


From Excel To VBA


Start Excel on your computer for later use today.

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Mechanical Engineering 209
Programming for Mechanical Engineers
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Outline

- Review last lecture on Excel: fixed cell references, functions and plotting
- Excel tables
- Introduction to VBA
 - The macro recorder
 - The VBA editor
- More on first programming assignment
 - Range names and data validation
 - Discussion of and work on remaining tasks




Review Cell References

- Copying formulas
 - A reference like =A1 will change as the formula is copied
 - A reference like =\$A\$1 will not change
 - The reference =A\$1 will keep column A, but change rows when copied
 - The reference =\$A1 will keep row 1, but change columns when copied
 - Formulas like \$C2*\$D\$1^2/2 for two-way tables

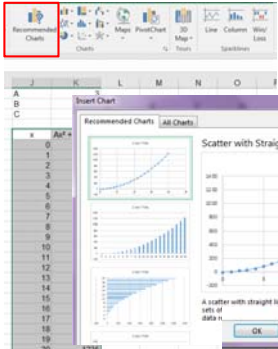


Review Functions


- Built-in worksheet functions listed at <https://support.office.com/en-us/article/Excel-functions-alphabetical-b3944572-255d-4efb-bb96-c6d90033e188>
- Use VBA to write your own functions
 - Functions calls from worksheet have the form: =<Function Name>(<Argument List>)
 - E.g.: RAND(), SIN(B10), ATAN2(C12, R4), ...
 - Square root is SQRT in Excel, SQR in VBA



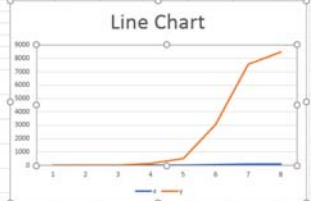
Review Plotting Basics



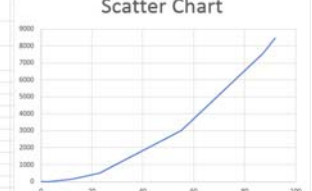
1. Select data
2. Click **Recommended Charts** on Insert tab
3. Select chart from resulting dialog
4. Click OK
5. Use resulting tools to add items such as legends, axis titles, and format chart



Data Set	
x	y
0	0
1	1
3	9
12	144
23	529
55	3025
87	7569
92	8464




Line Chart



Scatter Chart

USE SCATTER CHARTS!



Review Plotting Context Menus

- Use "Add Chart Element" to add chart parts
- Use "Select Data" to add/remove chart data
- Use "Current Selection" group pulldown menu to select item to format

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Data Tables (1/2)

- Data tables allow sorting and filtering by entries in a given column
- Enter data in columns with column headers
- Select any cell in table and click Table Icon in Insert Tab
- Edit cells selected in the Create Table dialog, if necessary, and click OK

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Data Tables (2/2)

- Table in default format, use pull down to filter/sort
- Menu for description pull-down shown here allows sorting or having only certain items show in table (filtering)

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Introduction to VBA

- Activate Developer Tab
 - Should be located after View Tab
 - If not there use following sequence: File Tab => Options => Customize Ribbon
 - Place check in Developer Tab checkbox
- See next slide Excel Options dialog

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Put check here and click OK

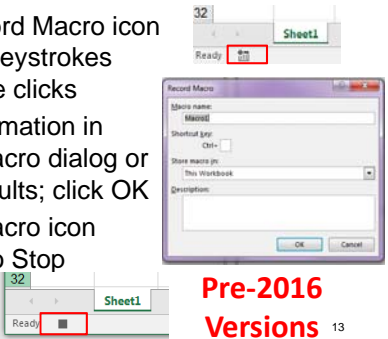
Macro Recorder (Developer Tab)

- Click Record Macro on developer tab to record keystrokes/mouse clicks
- Enter information in Record Macro dialog or leave defaults; click OK
- Record Macro icon changes to Stop Recording

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Macro Recorder (Task Bar)

- Click Record Macro icon to record keystrokes and mouse clicks
- Enter information in Record Macro dialog or leave defaults; click OK
- Record Macro icon changes to Stop Recording

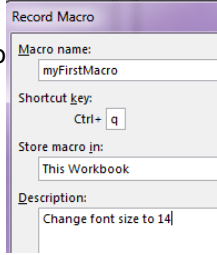


Pre-2016 Versions

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Record a Simple Macro 1/2


- Open a new worksheet
- Enter your first name into cell A1 and copy it into cells A2 to A5
- Select Cell A1 then click Record Macro icon
- Fill Record Macro dialog as shown at right and click OK



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Record a Simple Macro 2/2

- Change font size to 14 and click Stop Recording
- Move to cell A2 and press control+q – Did the font size change in cell A2?
- Go to the developer tab and click Visual Basic to go to the VBA editor
- You should see VBA code generated by the macro recorder as shown on the next slide



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Macro

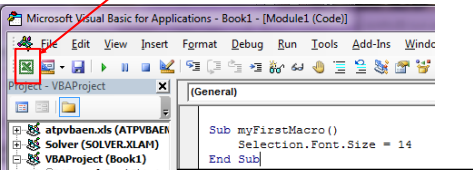
```
Sub myFirstMacro()
    myFirstMacro Macro
    Change font size to 14
    Keyboard Shortcut: Ctrl+q
    With Selection.Font
        .Name = "Arial"
        .Size = 14
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ThemeColor = xlThemeColorLight1
        .TintAndShade = 0
        .ThemeFont = xlThemeFontNone
    End With
End Sub
```

Edit this code to leave only the following:
 Sub myFirstMacro()
 Selection.Font.Size = 14
 End Sub

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Using Edited Macro

- Click Excel icon to return to worksheet



- On worksheet select cells A3:A5 and press control+q
- Did font size change?

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First Programming Assignment

- Download from course web site <http://www.csun.edu/~lcaretto/me209/pa1.pdf>
- Computations of ideal-gas density
 - R_u = Universal gas constant
 - Engineering gas constant, $R = R_u/M$
 - Ideal gas density: $\rho = m/V = P/RT$
 - For P in kPa, V in m^3 , T in K, and m in kg, use $R_u = 8.31447 \text{ kJ/kmol}\cdot\text{K}$
 - Create table of density versus temperature for a fixed pressure, P, and molar mass, M

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Assignment One – Task One 1/2

	A	B	C	D	E	F
1	Universal gas constant	8.31447	kJ/kmol.K		Ideal gas density for Air	
2	Substance	Air		Temperature	Density	
3	Molar Mass	28.966	kg/kmol	T(K)	ρ (kg/m ³)	
4	Pressure	101.325	kPa	=B5	300	1.17666
5	Minimum Temperature	300	K	=E4+\$B\$9	400	0.88249
6	Maximum Temperature	2500	K		500	0.70599
7	Temperature steps	22			700	0.58833
8					800	0.50428
9	Temperature increment	100		=(B6 - B5)/B7	900	0.44125
10	Engineering gas constant	0.287042	kJ/kg.K	=B1/B3	1000	0.39222
11					1100	0.35300
12					1200	0.32091
13					1300	0.29416
14					1400	0.27154
15					1500	0.25214
16					1600	0.23533

Density formula in cell F4 ($\rho = P/RT$) is =B\$4/(\$B\$10*E4)

Next slide looks at these two columns

Assignment One – Task One 2/2

1. Click and Drag fill handle down to get all T values from 300 to 2500
2. Enter first density formula and double click fill handle to get all values

Double click me

Review Range Names (Task 2)

- Can assign meaningful names to cells
- Names are used in formulas and show in name box when cell is selected
- Example below shows change with names

Worksheet Using Names Without Names

	A	B	C		A	B
1	Ideal Gas Equation for Air			1	Ideal Gas Equation for Air	
2	Pressure	100	kPa	2	Pressure	100
3	Temperature	300	K	3	Temperature	300
4	Gas Constant	0.287	kJ/kg.K	4	Gas Constant	0.287
5	Density	=Pressure/(Temperature*Gas Constant)		5	Density	=B2/(B3*B4)

Default range names absolute (like \$A\$1)

Review Getting Range Names

- Select cells with names adjacent to cells to be named
- Choose **Create from Selection** in **Defined Names** group of **Formula** tab
- In resulting dialog box make sure name location is correct and click **OK**

Review Name Box

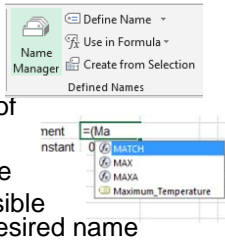
- The name box, to the left of the formula bar, shows the currently selected cell
- When range names are defined, this box becomes a pulldown menu that shows all the defined names
- Clicking on a name in this menu takes you to the named cell
- Range names may be used as names for a range of cells

Review Name Manager

- Main tool for managing range names
 - Choose **Name Manager** in **Defined Names** group of **Formula** tab
 - Create, delete or edit names in Manager
- By default names have scope of entire workbook (named range on one worksheet can be used on another worksheet)
- Name manager allows you to make name scope one worksheet

Using Names in Formulas

- When using point and click for a named range the name will be used instead of the usual A1 notation
- For large worksheets "Use in Formula" on Formula tab gives list of available names
- Starting to type a range name gives list of possible entries; double click desired name

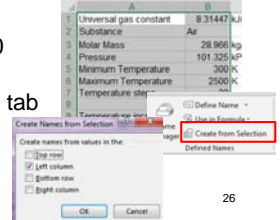


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25

Assignment One – Task Two 1/3

- Repeat task one using Range names
 - Name first tab "Cells"
 - Copy sheet and change tab to "Names"
 - Delete previous formulas for ΔT and R and all table formulas
 - Select range A1:B10
 - Click on **Create from Selection** in Formula tab
 - Select location for names and click OK

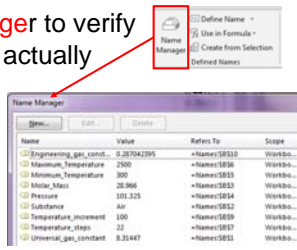


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26

Assignment One – Task Two 2/3

- Use **Name Manager** to verify that names have actually been created
- Workbook scope means that names can be used anywhere in workbook
- Note that names refer to \$B\$1, etc.; this means that names are absolute



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27

Assignment One – Task Two 3/3

	A	B	C	D	E	F	
1	Universal gas constant	8.31447 kJ/kmol·K			Ideal gas density for Air		
2	Substance	Air			Temperature	Density	
3	Molar Mass	28.966 kg/kmol		T(K)		ρ (kg/m ³)	
4	Pressure	101.325 kPa		=B5	300	1.17666	
5	Minimum Temperature	300 K		=E4 + \$B\$9	400	0.88249	
6	Maximum Temperature	2500 K			500	0.70599	
7	Temperature steps	22			600	0.58833	
8					700	0.50428	
9	Temperature increment	100	= (B6 - B5) / B7		800	0.44125	
10	Engineering gas constant	0.287042 kJ/kg·K	= B1 / B2		900	0.39222	
11					1000	0.35300	
12						0	
13	Density formula in cell F4 ($\rho = P/RT$) is = \$B\$4 / (\$B\$10 * E4)					0	0.32091
14					300	0.27154	
15					400	0.25214	
16					500	0.23533	

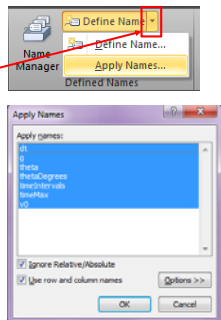
Reenter previous formulas using point and click to get range names

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28

Names to Existing Formulas

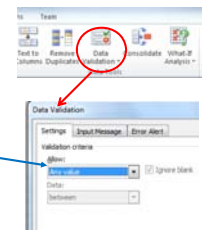
- Adding names after entering formulas does not use names in existing formulas
- Click the down arrow next to **Define Names** and select **Apply Names** from the resulting submenu
- Select names in Apply names dialog and click OK
 - Can leave settings for checkboxes at bottom of dialog as set by Excel



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Data Validation 1/2

- Allows spreadsheet designer to set limits on data by other users (or self)
- Validation icon located in Data Tools group of Data Tab
- Use **Allow:** box to set type of data and other boxes to set limits



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30

Data Validation 2/2

Selecting Whole Number, Decimal, Date, Time, or Text length gives choices below, with user-specified values

Selecting List gives box to input location of list

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Assignment One – Task Three

- Data validation gives user an automated molar mass entry based on substance choice
 - Download the workbook from the [molar mass table](#) link on the course home page
 - Copy table to your worksheet
 - Follow directions on assignment to get substance menu that gives molar mass automatically

Name	Molar Mass
Acetylene	26.0373
Air	28.966
Ammonia	17.0305
Argon	39.948
Benzene	78.1118
Butadiene	54.0904
Butane	58.1222
Carbon	44.0095
Dioxide	44.0095
Carbon Monoxide	28.0101
Chlorine	70.906
Ethane	30.069
Ethyl Chloride	64.5141
Ethylene	28.0532
Fluorine	37.996806
Helium	4.00260
Hexane	86.1754
Hydrogen Chloride	36.4609

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Data Validation for Lists

- Results in pulldown menu for valid choices selected by user

Click pulldown arrow to get menu of allowed names

Enter table-look-up formula to get molar mass from name table

See next slide for result of selecting Water

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Data Validation Choice: Water

	A	B	C	D
1	Gas Constant	8.31447	kJ/kmol·K	
2	Substance	Water		
3	Molar Mass	18.015	kg/kmol	
4	Pressure	101.325	kPa	
5	Tmin	300	K	
6	Tmax	2500	K	
7	Steps	22		
8				
9	deltaT	100		
10	EngrGasConst	0.46153	kJ/kmol·K	
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Assignment One – Task Four

- Construct two-way table

Final two-way Table

Final Table in Equation View

Detailed Instructions in Assignment

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Assignment One – Task Five

- Create density-temperature plot from two-way data table in Task Four
 - Plot three pressures only for simplicity
- Select T column and columns for pressures then insert scatter chart and format

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