



COSC 122
Computer Fluency

Spreadsheets

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Key Points

- 1) Spreadsheets are programs for storing and manipulating data that is represented as a table of cells.
- 2) Each cell has a row number and column label which combine to represent its address.
- 3) Spreadsheets allow you to organize data and write formulas to do computations. They are a powerful tool for data storage and analysis.

Spreadsheet Overview

A **spreadsheet** organizes information into a two-dimensional array of cells (a **table**).

A **cell** has two components:

- ◆ an address - specified given a row and column number
- ◆ a location - that can store a number, text, or formula

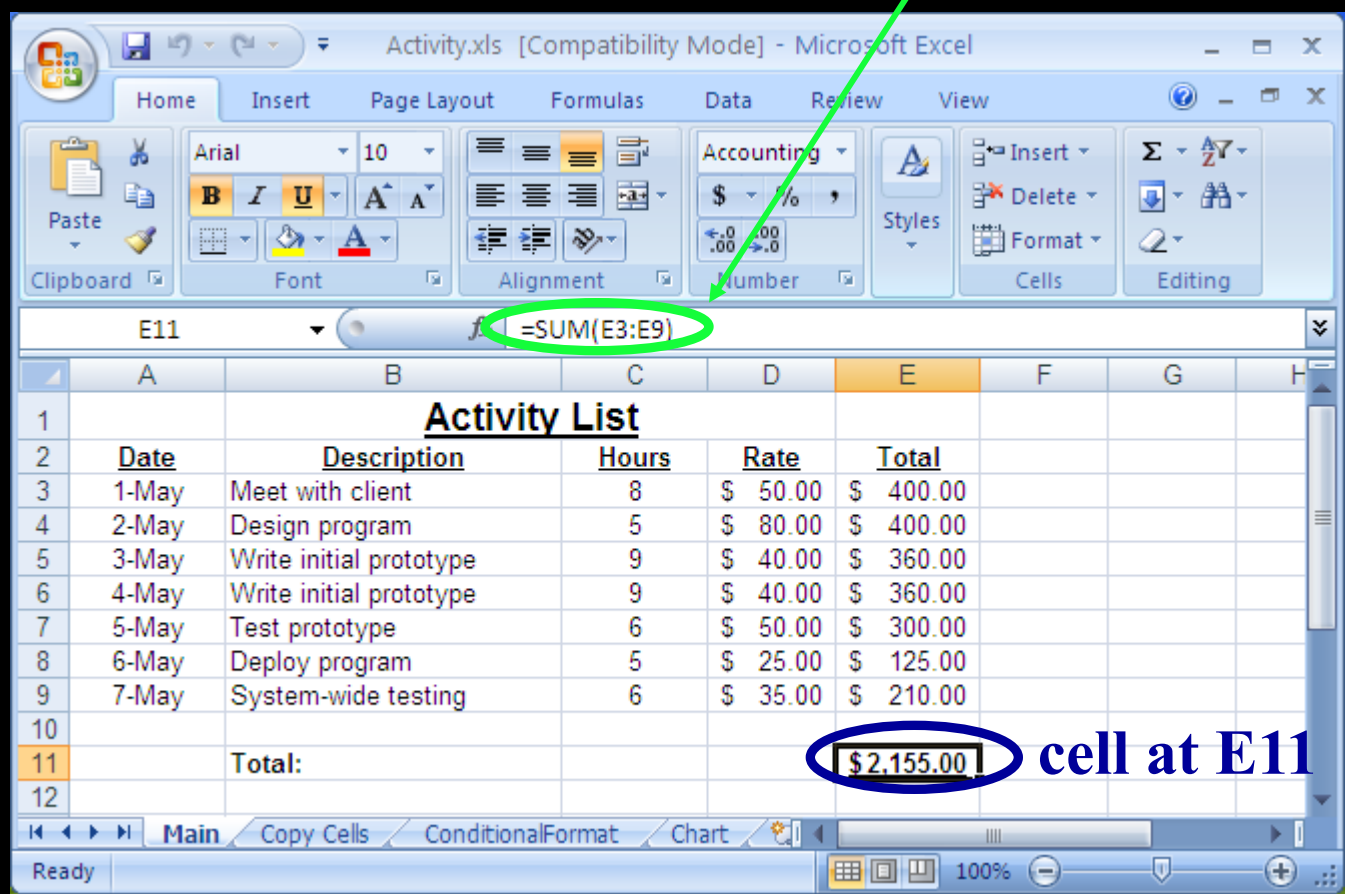
The power of a spreadsheet is that we can write simple formulas (commands) to perform calculations and **immediately see** the results of those calculations.

Spreadsheets are very common in accounting and reporting applications.

Spreadsheet Addressing

A **cell** is identified by a row number and column letter.

formula in selected cell



ROWS

COLUMNS

cell at E11

Spreadsheet Addressing

The rows in a spreadsheet are numbered starting from 1.

The columns are represented by letters.

- ◆ A is column 1, B is column 2, ..., Z is column 26, AA is column 27, ...

A cell is identified by putting the column letter first then the row number.

- ◆ e.g. B3 is the 2nd column and the 3rd row.

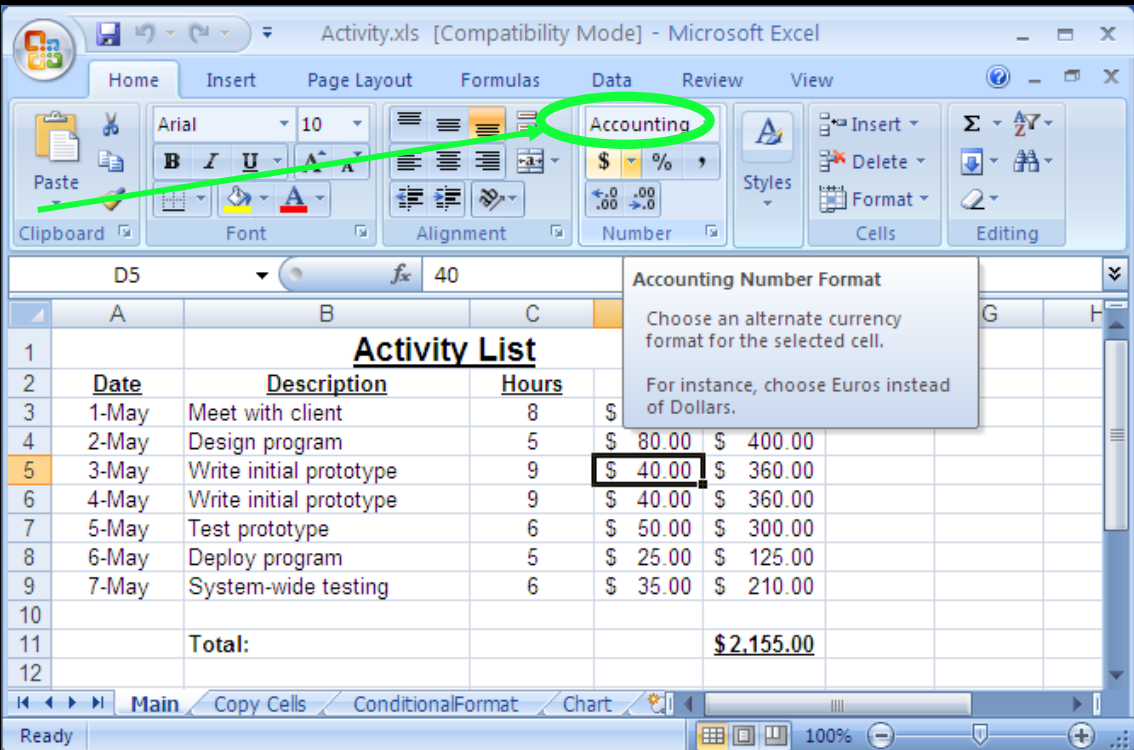
Question: What column number is AD? How about BAD?

Spreadsheet Data Entry

An entry can be added to a cell by clicking on it and typing in the data. The data may be a number, text, or a date.

- ◆ The spreadsheet attempts to detect the data type and format it accordingly. It is also possible to manually format the data.

format option



Spreadsheet Formatting

We can format cells in italics, underline, and bold similar to a text editor. It is also possible to justify data and change fonts.

format and justify shortcuts

The screenshot shows the Microsoft Excel interface with the Home ribbon selected. A red circle highlights the font and alignment options, including Bold (B), Italic (I), Underline (U), font size (10), and alignment (center, left, right, justify). The spreadsheet data is as follows:

	A	B	C	D	E	F	G	H	
1		Activity List							
2	Date	Description	Hours	Rate	Total				
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00				
4	2-May	Design program	5	\$ 80.00	\$ 400.00				
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00				
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00				
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00				
10									
11		Total:			\$2,155.00				
12									

Selecting Cells

Multiple ways of selecting spreadsheet cells:

- ◆ 1) With the mouse, (left) click and drag mouse to select a rectangle region of cells.
- ◆ 2) With keyboard, hold `SHIFT` key and use arrow keys to select a rectangle region of cells.
- ◆ 3) With mouse and keyboard, while holding `CTRL` key, (left) click on individual cells to select non-contiguous cells.
- ◆ 4) Click on a row number to select a whole row.
- ◆ 5) Click on a column header to select a whole column.

Range Selecting Cells Example

The screenshot shows the Microsoft Excel interface with the following data table:

	A	B	C	D	E	F	G	H	
1		Activity List							
2	<u>Date</u>	<u>Description</u>	<u>Hours</u>	<u>Rate</u>	<u>Total</u>				
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00				
4	2-May	Design program	5	\$ 80.00	\$ 400.00				
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
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8	6-May	Deploy program	5	\$ 25.00	\$ 125.00				
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00				
10									
11		Total:			\$2,155.00				
12									

The range B3:E6 is selected, highlighted with a thick black border. The formula bar shows the content of cell B3: "Meet with client". The status bar at the bottom indicates "Average: 146.75 Count: 16 Sum: 1761".

Selecting Individual Cells Example

The screenshot shows Microsoft Excel in Compatibility Mode with the file 'Activity.xls'. The ribbon includes Home, Insert, Page Layout, Formulas, Data, Review, and View. The formula bar shows the active cell contains the formula `=SUM(E3,E5,E7,E9)`. The spreadsheet data is as follows:

	A	B	C	D	E	F	G	H
1		Activity List						
2	<u>Date</u>	<u>Description</u>	<u>Hours</u>	<u>Rate</u>	<u>Total</u>			
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00			
4	2-May	Design program	5	\$ 80.00	\$ 400.00			
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00			
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00			
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00			
10								
11		Total:			\$ 2,155.00			
12					<code>=SUM(E3,E5,E7,E9)</code>			

Manipulating Cells

Once you have selected one or more cells, there are several common actions you can perform:

◆ 1) DELETE

- ❑ delete the contents of all cells by pressing delete key
- ❑ delete the contents and the cell locations (then shift remaining) by choosing Delete... from pop-up menu (brought up by right click).

◆ 2) Cut, Copy, Paste

- ❑ cut - copies selected cells to clipboard and removes from document
- ❑ copy - copies selected cells to clipboard
- ❑ paste - copies cells in clipboard to sheet starting at currently selected cell

◆ 3) Add selected cells to a formula (requires that you were previously constructing a formula before selecting the cells).

Manipulating Cells - Filling

Filling combines copy and paste.

There is a small box or tab beyond the cell's lower right corner (fill handle). Grab it with the cursor and pull to other cells.

Cut, Copy, Paste

cut,
copy,
paste

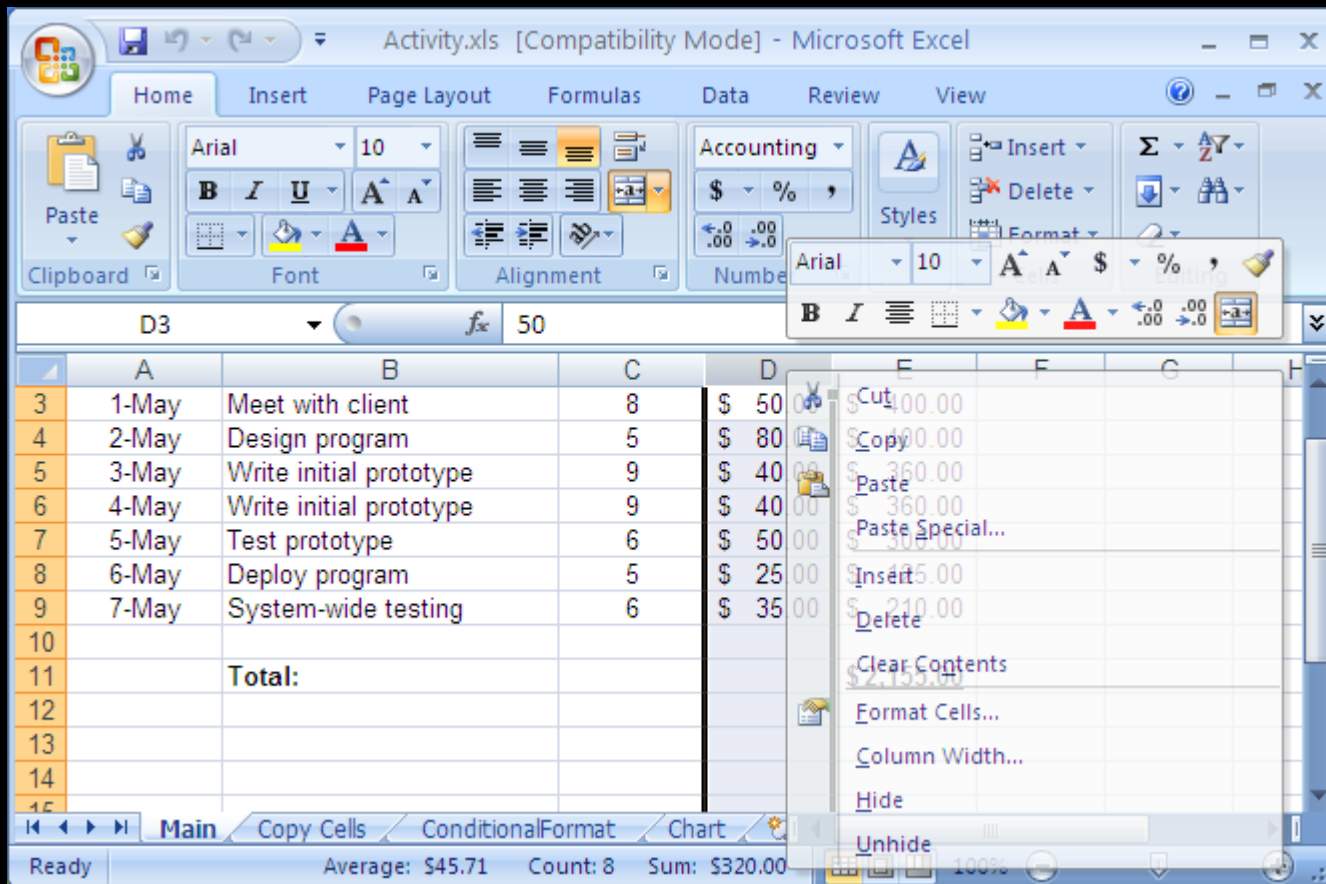
The screenshot shows the Microsoft Excel interface with the following data:

	A	B	C	D	E	F	G	H	
1		Activity List							
2	Date	Description	Hours	Rate	Total				
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00				
4	2-May	Design program	5	\$ 80.00	\$ 400.00				
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
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9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00				
10									
11		Total:			\$2,155.00				
12									

The formula bar shows the formula for cell E11: `=SUM(E3:E9)`. The status bar at the bottom indicates 'Ready' and '100%' zoom.

Hiding Columns and Rows

You can **hide** a column or row by right-clicking on the column or row header and selecting **Hide**. The column/row still exists but will not be displayed or printed unless unhidden.



Entering Formulas

A **formula** is any expression that begins with an equal sign ("=").

The equal sign indicates to the spreadsheet that a calculation must be performed to compute the value of the cell.

The screenshot shows the Microsoft Excel interface with the following data in the spreadsheet:

	A	B	C	D	E	F	G	H
1		Activity List						
2	Date	Description	Hours	Rate	Total			
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00			
4	2-May	Design program	5	\$ 80.00	\$ 400.00			
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00			
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00			
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00			
10								
11		Total:			\$2,155.00			
12								

Formula Expressions

A **formula** expression can consist of literals (numbers, text strings), operators, functions, and cell references.

Simple mathematical expressions:

◆ = 1 + 5

◆ = 1.5 * 3.14 + 42

Common functions:

◆ = ROUND(PI, 2) // Result is 3.14

◆ = CONCATENATE("Hello", " World") // Hello World

◆ Other common functions for trigonometry, dates, and financial.

Formula Expressions

The power of formulas comes from using cell references (similar to variable names in programming).

Cell reference examples:

$$\blacklozenge = A1 + A2$$

$$\blacklozenge = B1 + A3 - A4$$

CQ 5.1- Spreadsheets

Selecting Cells

Question: Which method allows you to select non-contiguous cells in a spreadsheet?

- A)** hold `SHIFT` key and use arrow keys
- B)** With the mouse left click on a cell and drag mouse
- C)** hold `CTRL` key and use arrow keys
- D)** hold `CTRL` key and left click on cells

CQ 5.2- Spreadsheets

Formulas

Question: A cell contains the following:

$$= 3 + 5 * 2$$

What is the value of the cell?

A) 13

B) 16

C) =3+5*2

CQ 5.3- Spreadsheets

Formulas

Question: A cell contains the following:

"ABC" + "DEF"

What is the value of the cell?

A) error

B) ABCDEF

C) "ABC" + "DEF"



Advanced Spreadsheet Addressing

The dollar sign "\$" is a special symbol that indicates an **absolute address**.

- ◆ **By default**, addresses are "**relative**" in the sense that if they are in a formula that is **copied to another cell, they will be changed** relative to where they were copied from their origin.

Example:

- ◆ Cell A1 has the formula $=A2+B1$
- ◆ Copy contents of cell A1 to cell C4.
- ◆ Formula changes to $=C5+D4$ because moved down three rows and over two columns.
- ◆ If cell A1 had the formula $=\$A\$2+\$B\1 , then the same formula would be in cell C4.
- ◆ Question: What if formula was $=\$A2+B\1 ?

CQ 5.4- Spreadsheets

Formulas and References

Question: Cell **A1** contains the following: **=\$B2+D\$4** What is the formula if the cell is copied to cell **D3**?

A) error

B) =\$B2+D\$4

C) =\$B4+F\$4

D) =\$B4+G\$4

Naming Cells

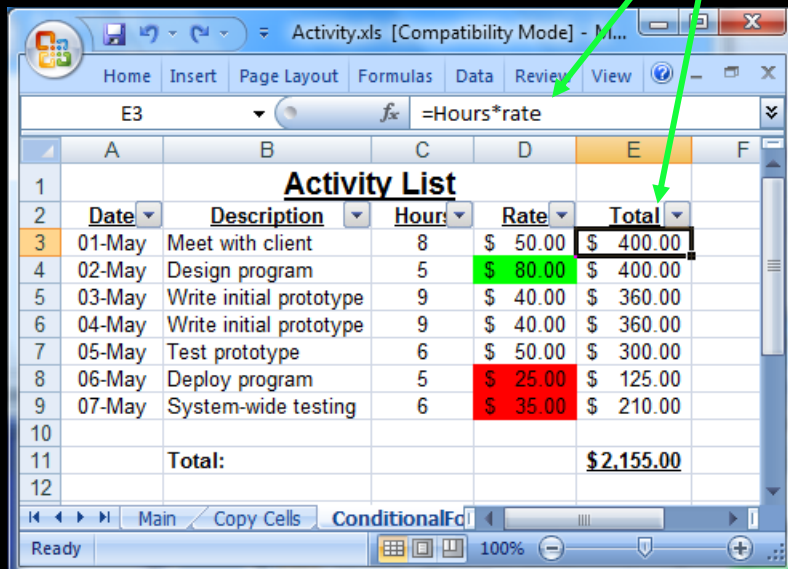
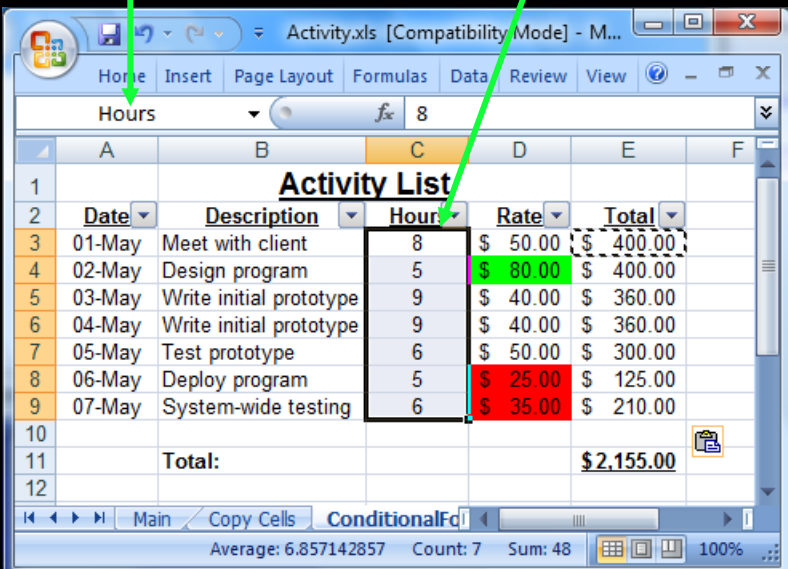
Instead of referring to cells by their address, you can give a cell a name and use that name in cell formulas.

- ◆ This makes it easier to read and understand formulas.
 - Like programming variables where we use names instead of addresses to refer to data locations.

Example: Refer to columns by name Hours and Rate.

name box named cells

use names in formula



Aggregate Formulas

An **aggregate formula** computes a summary function over a range of cells. The values can either be literals or cell locations.

Common functions are:

- ◆ `MIN(<value list>)` - returns minimum value in list
- ◆ `MAX(<value list>)` - returns maximum value in list
- ◆ `SUM(<value list>)` - returns sum of all values in list
- ◆ `AVERAGE(<value list>)` - returns average of values in list
- ◆ `COUNT(<value list>)` - returns count of 'numbers' in list
- ◆ `MEDIAN(<value list>)` - returns median value of list

If specifying a cell rectangle, give the upper left and lower right corners, separated by a colon.

- ◆ e.g. `=average(A3:E6)` - rectangle of 4 rows and 5 columns

Aggregate Formula Example

building formula
by selection

The screenshot shows a Microsoft Excel spreadsheet titled 'Activity.xls [Compatibility Mode] - Microsoft Excel'. The ribbon is set to 'Formulas'. The formula bar displays '=max(C3:C9)'. A green arrow points from the text 'building formula by selection' to the formula bar. The spreadsheet contains the following data:

	A	B	C	D	E	F	G	H	
1		Activity List							
2	Date	Description	Hours	Rate	Total				
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00				
4	2-May	Design program	5	\$ 80.00	\$ 400.00				
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00				
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00				
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00				
10									
11		Total:	=max(C3:C9)		\$ 2,155.00				
12									

The formula bar shows the formula for the 'Total' cell in row 11: `=max(C3:C9)`. The status bar at the bottom indicates the active cell is C11, with the formula `MAX(number1, [number2], ...)`.

Sorting Data

The screenshot shows Microsoft Excel with the following data table:

	A	B	C	D	E	F	G	H
1	Activity List							
2	Date	Description	Hours	Rate	Total			
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00			
4	2-May	Design program	5	\$ 80.00	\$ 400.00			
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00			
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00			
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00			
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00			

The Sort dialog box is open, showing the following configuration:

- My data has headers:
- Sort by: Hours (Values, Smallest to Largest)
- Then by: Rate (Values, Smallest to Largest)

Data can be sorted by selecting the **Sort** option under the **Data** menu.

Select the column(s) to sort on.

CQ 5.5- Spreadsheets

Aggregate Formulas

Question: Assume the three cells in the range A1:C1 contain numbers. Which of these formulas is **ALWAYS** the largest?

A) MAX(A1:C1)

B) MIN(A1:C1)

C) COUNT(A1:C1)

D) SUM(A1:C1)

E) none of the above are always guaranteed to be the largest

Charts

A **chart** is a graphical representation of spreadsheet data.

A chart is of a particular type (line, bar, etc.) and requires the user to supply the data that will be displayed in the chart.

Chart: Step #1 - Select Data and Type

Select **Insert**, then click **Chart** Icon, and pick the chart type.

chart shortcut

The screenshot shows the Microsoft Excel interface with the 'Insert' tab selected. The 'Charts' group in the ribbon is highlighted, and the 'Insert Chart' task pane is open. A red arrow points from the text 'chart shortcut' to the 'Chart' icon in the ribbon. The task pane shows various chart types, with 'Column' selected and 'Clustered Column' highlighted. The background spreadsheet contains the following data:

	A	B	C	D	E
1		Activity List			
2	Date	Description	Hours	Rate	Total
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00
4	2-May	Design program	5	\$ 80.00	\$ 400.00
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00
10					
11		Total:			\$2,155.00
12					
13					

Chart Options

Chart design tools allows you to modify the data in the chart, change the chart type, and move the chart in the Worksheet.

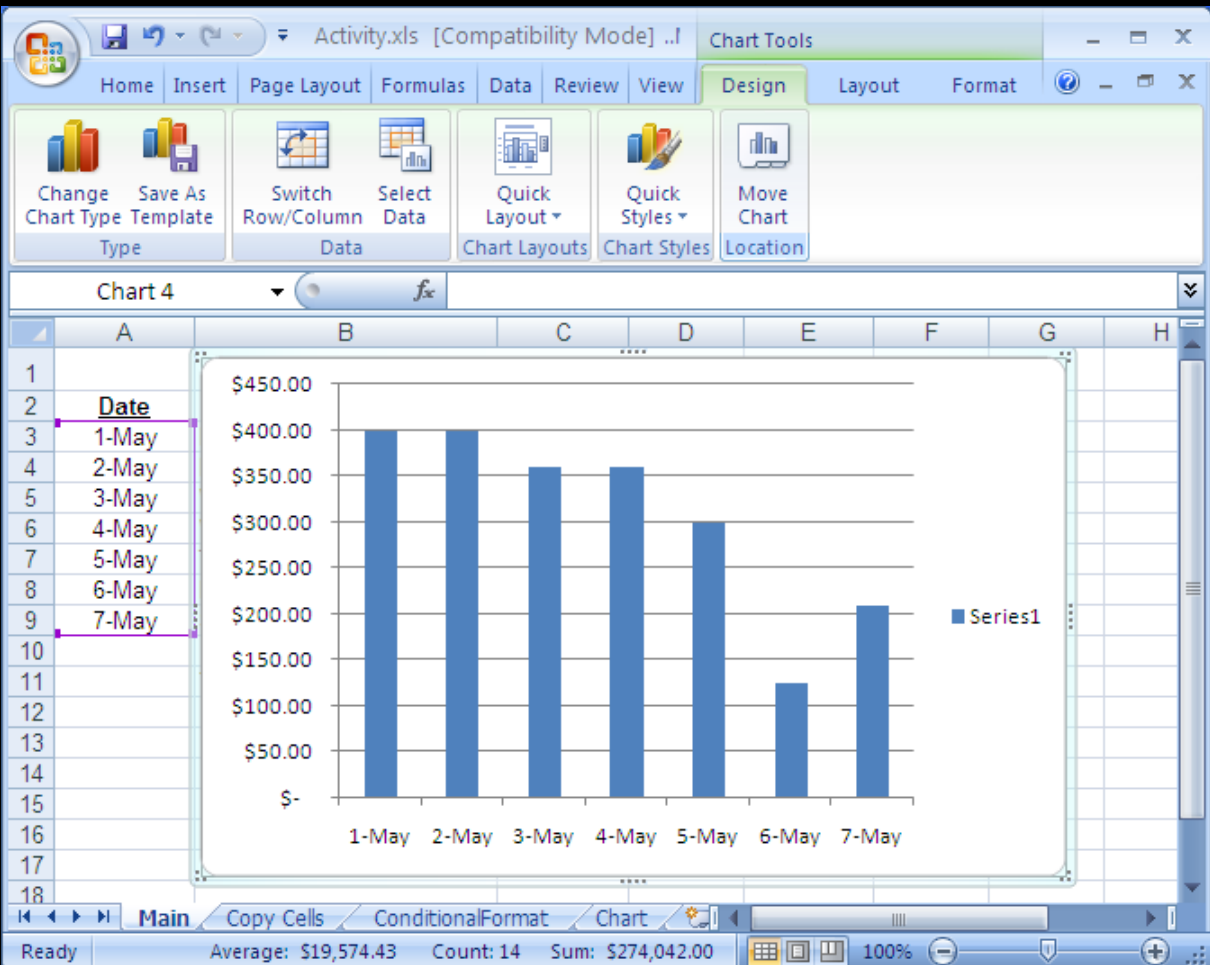


Chart: Step #2 - Verify Data

You may modify the data displayed in the chart using the Select Data option. This includes adding legends.

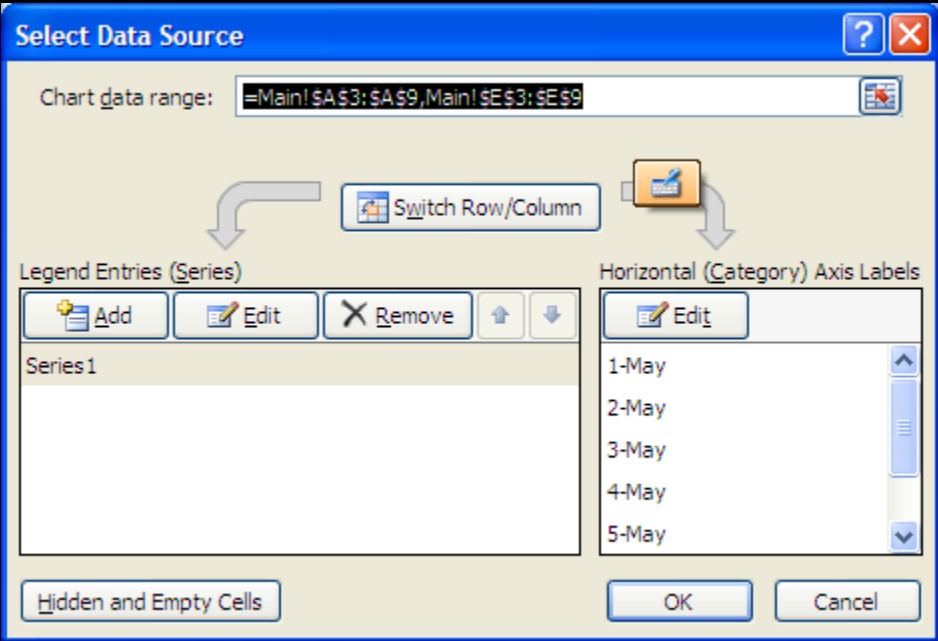


Chart: Step #3 - Chart Options

Under **Layout (Chart Tools)** you can set the title, legend, and colors. There are more format options under **Format**.

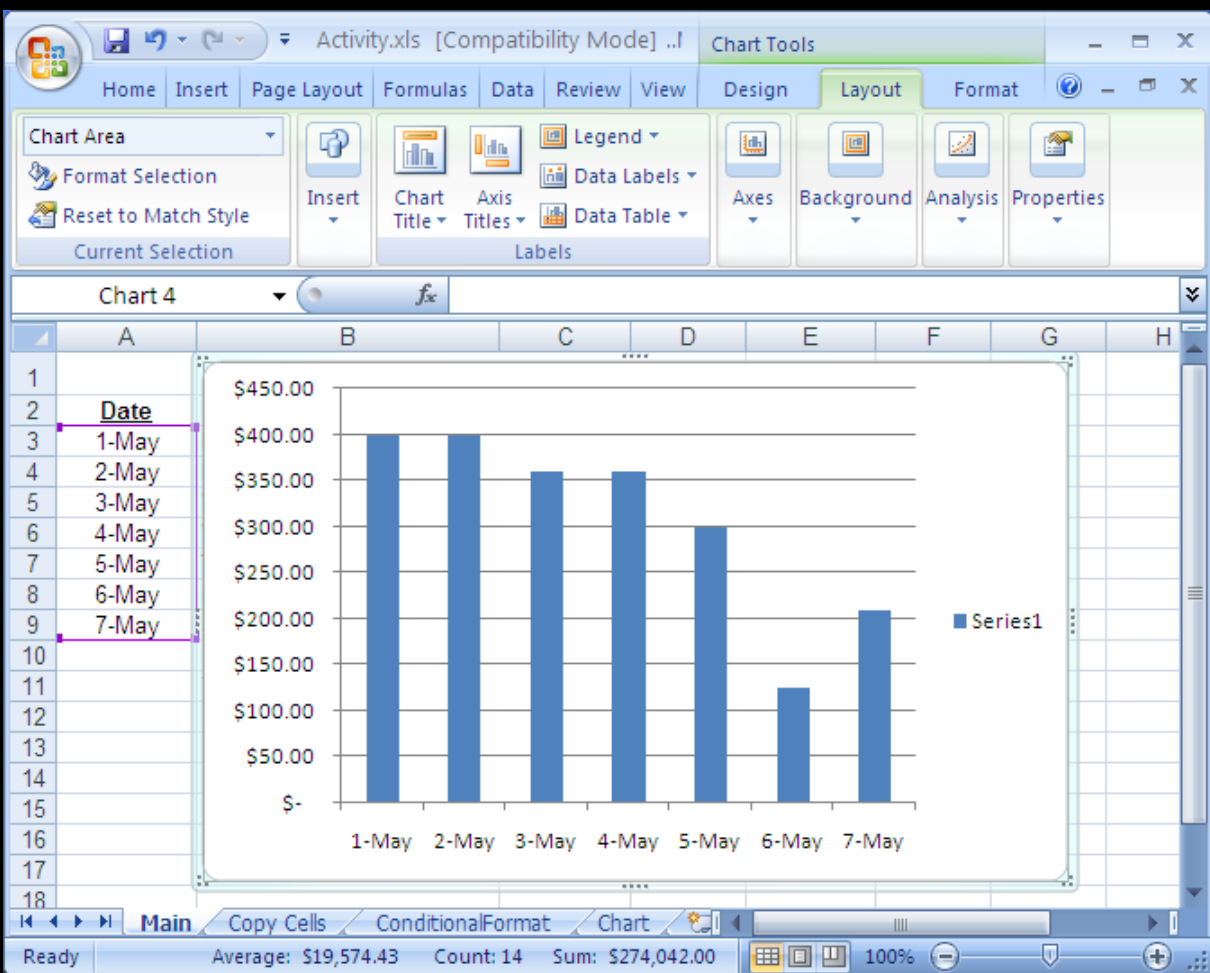
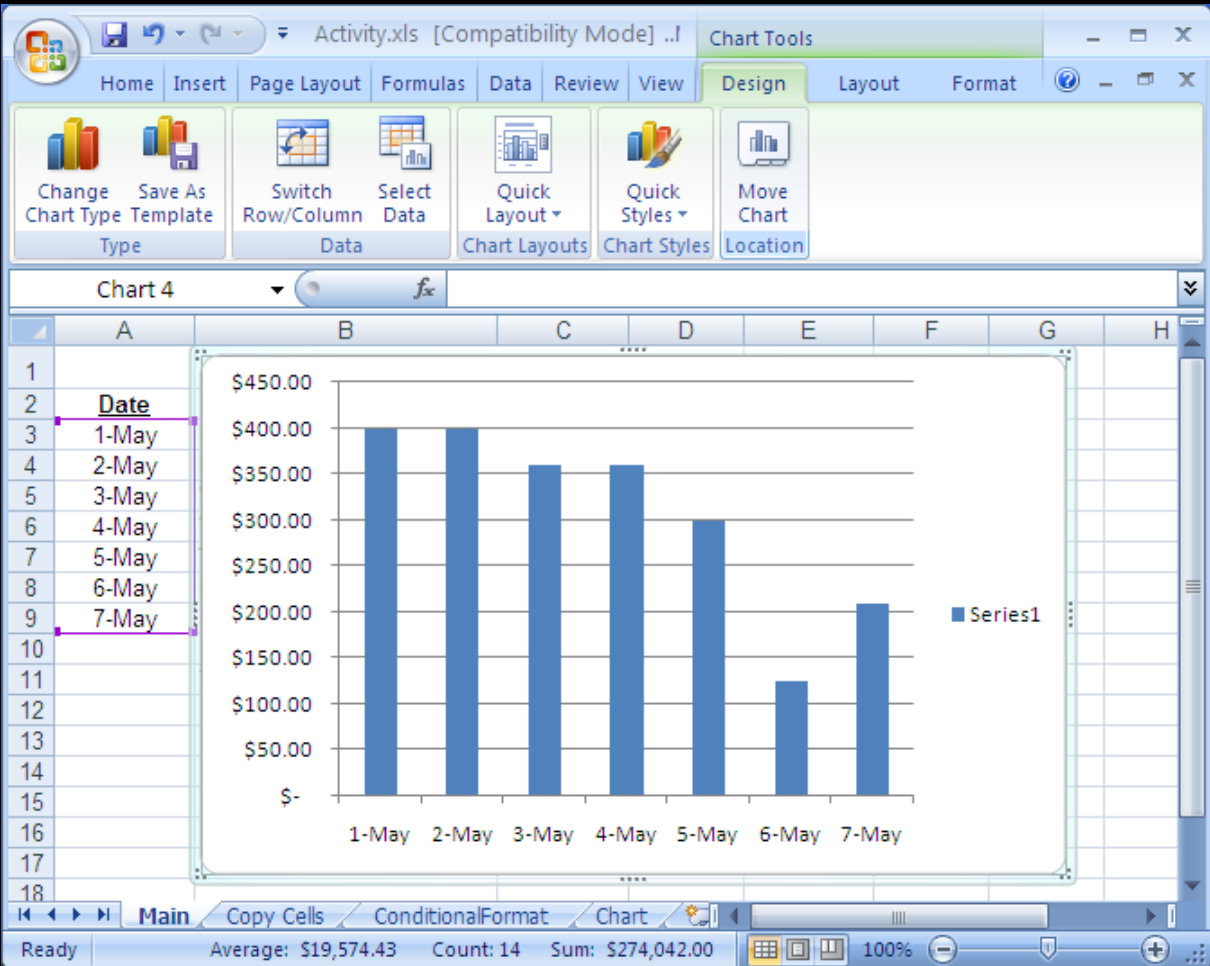
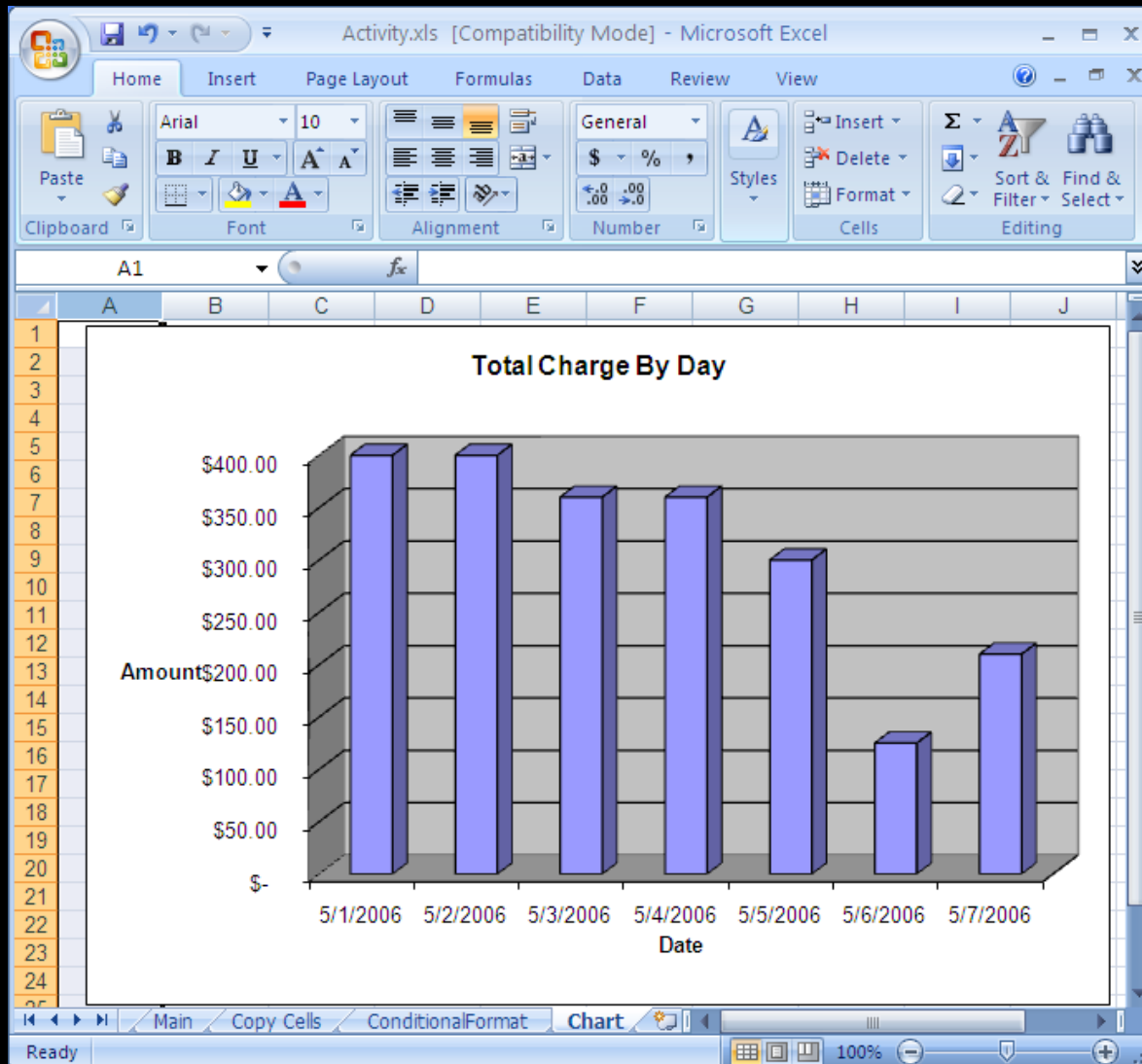


Chart: Step #4 - Chart Location

Put chart on an existing sheet or on its own sheet by selecting **Move Chart** in the **Design** area.



Final Chart



Other Formatting: Column Width

The screenshot shows the Microsoft Excel interface with a spreadsheet titled 'Activity.xls [Compatibility Mode]'. The 'Home' tab is active, and the 'Cell Size' context menu is open over column B. The spreadsheet contains the following data:

	A	B	C	D	E
1		Activity List			
2	Date	Description	Hours	Rate	Total
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00
4	2-May	Design program	5	\$ 80.00	\$ 400.00
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00
10					
11		Total:			\$2,155.00
12					
13					
14					
15					
16					
17					
18					
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20					
21					
22					
23					
24					

The 'Cell Size' context menu is open, showing options for Row Height, AutoFit Row Height, Column Width, AutoFit Column Width, Default Width, Hide & Unhide, Organize Sheets, and Protection.

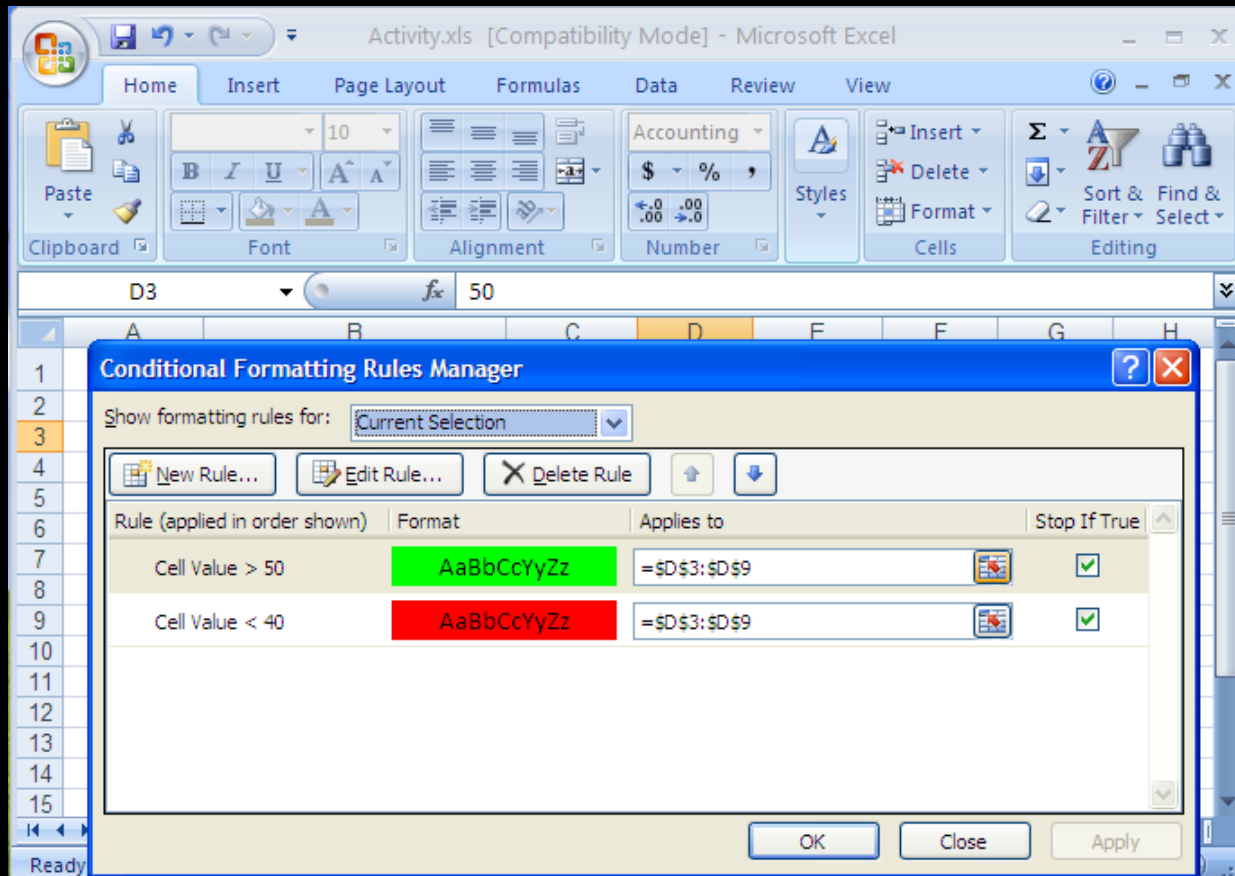
Resizing columns:
Auto-resize by double clicking on border between columns or using the Format option.

May also right-click on column to get Format option in the pop-up menu.

Conditional Formatting

Conditional formatting allows you to change the cell format based on data values. This is accessible under **Styles**.

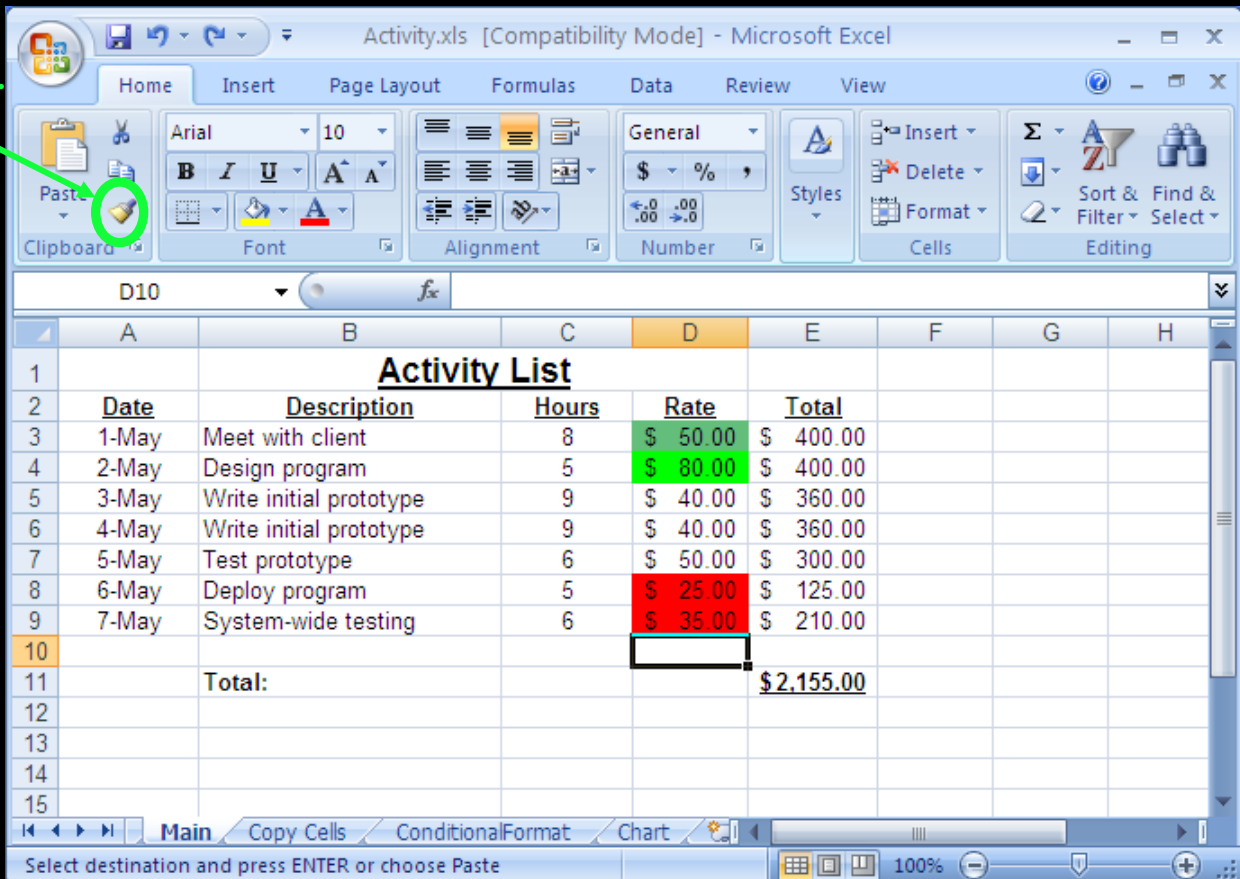
◆ Other options: data bars, color scales



Conditional Formatting Result

The paint format button allows you to copy formatting to many cells. Select the cell, click paint button, then highlight cells to have identical formatting.

paint
formatting
button



Spreadsheets for Data Management

A spreadsheet is often used as a simple form of a "database". A database is an organized representation of information.

- ◆ Examples: schedules and calendars, timesheets, expenses and finances, records, notes, and recipes, data research/analysis

We can use a spreadsheet as a database by:

- ◆ Using a row to store all the information about something we want to represent.
- ◆ Giving each column a meaningful name. A column represents a property or feature of the object stored in the row.
- ◆ Using the formulas to calculate new facts from the data.
- ◆ Using sorting to organize the data by key features.
- ◆ Using simple filtering (querying) to only show the most important data or data of interest.

Filtering

A **filter** shows a subset of the rows in the spreadsheet by only showing rows that pass a given condition (test).

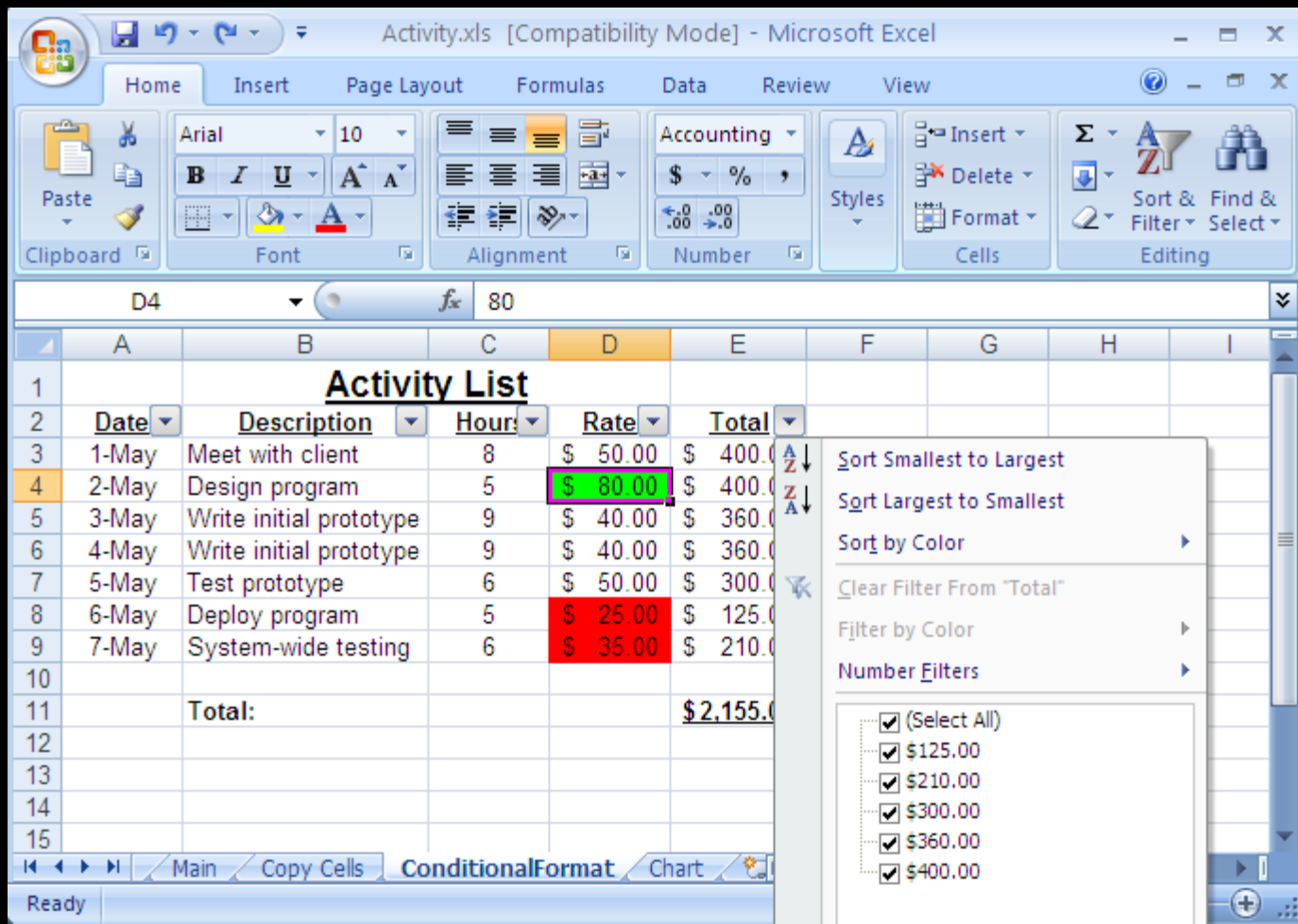
For our purposes, the **Auto Filter** under the **Data** then **Filter** menu is sufficient.

Once you select `Auto Filter`, each column heading has a drop-down list. By selecting a filtering criteria from the list, you can limit the rows that are displayed.

It is possible to filter on more than one column at the same time.

Filter Example

Filter on Total column: Can select a value, Top 10 items, or write a custom filter.

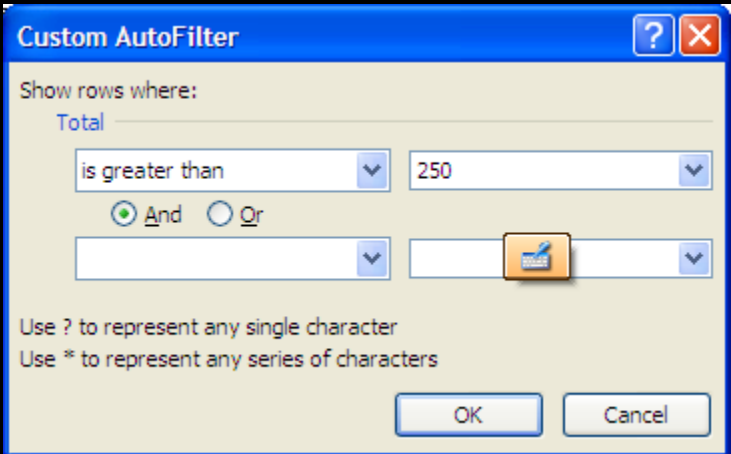


The screenshot shows Microsoft Excel with a spreadsheet titled 'Activity.xls [Compatibility Mode]'. The 'Home' tab is active. The spreadsheet contains an 'Activity List' with columns: Date, Description, Hours, Rate, and Total. The 'Total' column is filtered, and a dropdown menu is open over it, showing options like 'Sort Smallest to Largest', 'Sort Largest to Smallest', 'Sort by Color', 'Clear Filter From "Total"', 'Filter by Color', and 'Number Filters'. The 'Number Filters' section is expanded, showing a list of values to filter by: (Select All), \$125.00, \$210.00, \$300.00, \$360.00, and \$400.00. The 'Total' column values are: \$400.00, \$400.00, \$360.00, \$360.00, \$300.00, \$125.00, and \$210.00. The 'Rate' column values are: \$50.00, \$80.00, \$40.00, \$40.00, \$50.00, \$25.00, and \$35.00. The 'Hours' column values are: 8, 5, 9, 9, 6, 5, and 6. The 'Date' column values are: 1-May, 2-May, 3-May, 4-May, 5-May, 6-May, and 7-May. The 'Description' column values are: Meet with client, Design program, Write initial prototype, Write initial prototype, Test prototype, Deploy program, and System-wide testing. The 'Total' row is highlighted in blue.

	A	B	C	D	E	F	G	H	I
1		Activity List							
2	Date	Description	Hours	Rate	Total				
3	1-May	Meet with client	8	\$ 50.00	\$ 400.00				
4	2-May	Design program	5	\$ 80.00	\$ 400.00				
5	3-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
6	4-May	Write initial prototype	9	\$ 40.00	\$ 360.00				
7	5-May	Test prototype	6	\$ 50.00	\$ 300.00				
8	6-May	Deploy program	5	\$ 25.00	\$ 125.00				
9	7-May	System-wide testing	6	\$ 35.00	\$ 210.00				
10									
11		Total:			\$2,155.00				
12									
13									
14									
15									

Custom Filter Example

Filter on Total column: Custom filter with **Total > 250**



Custom Filter Result

Filter on Total column: Custom filter result with **Total > 250**

The screenshot shows an Excel spreadsheet titled 'Activity List' with the following data:

Date	Description	Hour	Rate	Total
1-May	Meet with client	8	\$ 50.00	\$ 400.00
2-May	Design program	5	\$ 80.00	\$ 400.00
3-May	Write initial prototype	9	\$ 40.00	\$ 360.00
4-May	Write initial prototype	9	\$ 40.00	\$ 360.00
5-May	Test prototype	6	\$ 50.00	\$ 300.00
Total:				\$2,155.00

Conclusion

Spreadsheets are programs for storing and manipulating data that is represented as a table of cells.

Each **cell** has a row number and column label which combine to represent its address. A cell can contain a number, text, date, or a formula that calculates its value.

Spreadsheets allow you to organize data and write formulas to do computations. They are a powerful tool for data storage and analysis.

Objectives

- ◆ Define: spreadsheet
- ◆ Explain how cells are addressed in a spreadsheet.
- ◆ List some of the ways to select cells in a spreadsheet.
- ◆ Explain: filling
- ◆ Define and explain: formula
- ◆ Explain how an aggregate function works. List some examples.
- ◆ Explain the usefulness of charts.
- ◆ Define: conditional formatting
- ◆ Explain how spreadsheets can be used as a database.