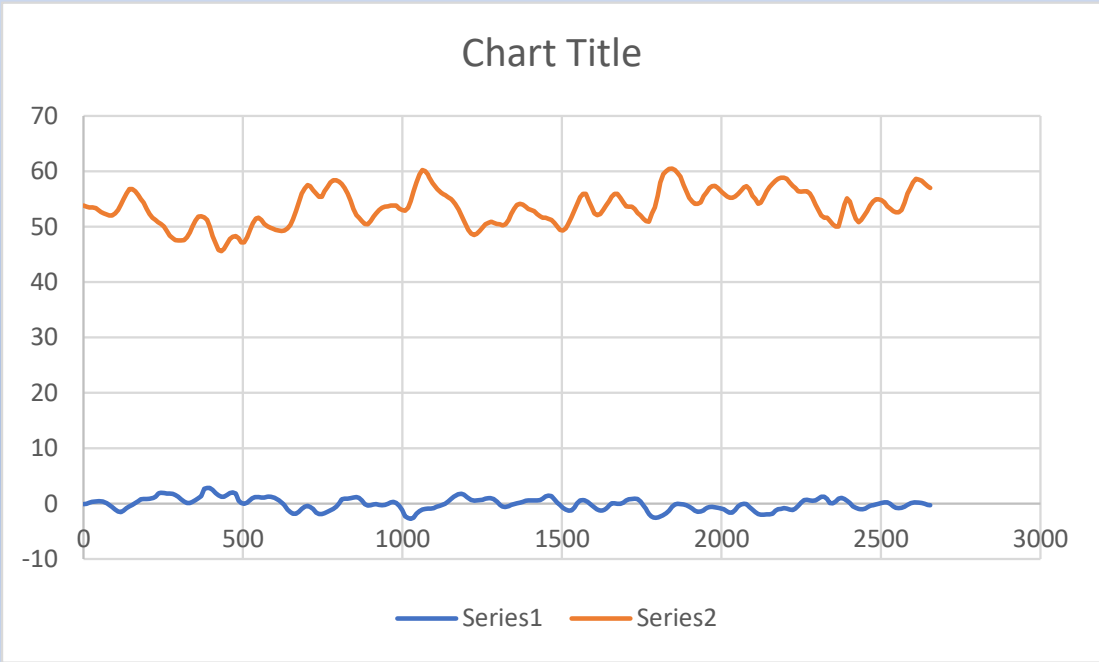
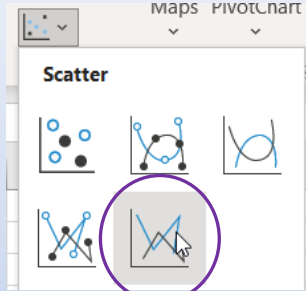
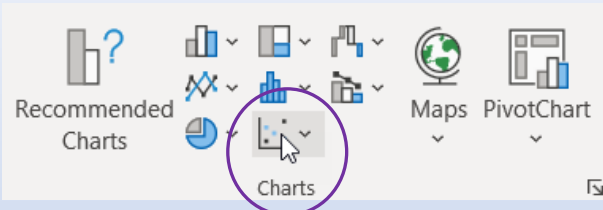
# Creating Plots with Multiple Series

## X-Y Plot – Straight Lines, No Markers

	A	B	C
1	0	-0.109	53.8
2	9	0	53.6
3	18	0.178	53.5
4	27	0.339	53.5
5	36	0.373	53.4
6	45	0.444	53.4



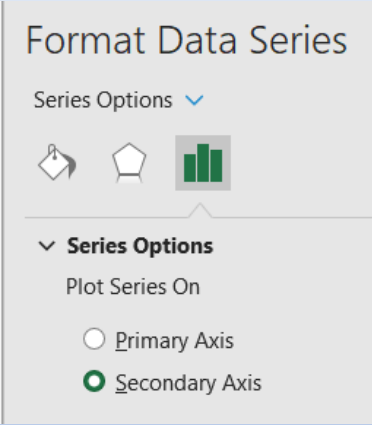
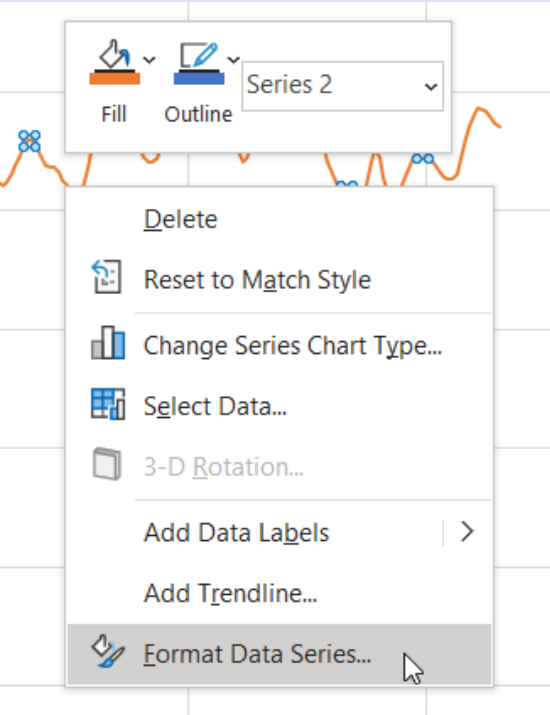
Insert



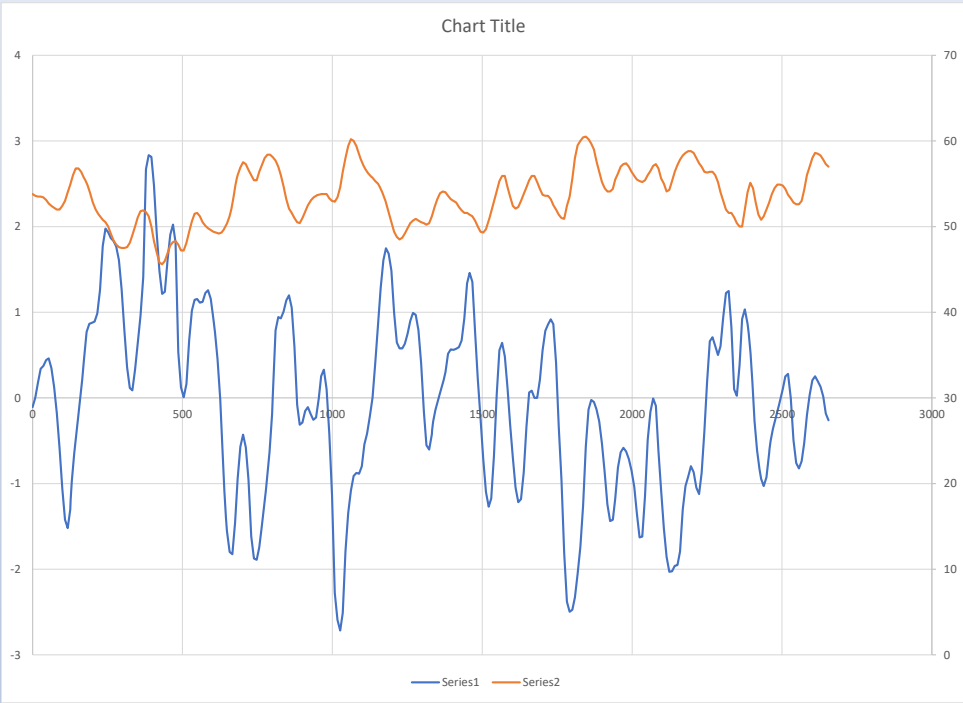
# Creating Plots with Multiple Series

## X-Y Plot – Straight Lines, No Markers

select one series, here y2  
(could be either)

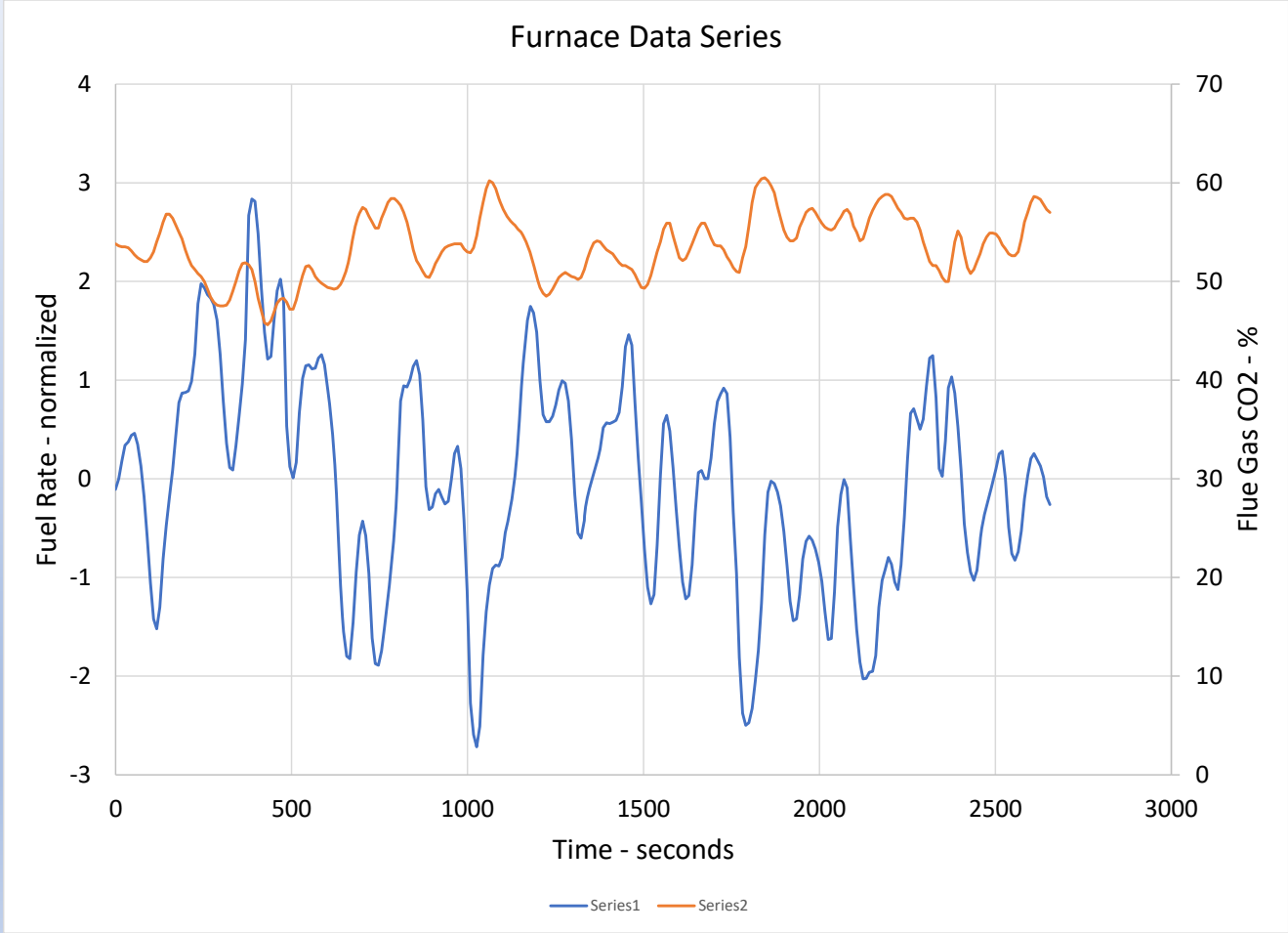


move to Secondary  
(right) axis



# Creating Plots with Multiple Series

## Format Axes and Add Titles



# Creating Plots with Multiple Series

## Move and Format Legend



**Format Legend**

Legend Options Text Options

Legend Position

- Top
- Bottom
- Left
- Right
- Top Right

Show the legend without overlapping the chart



Calibri (Body) 14

**B I U** | [Grid] | [Color] | **A**

Font

Legend Options Text Options

**Fill**

- No fill
- Solid fill
- Gradient fill
- Picture or texture fill
- Pattern fill
- Automatic

Color [Color Picker]

Transparency | 0%

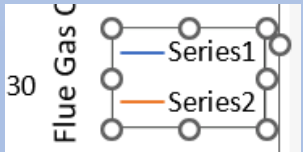
**Border**

- No line
- Solid line
- Gradient line
- Automatic

Color [Color Picker]

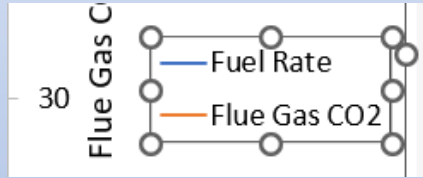
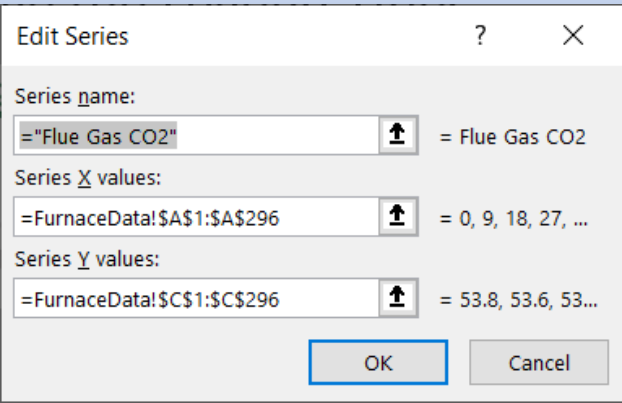
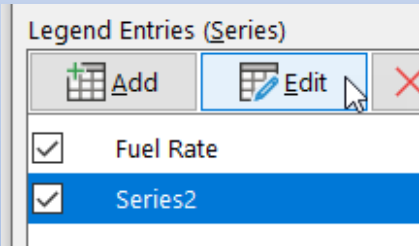
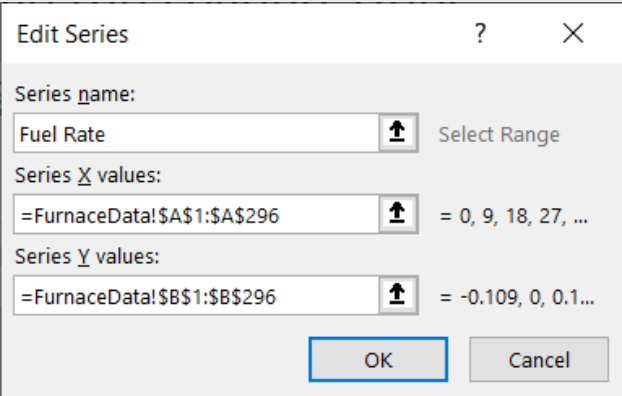
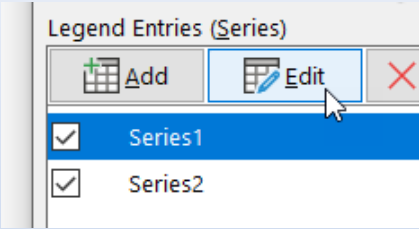
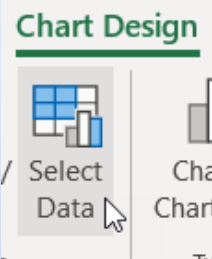
Transparency | 0%

Width | 0.75 pt



# Creating Plots with Multiple Series

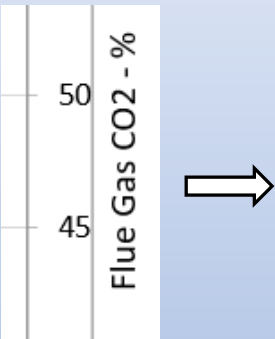
## Change the Legend Titles





# Creating Plots with Multiple Series

- Change Right Vertical Axis Scale
- Move Legend Into the Plot
- Stretch the Plot



Format Axis

Axis Options Text Options

Axis Options

Bounds

Minimum 30.0 Reset

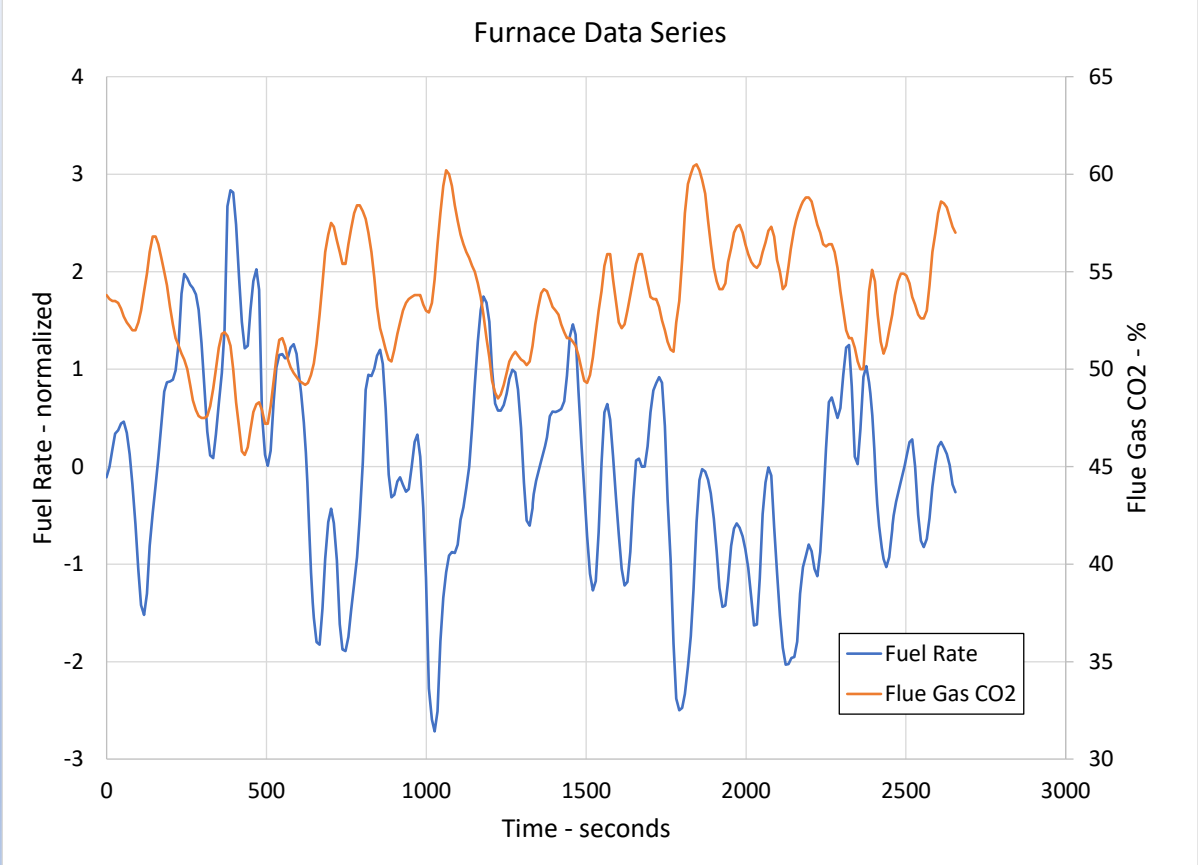
Maximum 65.0 Auto

Units

Major 5.0 Auto

Minor 1.0 Auto

Select Secondary axis scale



# Creating Plots with Multiple Series

## Change Line Styles for B&W Presentation

Format Data Series

Series Options

Line Marker

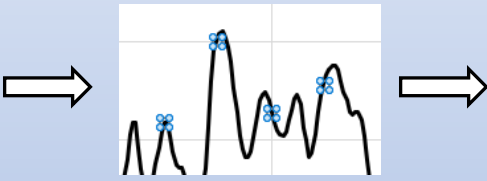
Line

- No line
- Solid line**
- Gradient line
- Automatic

Color

Transparency 0%

Width 2 pt



Line

- No line
- Solid line**
- Gradient line
- Automatic

Color

Transparency 0%

Width 2 pt

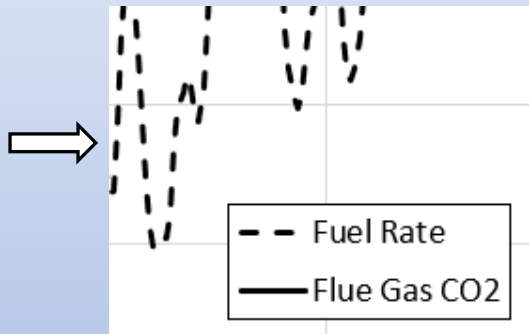
Compound type

Dash type

Cap type

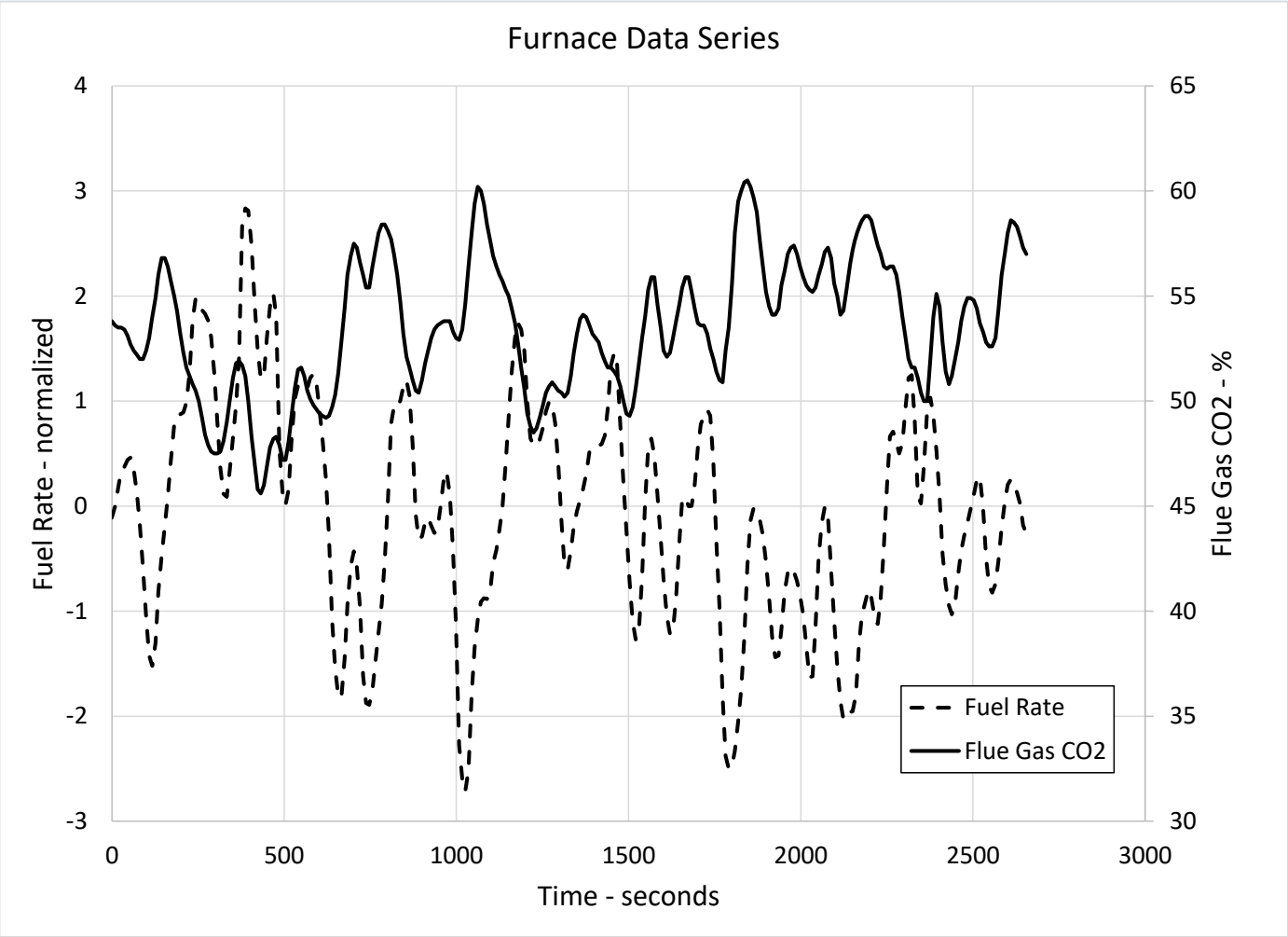
Join type

Begin Arrow type



# Creating Plots with Multiple Series

## Final Plot



# Plots with Logarithmic Scale(s)

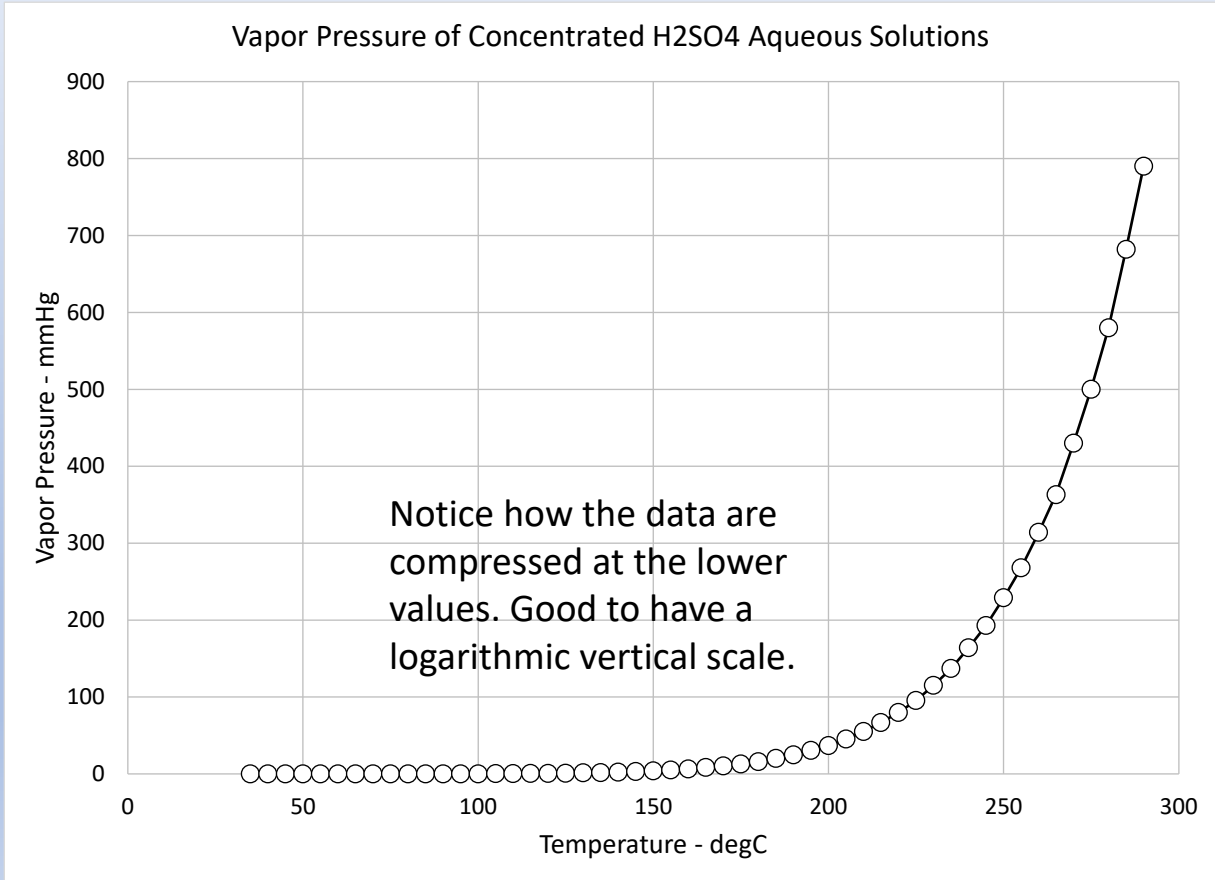
## Vapor Pressure of 95%(wt) Sulfuric Acid Aqueous Solution

	A	B
2	Temperature (degC)	Vapor Pressure (torr)
3	35	0.0015
4	40	0.00235
5	45	0.0037
6	50	0.0058
7	55	0.00877



50	270	430
51	275	500
52	280	580
53	285	682
54	290	790

Create X-Y plot with markers and lines




# Plots with Logarithmic Scale(s)

## Vapor Pressure of 95%(wt) Sulfuric Acid Aqueous Solution

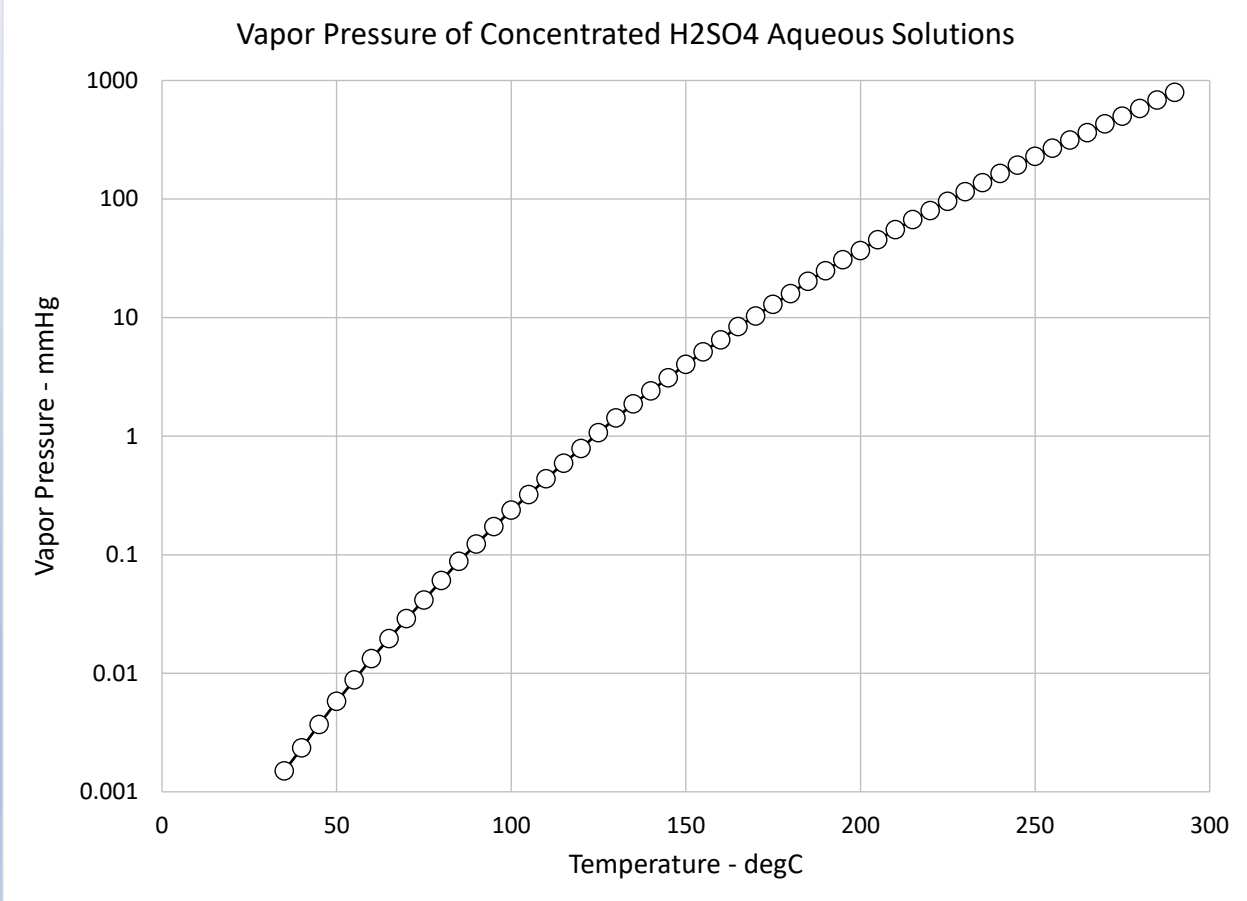
Logarithmic vertical scale

Format Axis

Axis Options  Text Options



Logarithmic scale Base



# Creating Plots of Analytical Functions

Create table of function values

$$y = \cos(x) \cdot \cosh(x) - 1 \quad 0 \leq x \leq 5$$

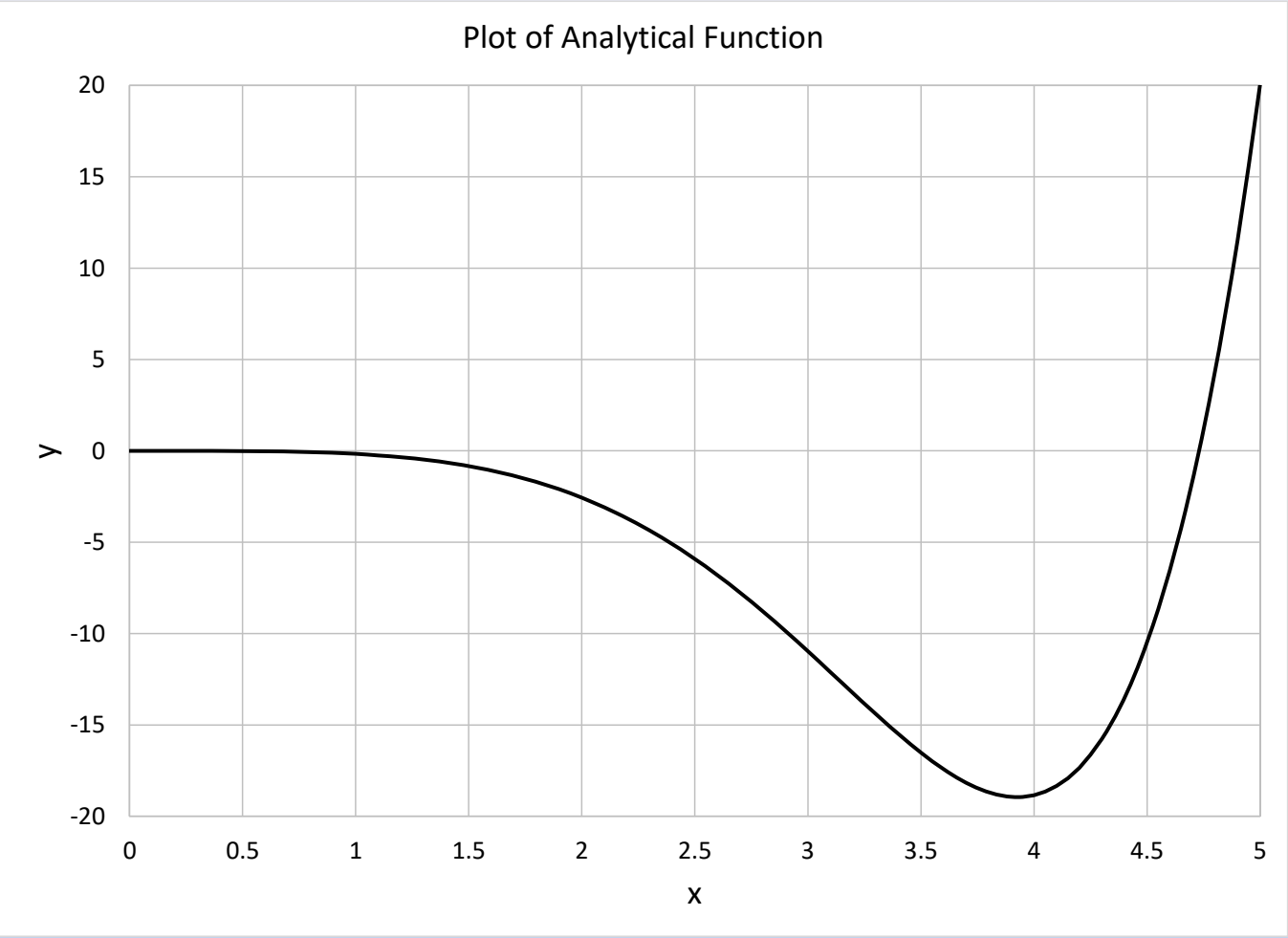
The screenshot shows an Excel spreadsheet with columns labeled 'x' and 'y'. The cell containing '0' in the 'x' column is highlighted with a green border. Overlaid on the spreadsheet is the 'Series' dialog box. In the 'Series in' section, the 'Columns' radio button is selected and circled in purple. In the 'Type' section, the 'Linear' radio button is selected. In the 'Date unit' section, the 'Day' radio button is selected. At the bottom, the 'Step value' is set to 0.05 and the 'Stop value' is set to 5, both of which are circled in purple. The 'OK' button is highlighted with a blue border.

The screenshot shows an Excel spreadsheet with columns B, C, and D. Row 3 has 'x' in column B. Row 4 has the formula '=COS(B4)\*COSH(B4)-1' in column C. A large white arrow points downwards from row 4 to a table of values. The table has two columns: the first column lists x values (4.85, 4.9, 4.95, 5) and the second column lists the corresponding y values (7.76207, 11.524, 15.6158, 20.0506). The row with x=5 and y=20.0506 is highlighted with a green border.

x	y
4.85	7.76207
4.9	11.524
4.95	15.6158
5	20.0506

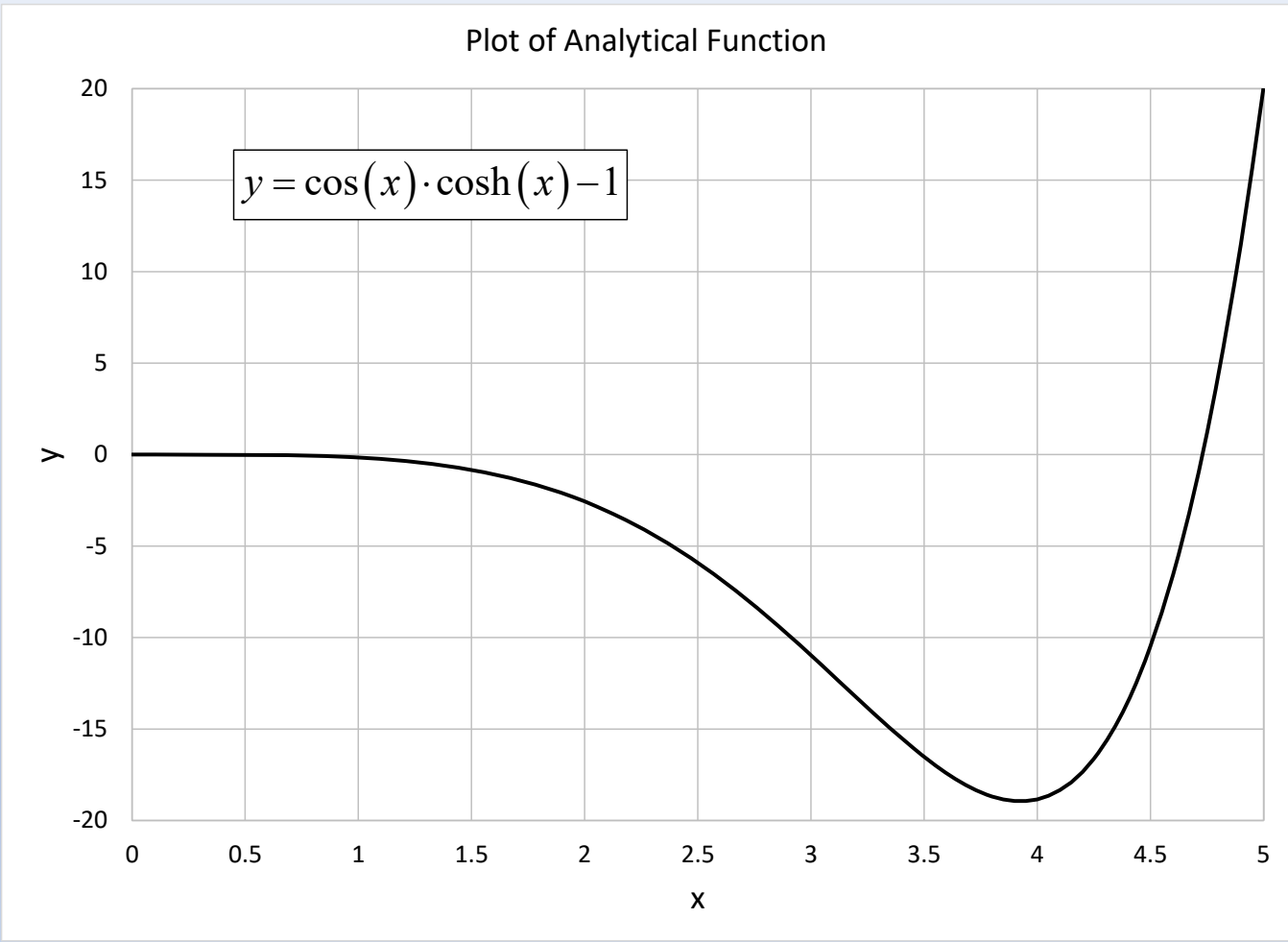
# Creating Plots of Analytical Functions

Create Formatted Plot of  $y$  vs.  $x$



# Creating Plots of Analytical Functions

Insert Equation Object on Plot





# Histogram Bar Charts

ConcentrationData.txt

Create histogram data with the FREQUENCY function

File name:



Text Files (\*.prn;\*.txt;\*.csv)

F12 ↓

File name:

Save as type:



	A
1	17
2	16.6
3	16.3
4	16.1
5	17.1
6	16.9



193	17.6
194	17.8
195	17.7
196	17.2
197	17.4

name the range of data Conc

n	197
max	16.1
min	18.2

Bin Boundaries	Frequencies	Bin Centers
16.05	0	
16.25	3	16.15
16.45	10	16.35
16.65	17	16.55
16.85	28	16.75
17.05	42	16.95
17.25	35	17.15
17.45	34	17.35
17.65	14	17.55
17.85	9	17.75
18.05	3	17.95
18.25	2	18.15

array formula  
=FREQUENCY(Conc,Bins)

create a bar chart of frequencies versus bin centers

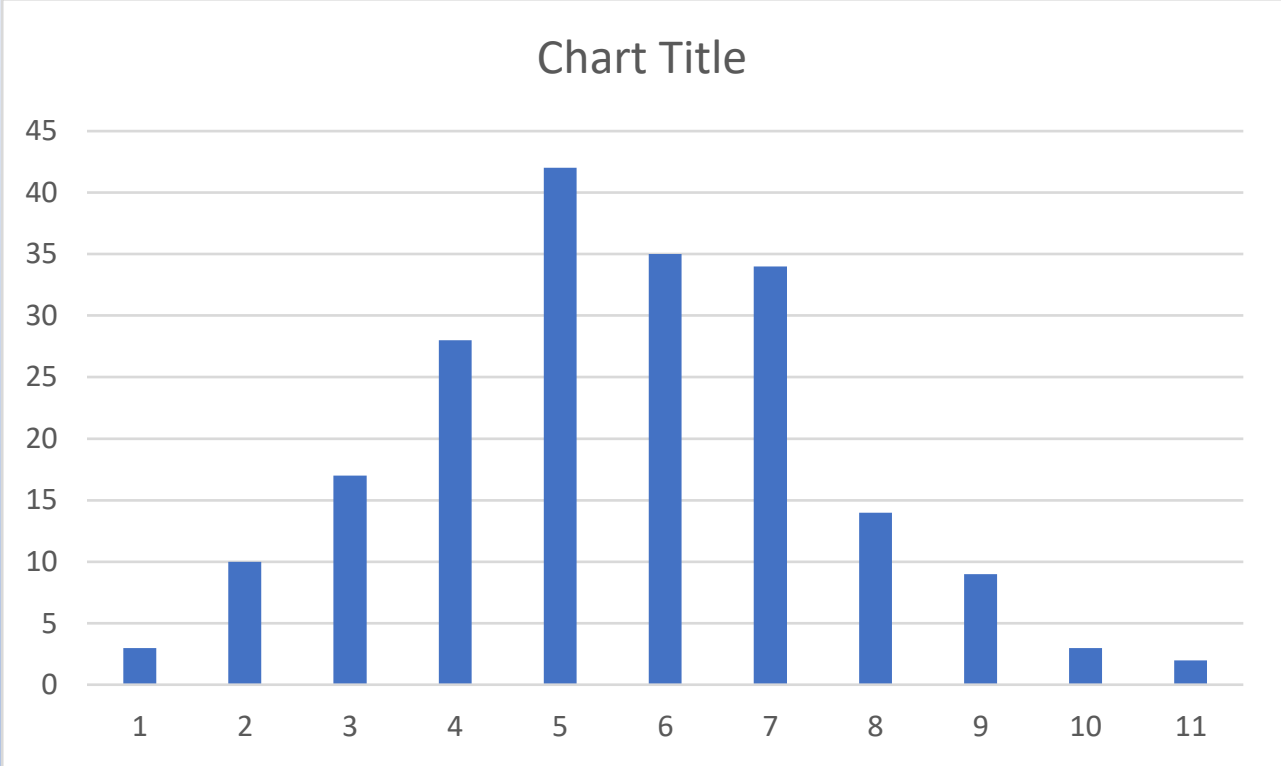
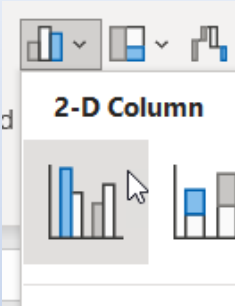
2 data  
≥ 18.05  
< 18.25



# Histogram Bar Charts

Create bar chart based on histogram data

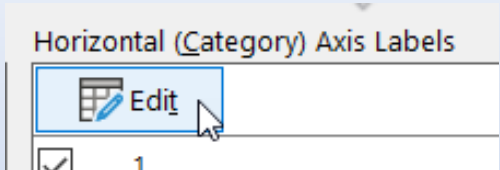
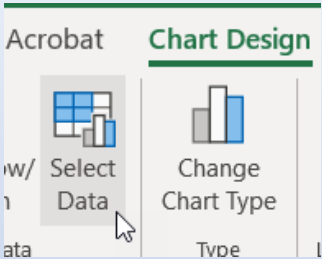
Frequencies
0
3
10
17
28
42
35
34
14
9
3
2
0



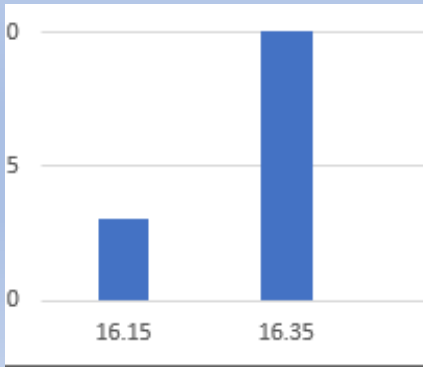
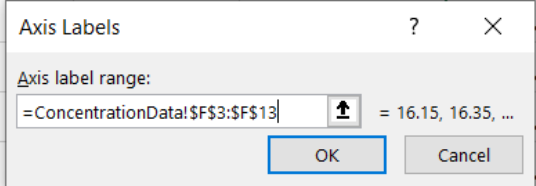
move the chart to its own sheet

# Histogram Bar Charts

Change x-axis labels to bin centers

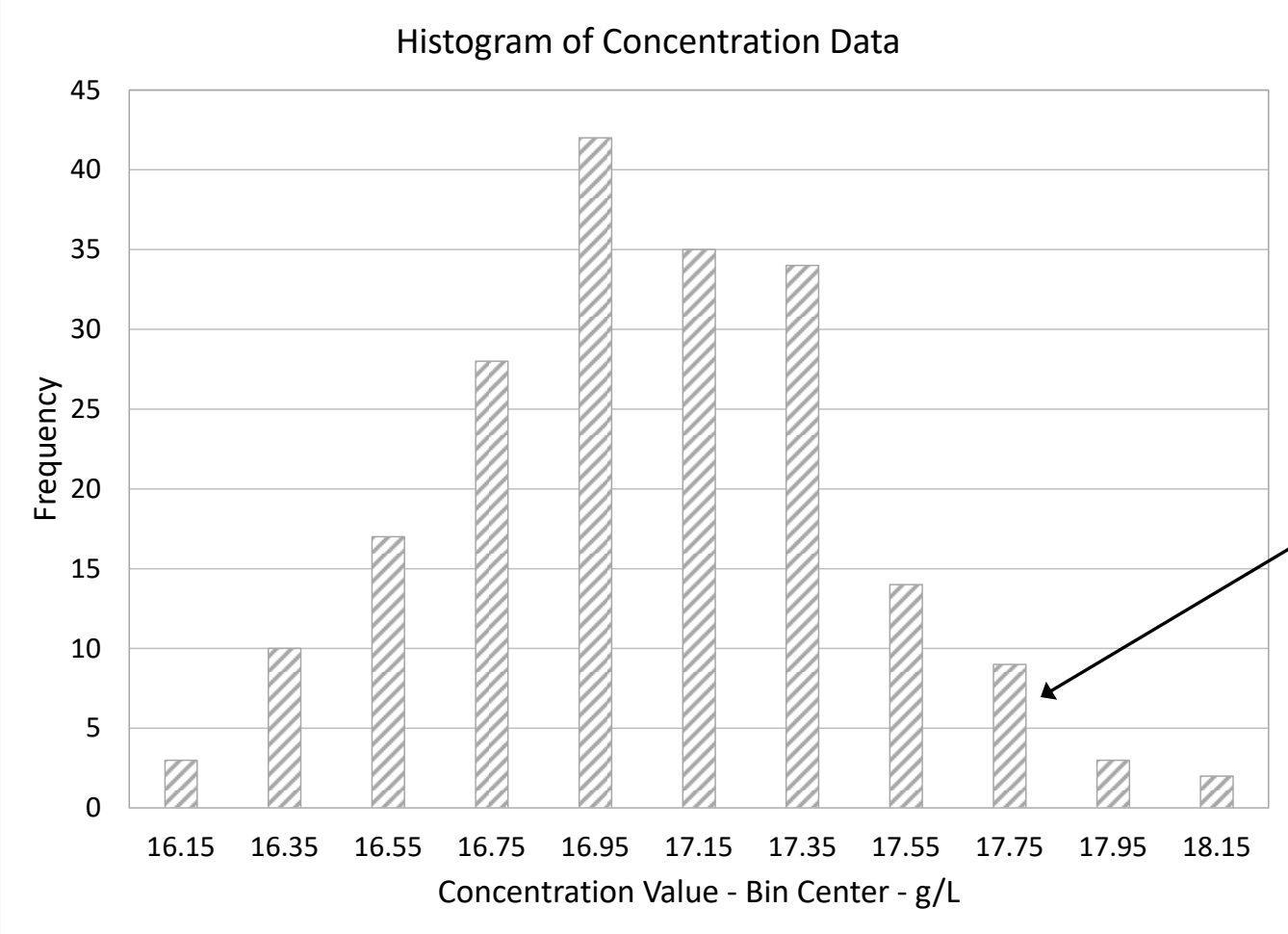


8.2	16.25	16.15
	16.45	16.35
		16.55
		16.75
		16.95
		17.15
	17.45	17.35
	17.65	17.55
	17.85	17.75
	18.05	17.95
	18.25	18.15



# Histogram Bar Charts

Complete formatting of the chart

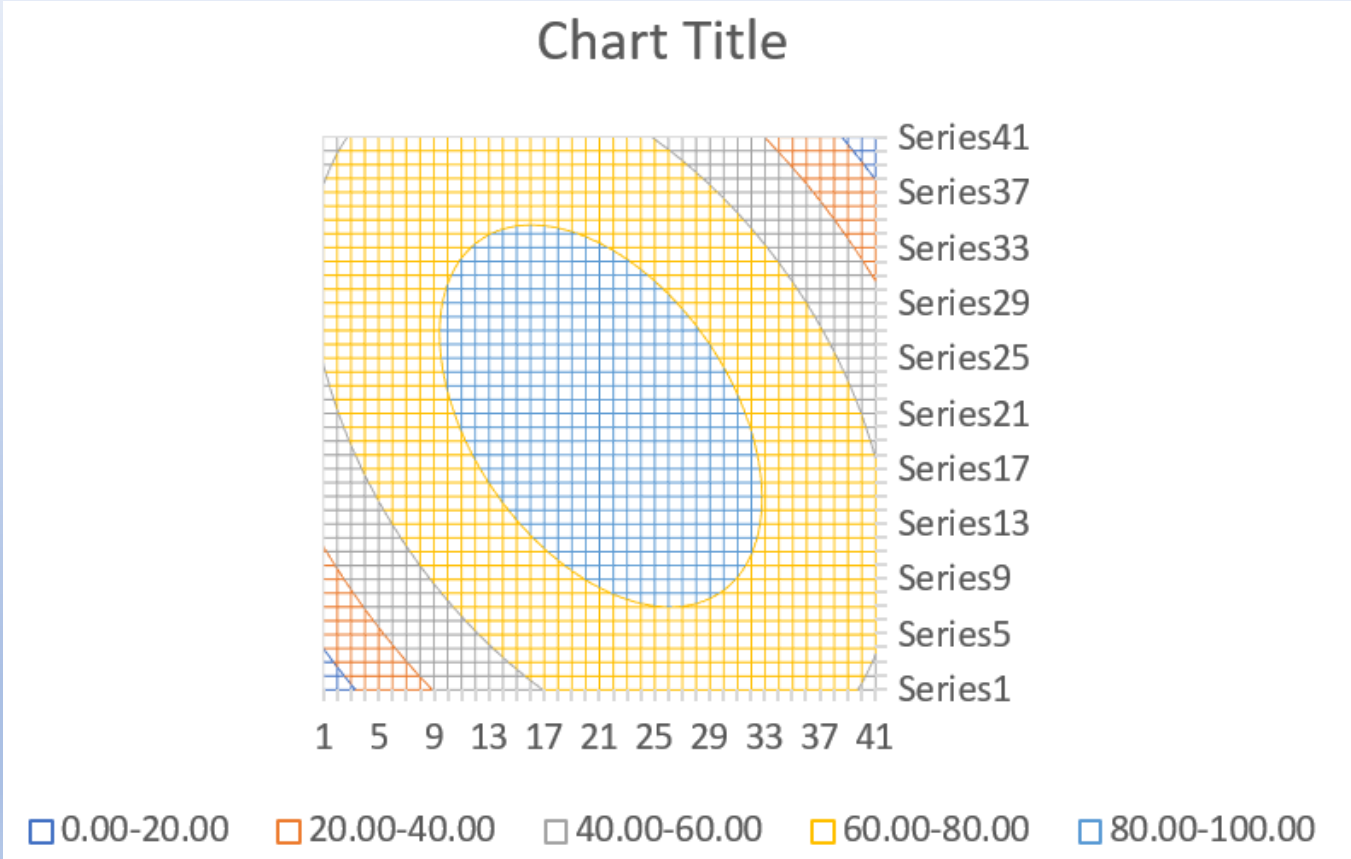
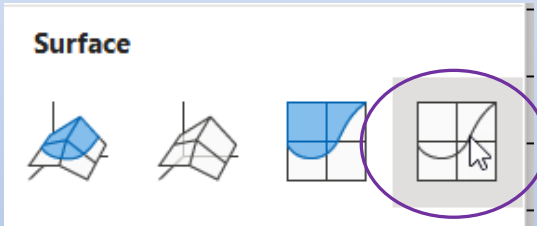
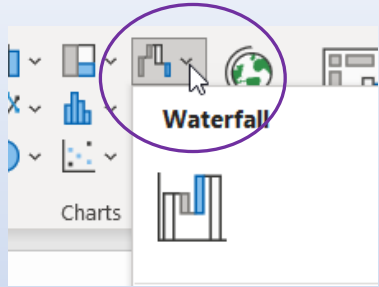


change bar fill to a dark gray pattern



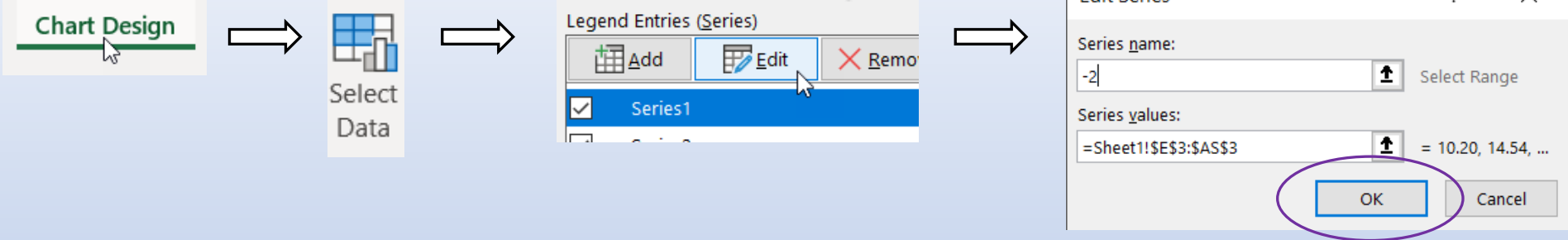
# Contour and Surface Plots

Select interior of the table and create a contour plot



# Contour and Surface Plots

Adjust contour plot settings

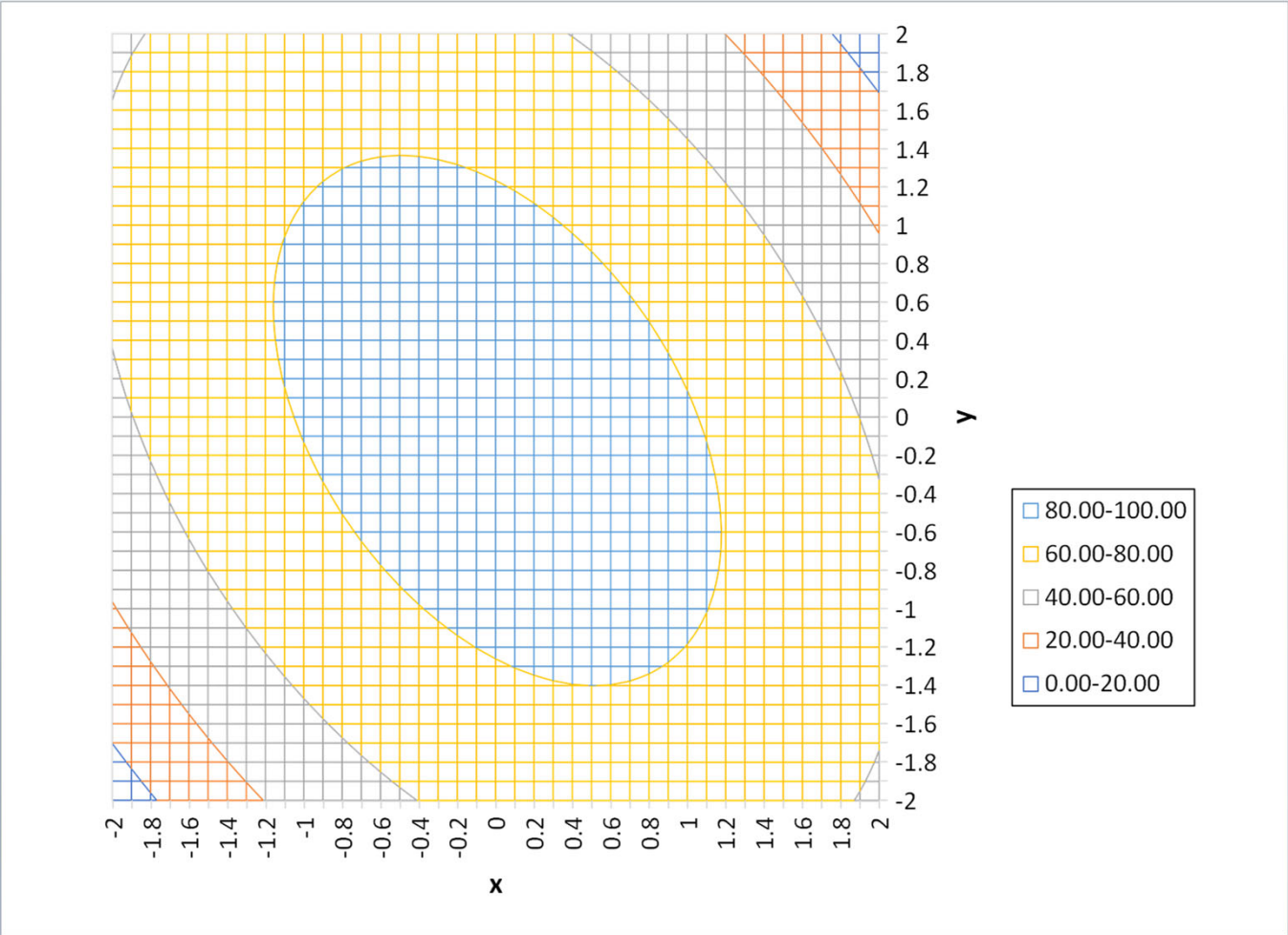


Repeat for all series (tedious!)

- Add axes titles
- Format axes ticks
- Move and format legend

# Contour and Surface Plots

Final version of contour plot





# Contour and Surface Plots

Surface mesh plot of experimental data

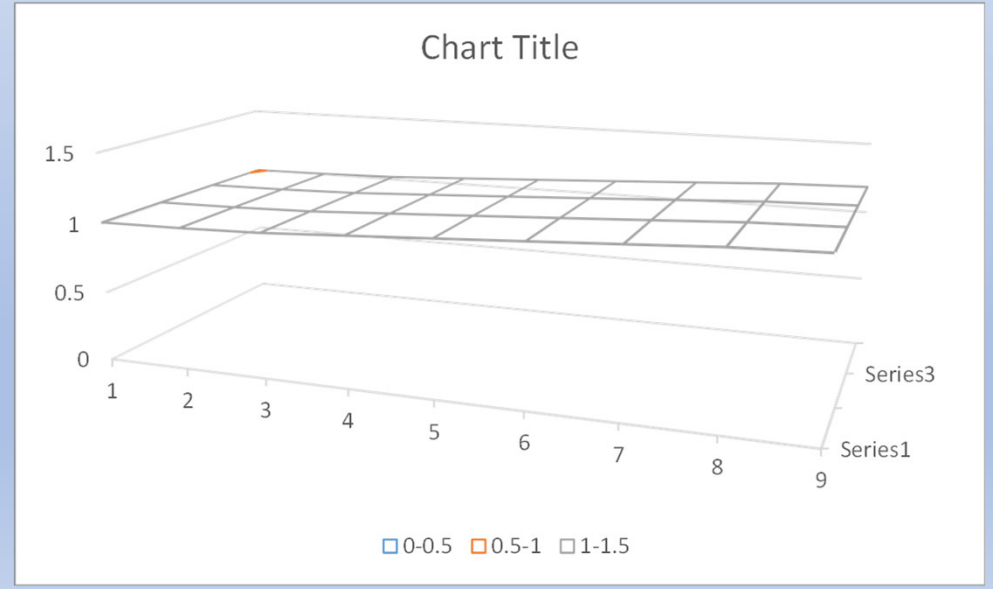
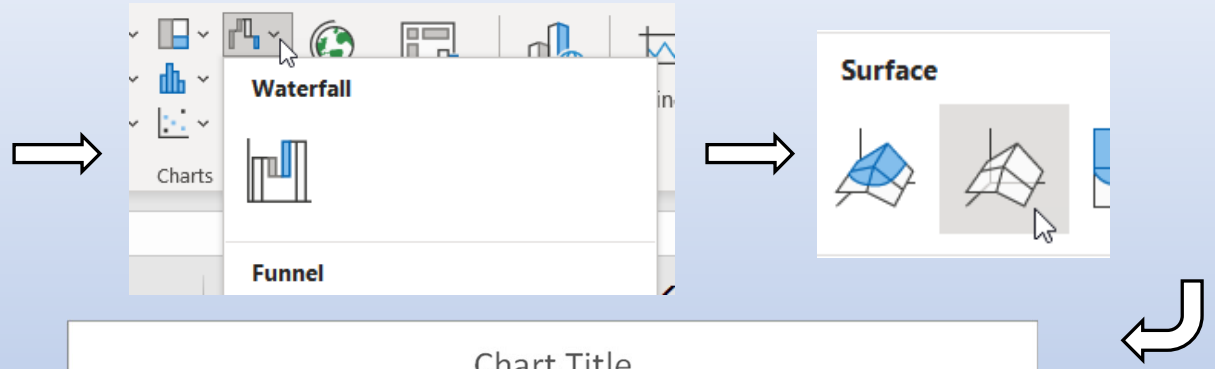
NaClDensityStarter.xlsx

	A	B	C	D	E	F
1	Density of NaCl Aqueous Solutions					
2			Temperature			
3			0 °C	10 °C	25 °C	40 °C
4	Wt % NaCl	1	1.00747	1.00707	1.00409	0.99908
5		2	1.01509	1.01442	1.01112	1.00593
6		4	1.03038	1.02920	1.02530	1.01977
7		8	1.06121	1.05907	1.05412	1.04798
8		12	1.09244	1.08946	1.08365	1.07699
9		16	1.12419	1.12056	1.11401	1.10688
10		20	1.15663	1.15254	1.14533	1.13774
11		24	1.18999	1.18557	1.17776	1.16971
12	26	1.20709	1.20254	1.19443	1.18614	

# Contour and Surface Plots

Surface mesh plot of experimental data

	0 °C	10 °C	25 °C	40 °C
1	1.00747	1.00707	1.00409	0.99908
2	1.01509	1.01442	1.01112	1.00593
4	1.03038	1.02920	1.02530	1.01977
8	1.06121	1.05907	1.05412	1.04798
12	1.09244	1.08946	1.08365	1.07699
16	1.12419	1.12056	1.11401	1.10688
20	1.15663	1.15254	1.14533	1.13774
24	1.18999	1.18557	1.17776	1.16971
26	1.20709	1.20254	1.19443	1.18614



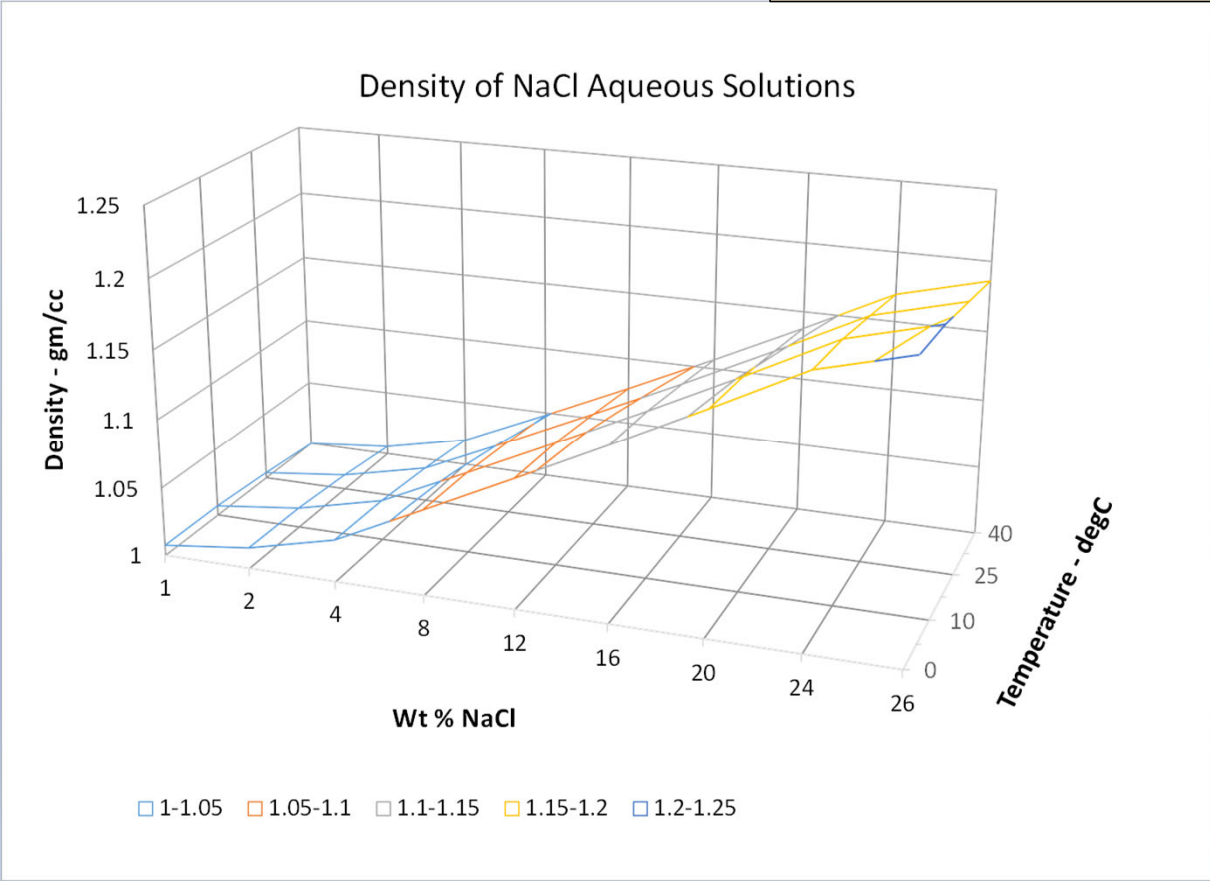
# Contour and Surface Plots

Surface mesh plot of experimental data

Move plot to chart sheet and format

Note: Excel's contour and surface plots are limiting. A better choice is to use the Excel link to Matlab and create plots there.

Note: Since this is a categorical plot, both grids aren't spaced correctly.



Reference:

## Spreadsheet Problem Solving and Programming for Engineers and Scientists,

David E. Clough and Steven C. Chapra,  
CRC Press - Taylor & Francis Group, 2024.

What's next?

## Excel Bootcamps 1, 2, 3 and 4

- ✓ 1: Getting up to speed with Excel
- **2: Introducing VBA**
- 3: Learning to use Excel to solve typical problem scenarios
- 4: Detailed modeling of packed-bed and plug-flow reactors



"Prof. Clough, may I be excused? My brain is full."