Calculations in Excel

Spreadsheet formulas
Functions

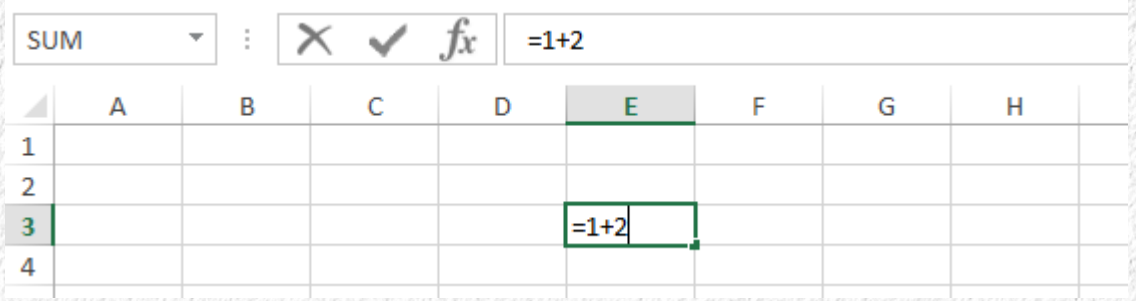
Spreadsheet formulas

- This is the reason to use spreadsheets
- Excel has many built-in functions that can be used
- Functions can be “nested” and combined
- Arithmetic calculations can be done as well

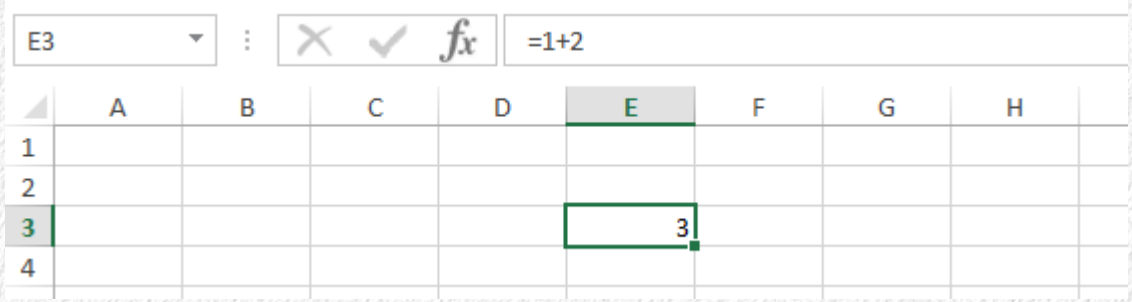
Basic arithmetic in cells

- Use an “=” to start a formula
- Arithmetic operators are:
  + (addition)
  - (subtraction)
  * (multiplication)
  / (division)
  ^ (exponential)

Entering formulas, getting the results



Editing a cell – the formula bar and the cell itself show the formula



After hitting Enter, the formula bar still shows the formula, but the cell shows the result

From here, can copy/paste entire cells

Addition, subtraction, multiplication, division

	B	C	
	Formula	Result	
	=3+2	5	
	=3-2	1	
	=3*2	6	
	=3/2	1.5	

Exponentials

=3^2 gives 9

What is 9^(1/2)?

What is the cube root of 8?

	B	C	
	Formula	Result	
	=3^2	9	
	=9^(1/2)	3	
	=9^0.5	3	
	=9^-0.5	0.333333	
	=8^(1/3)	2	

Parentheses used to determine order of operations

Operations inside parentheses done first

Comparison

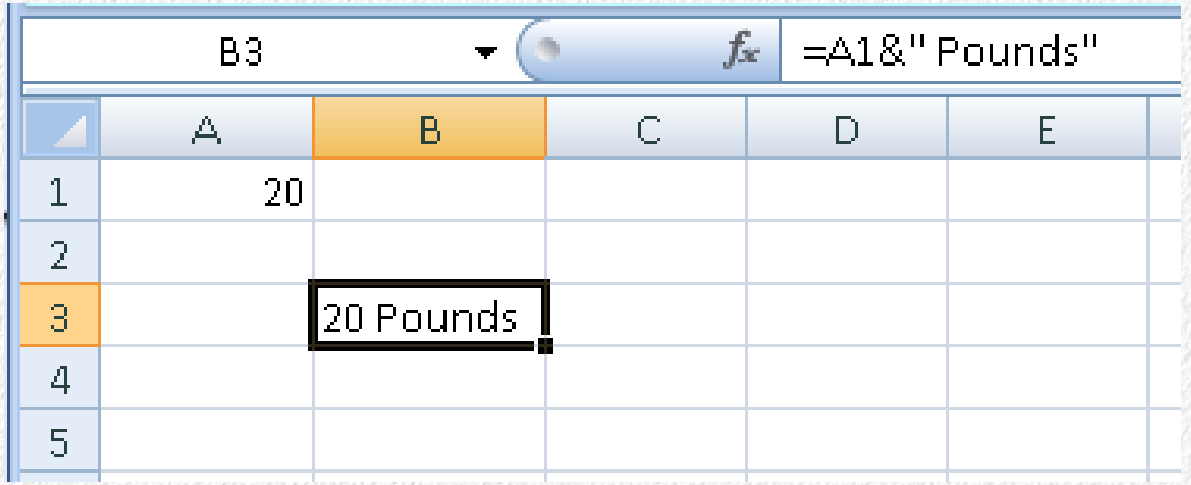
- Used to compare one cell to another
- Returns only “True” or “False” (true is equal to 1 to a computer, false is equal to 0)
- = , equals
- > , greater than
- < , less than
- >= , greater than or equal to
- <= , less than or equal to
- <> , not equal to

Concatenation

- You can combine the values in two different arguments (values, cells) with &
- Example:

  =A1&” Pounds”

  gives:
  20 Pounds

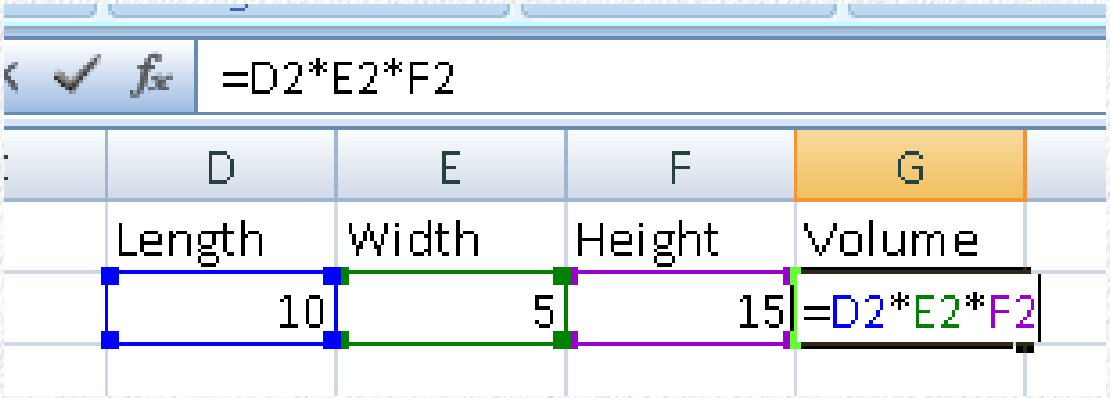


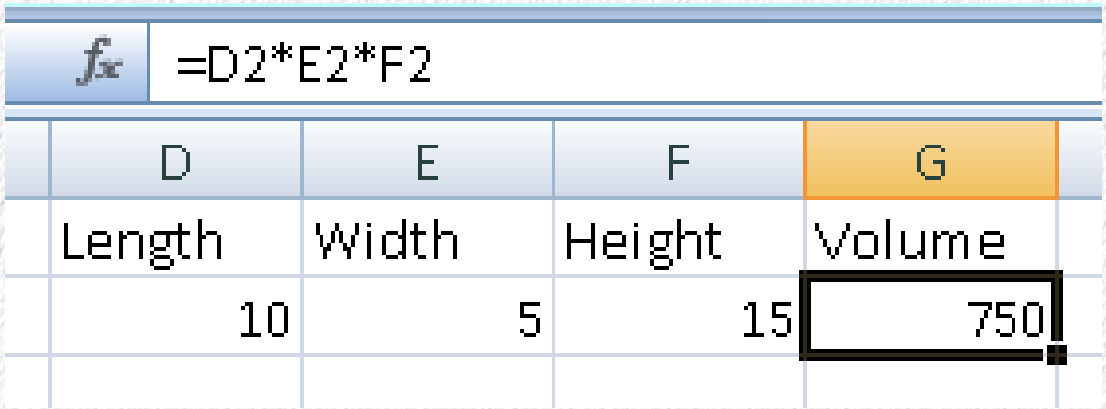
- Data type of the inputs determines the data type of the output – if any of the inputs are text, the output will be text

Cell references

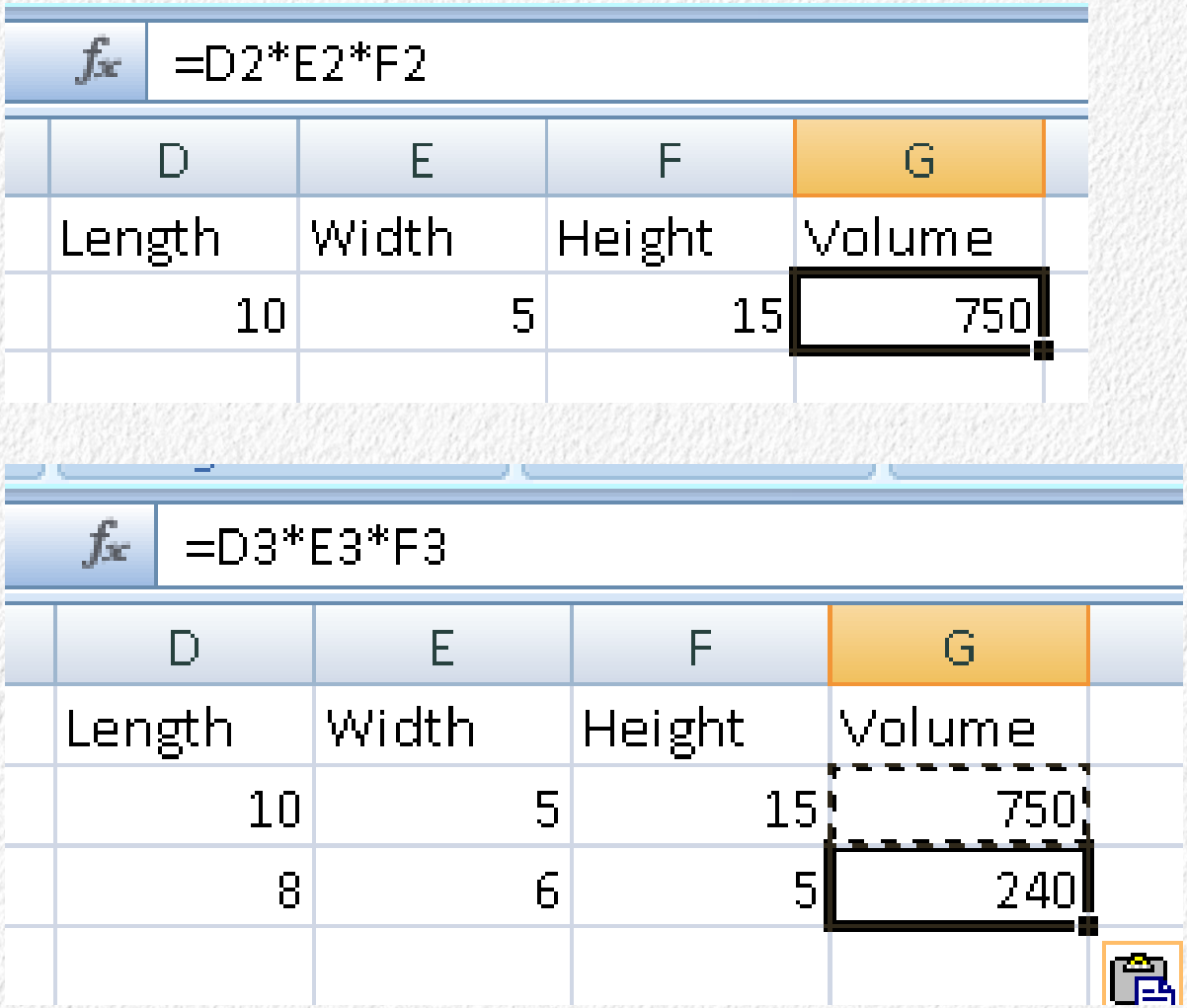
- Spreadsheet formulas are placed in cells, often use data in other cells
- Need a way to refer to the data in other cells
- If the data changes, the formula automatically re-calculates, updates formula's result
- Cell references can be absolute or relative
  - Absolute = refers to a particular cell, won't change if the formula is copy/pasted elsewhere
  - Relative = refers to a cell by its position relative to the formula, will change if the formula is copy/pasted elsewhere

Example: relative references





Relative references change when the cell is copied and pasted

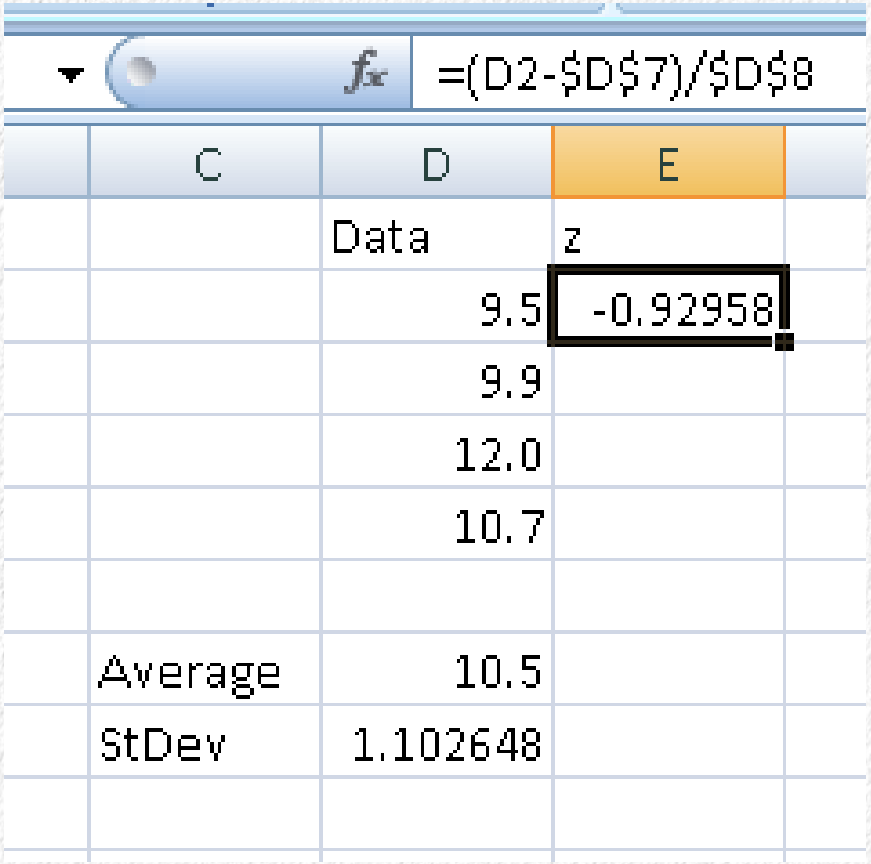


Absolute references

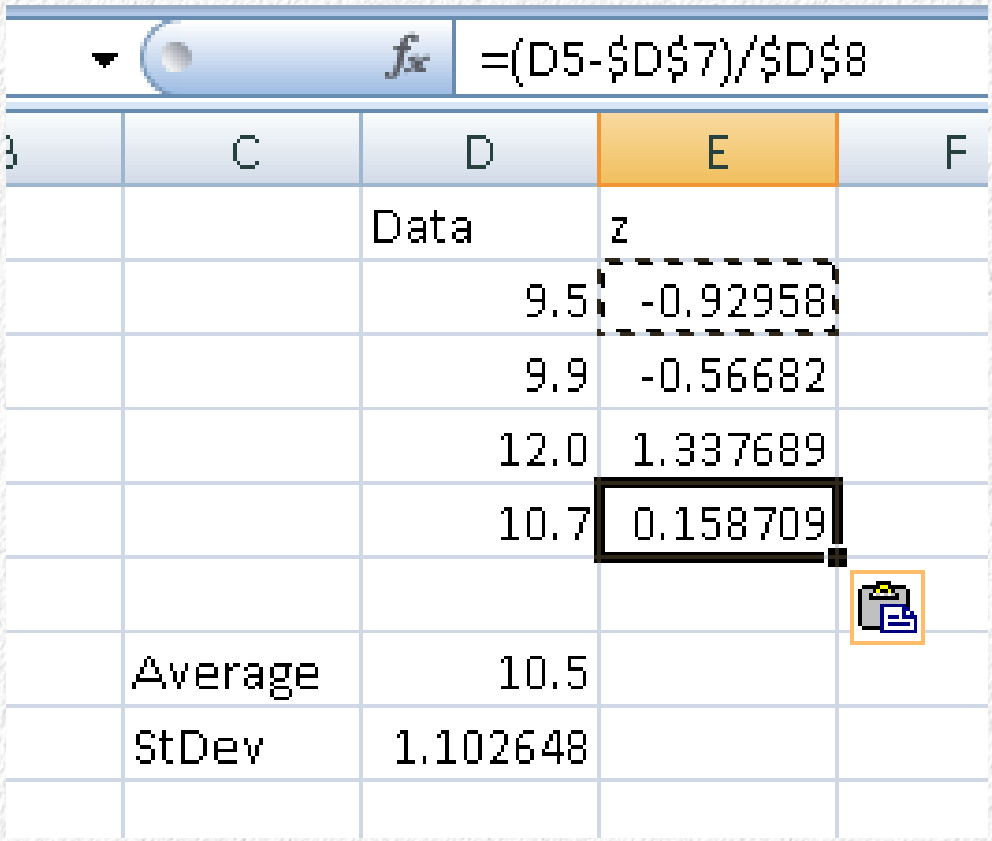
- Use a dollar sign before the row and/or column reference to prevent it from changing when the formula is copy/pasted
- Example: z-transformation
  - Gives the number of standard deviations from the mean
  - Need to subtract the mean from the data point, then divide the difference the standard deviation
- The mean and standard deviation are constants, each calculated in one cell
- Need absolute cell references to subtract these from each data point in turn

z-transformation

First entry



Copied and pasted to rest



Why copy/paste instead of entering the formula repeatedly?

Functions

- Functions return a result
- Most take “arguments” that tell them how to work
- Most also work on data in one or more cells of your worksheet
- Functions are followed by parentheses – no space between function name and left parentheses

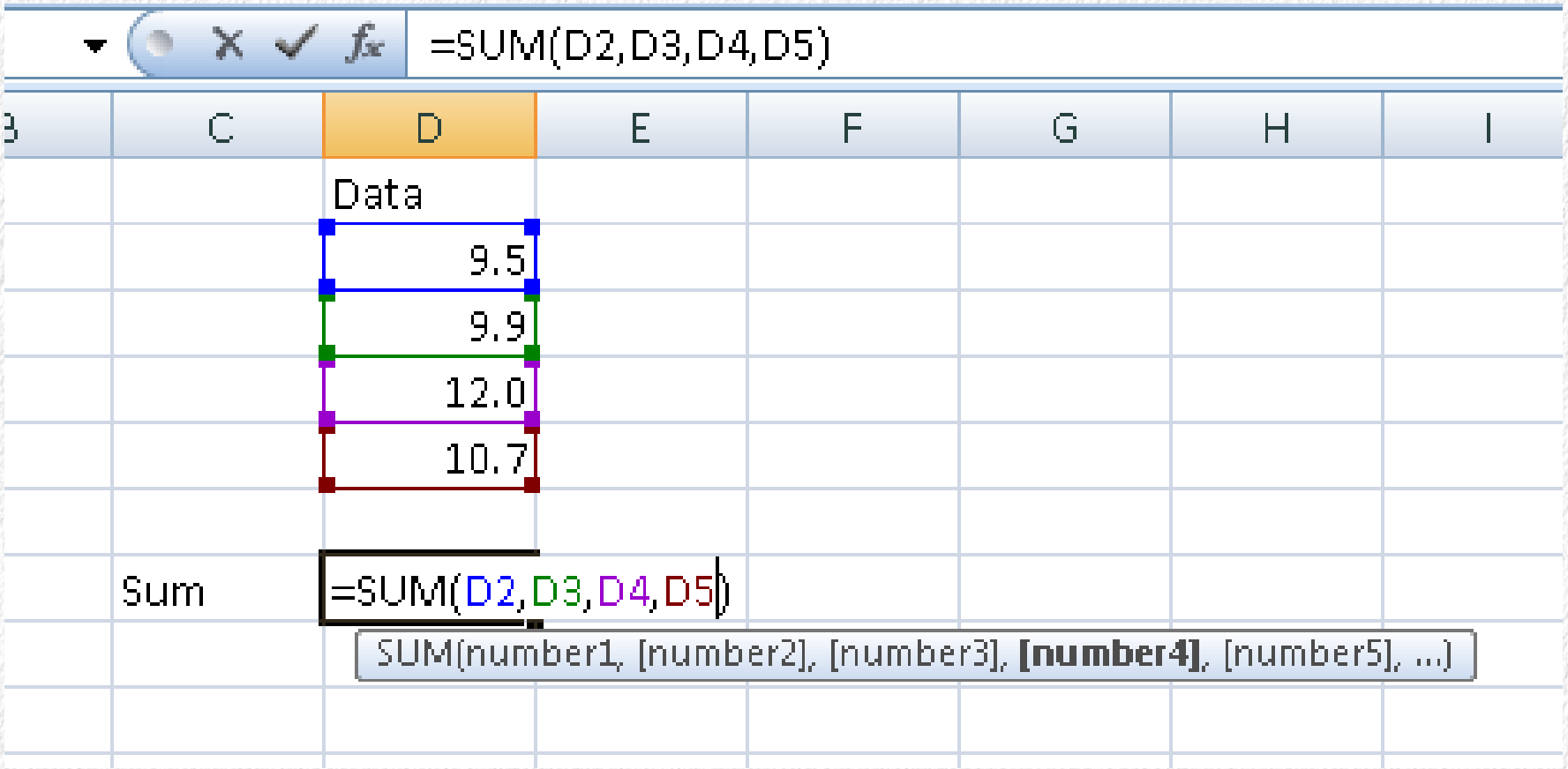
Examples of functions with no arguments

	A	B	C
1	Function	Returns	Explanation
2	pi()	3.141592654	Value of pi to 15 decimal places
3	rand()	0.751827802	A random uniform number
4	false()	FALSE	Enters the logical value FALSE into the cell
5	true()	TRUE	Enters the logical value TRUE into the cell
6	today()	1/17/2012	Enters today's date
7	now()	1/17/2012 10:17	Enters today's date and current time
8			

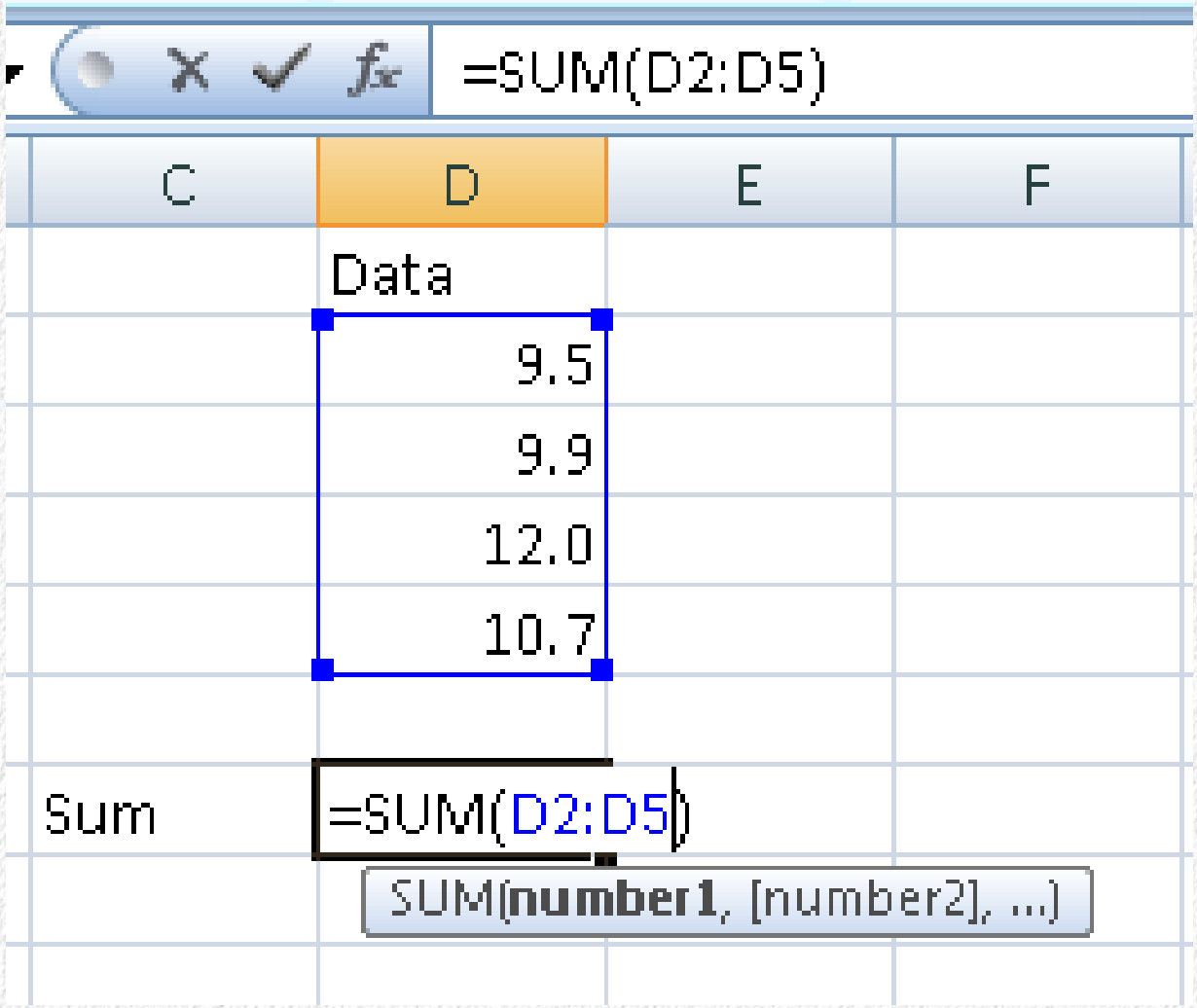
Functions with variable numbers of arguments

- Some functions operate on whatever entries (of the right data type) you specify
  - All arguments treated the same
  - Order/position doesn't matter
- The number of entries varies depending on the data
- Examples are sum(), average(), stdev()...

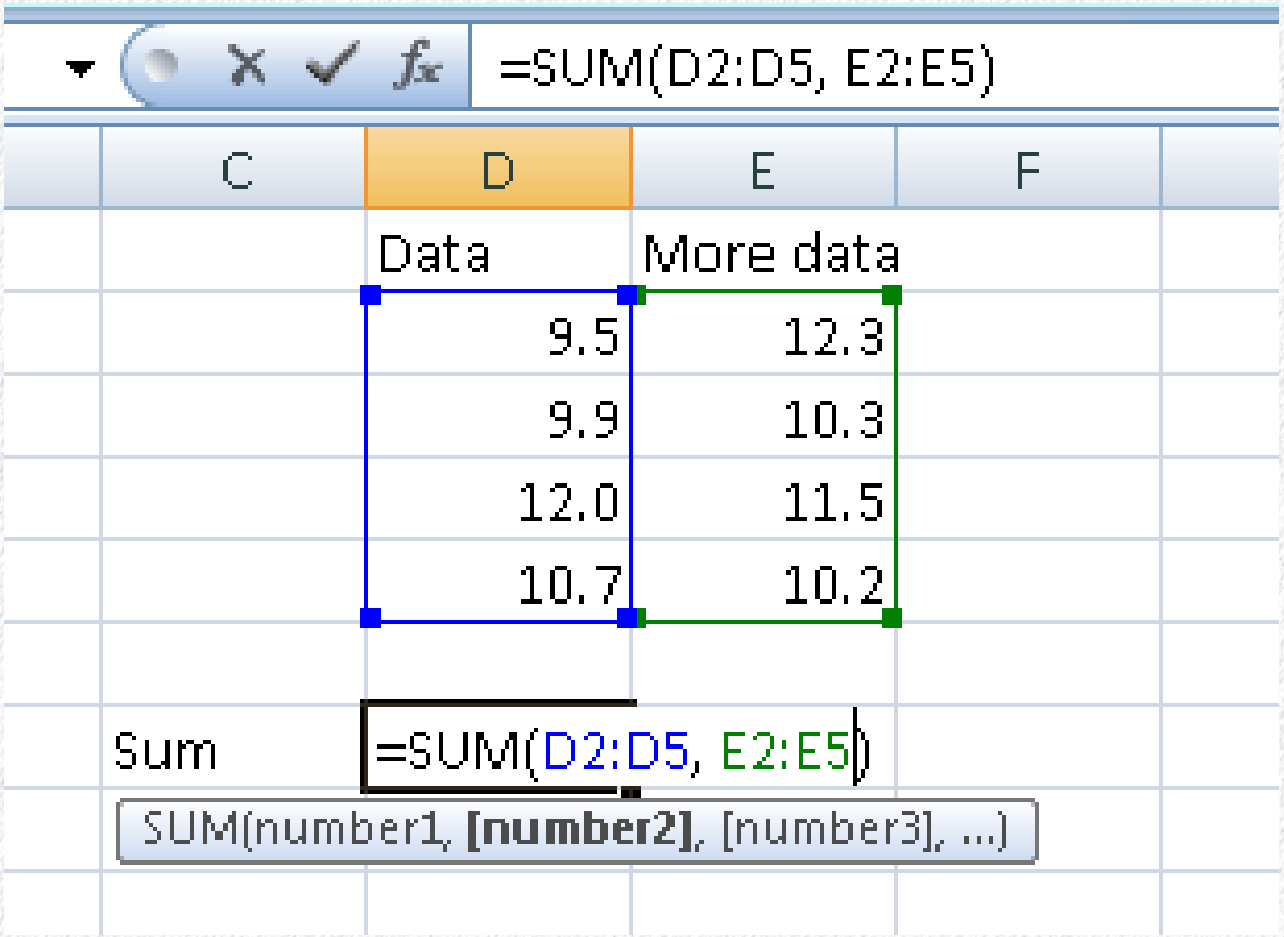
Sums take variable numbers of arguments



Alternative: specify a cell range with a colon



Specifying two discontinuous blocks of cells



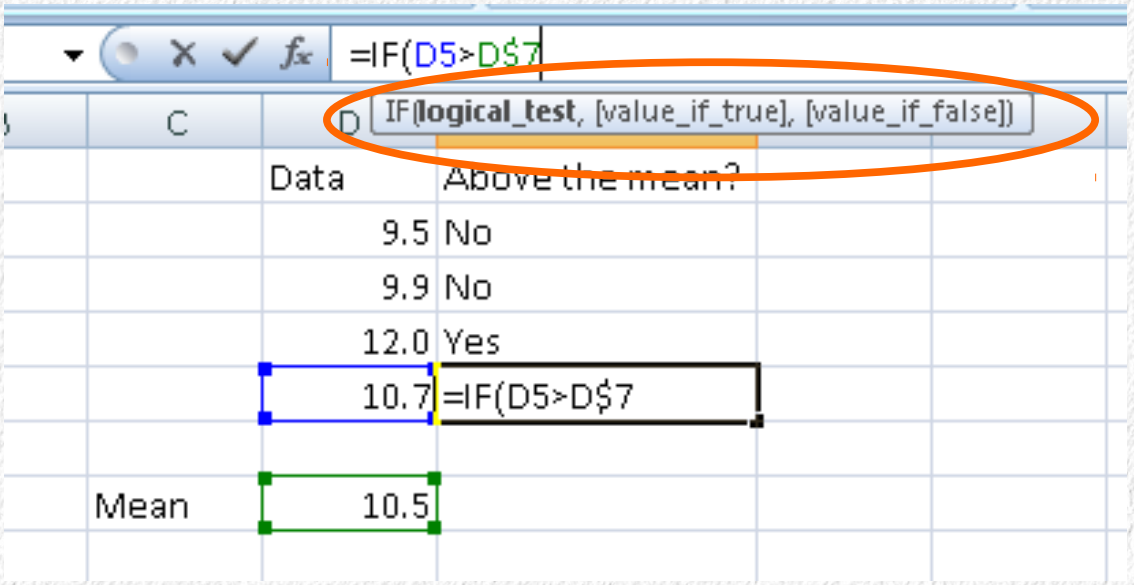
Note: no spaces between SUM and (, or within a cell range, or between row and column reference, BUT spaces between arguments don't matter

Functions with specific arguments

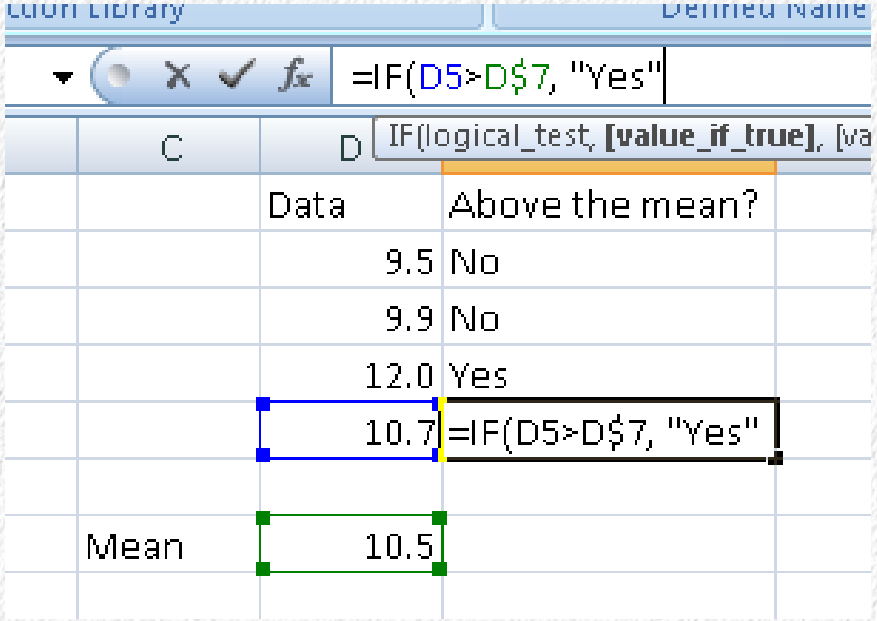
- Some functions take a specific set of arguments
- Some arguments can be optional (you may get the wrong answer, but the function will still execute), others are mandatory (you will get an error message without them)
- The order/position of the arguments tells Excel what they are – need to enter them in the correct order

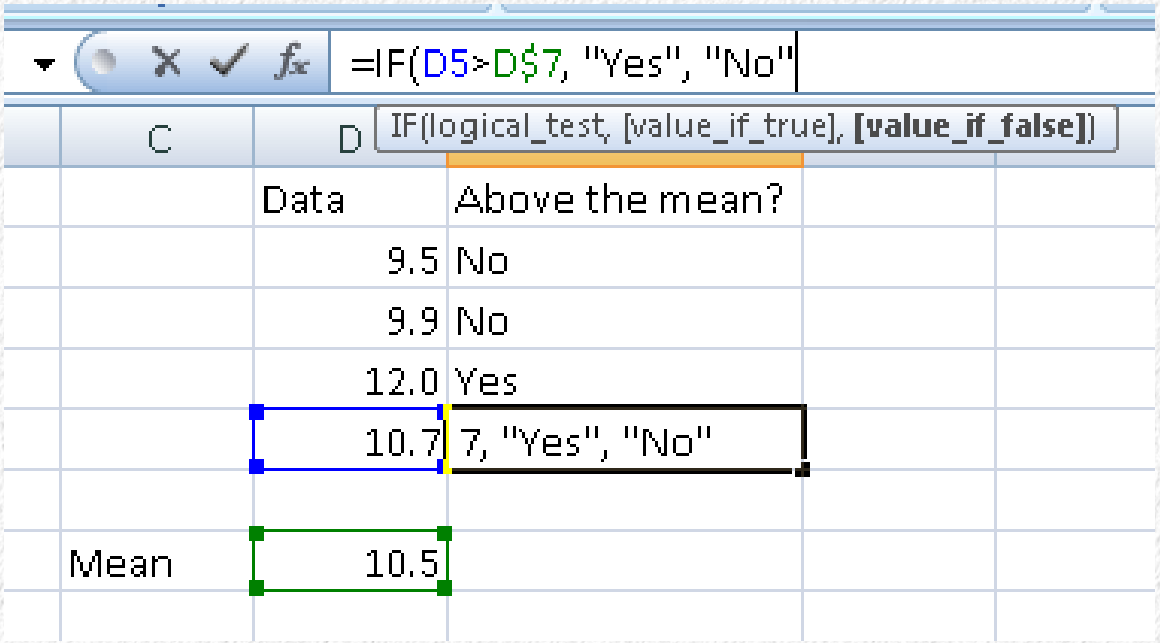
Example: the if() function

- The function if() is actually an “if...then...else” function
- It takes three arguments
  - A logical test
  - A value if the criterion is true
  - A value if the criterion is false
- The order of the arguments tells Excel which is which



Excel prompts you for the needed arguments as you enter the function





Functions can save you work

- Some built-in functions can be calculated using the arithmetic operators with more work
- Example: average()

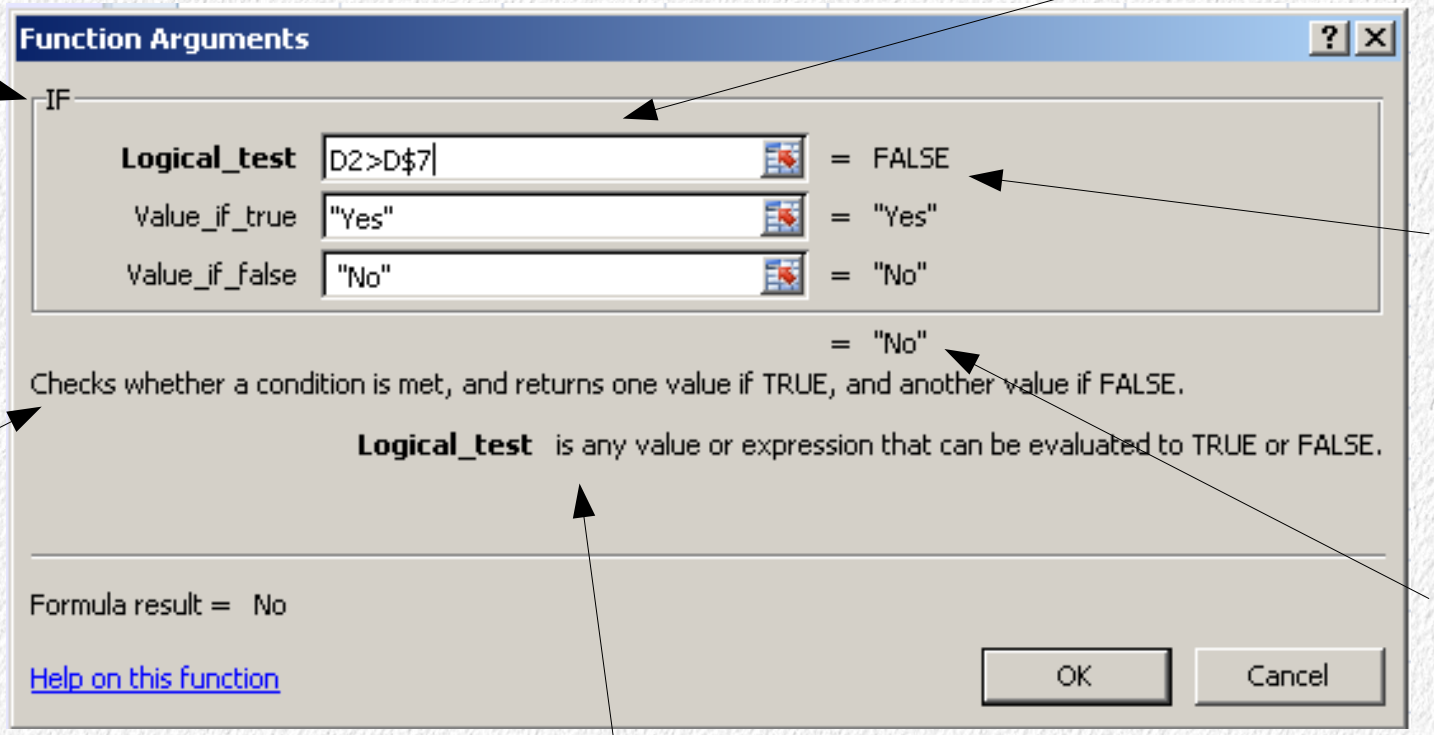
B	C	D	E	F
		Data		
		9.5		
		9.9		
		12.0		
		10.7		
Average by hand		10.525	=(D2+D3+D4+D5)/4	
Average function		10.525	=average(d2:d5)	

The “function wizard”

- There are various ways that Excel guides you in properly using functions
- The “function wizard” is a window with each of the arguments listed, with a brief description of what they mean
- Help can be easily accessed as well

Function wizard example

- The function wizard for if()



Arguments

Name of the function

Values for each argument currently entered in cell

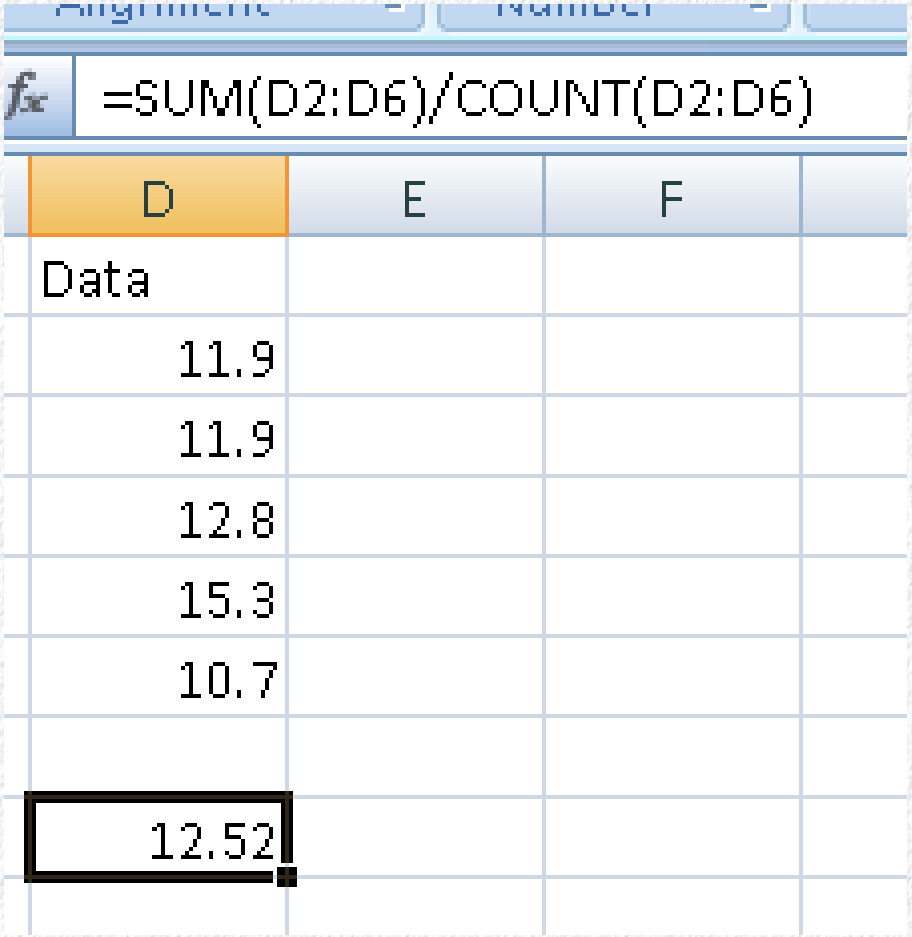
Brief explanation of function's purpose

Value returned by the function with the current arguments

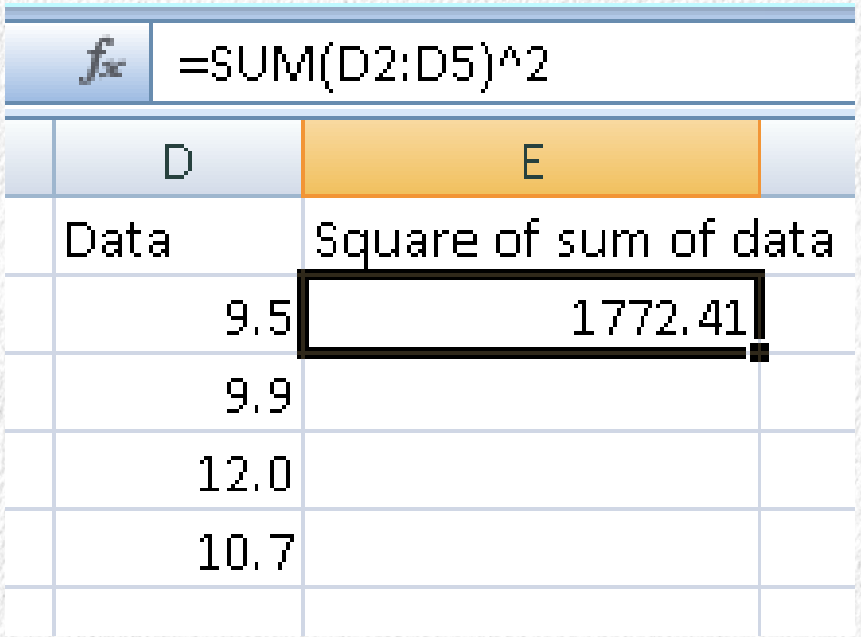
Brief explanation of currently selected argument

Combining functions in a cell

- Calculate the average with:



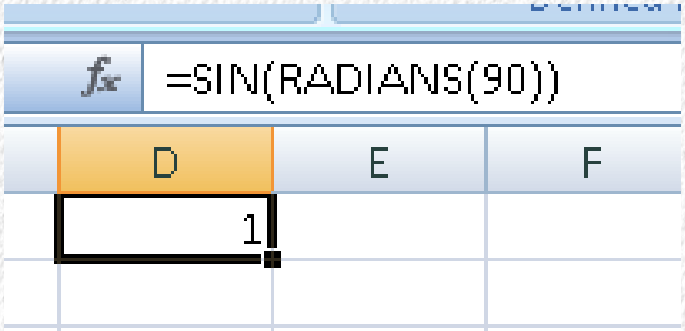
Doing arithmetic operations on results of functions



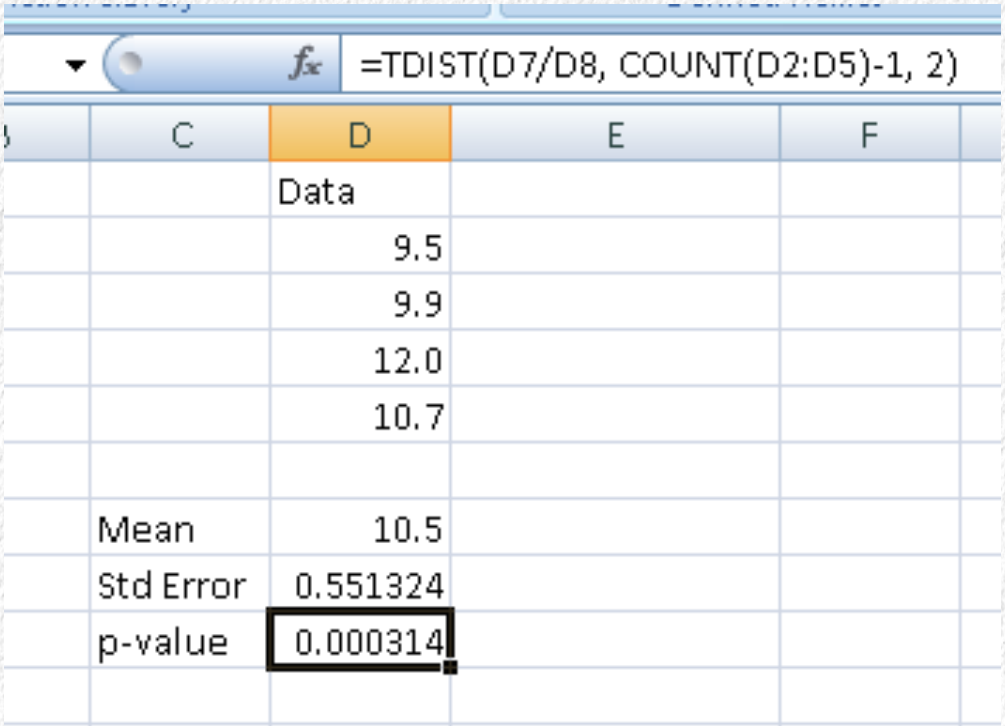
Nesting functions

- Functions can be used as arguments to other functions
- Examples...

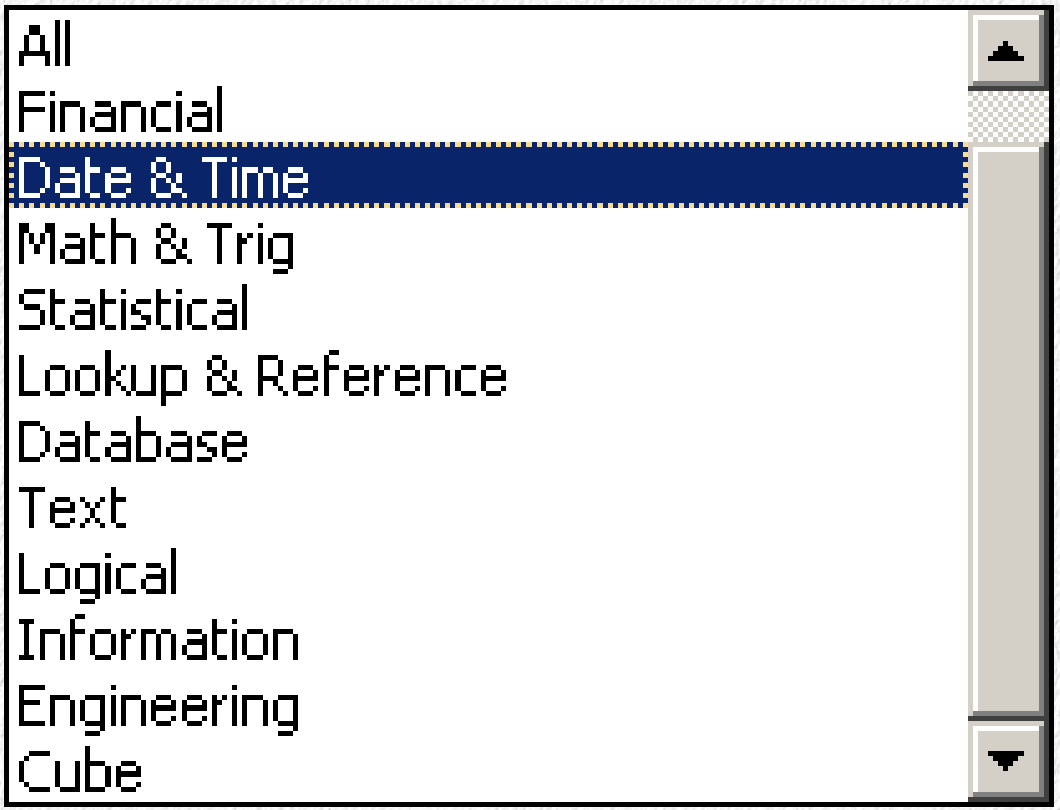
Nesting functions



But, be careful... harder to error check



Functions are grouped by:



Data types in Excel

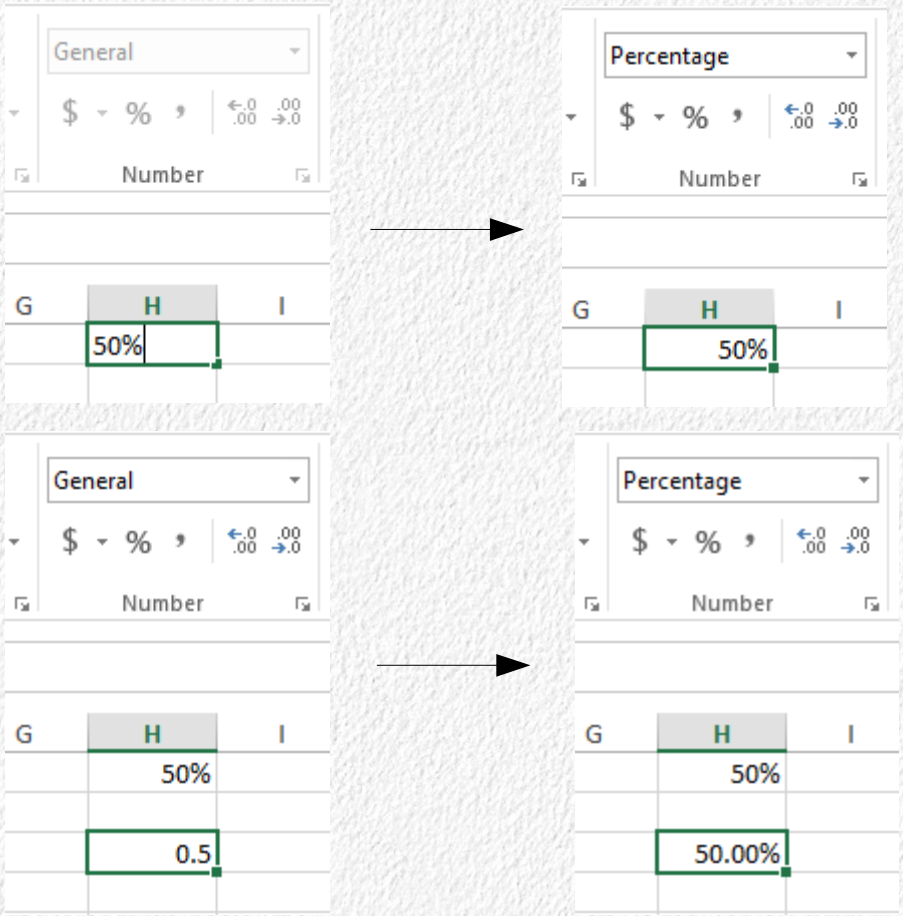
- Unlike Access, we don't have to assign a data type to the data we enter in Excel
- But, Excel does have data types – it assigns them as you enter the data...in other words, it guesses
- Functions, formulas only work on the correct data type
- The data types to be aware of are:
  - Numbers
    - Percents
  - Text
  - Dates/times
  - Logical

Numbers

- All numbers are recorded as double-precision floating point values
- Why? Integer math drops decimal places
- If you enter an integer, it will display in the cell without decimal places, but internally it's recorded as floating point
- Most of the time what is entered and what is stored and displayed are the same
- Exception: percents

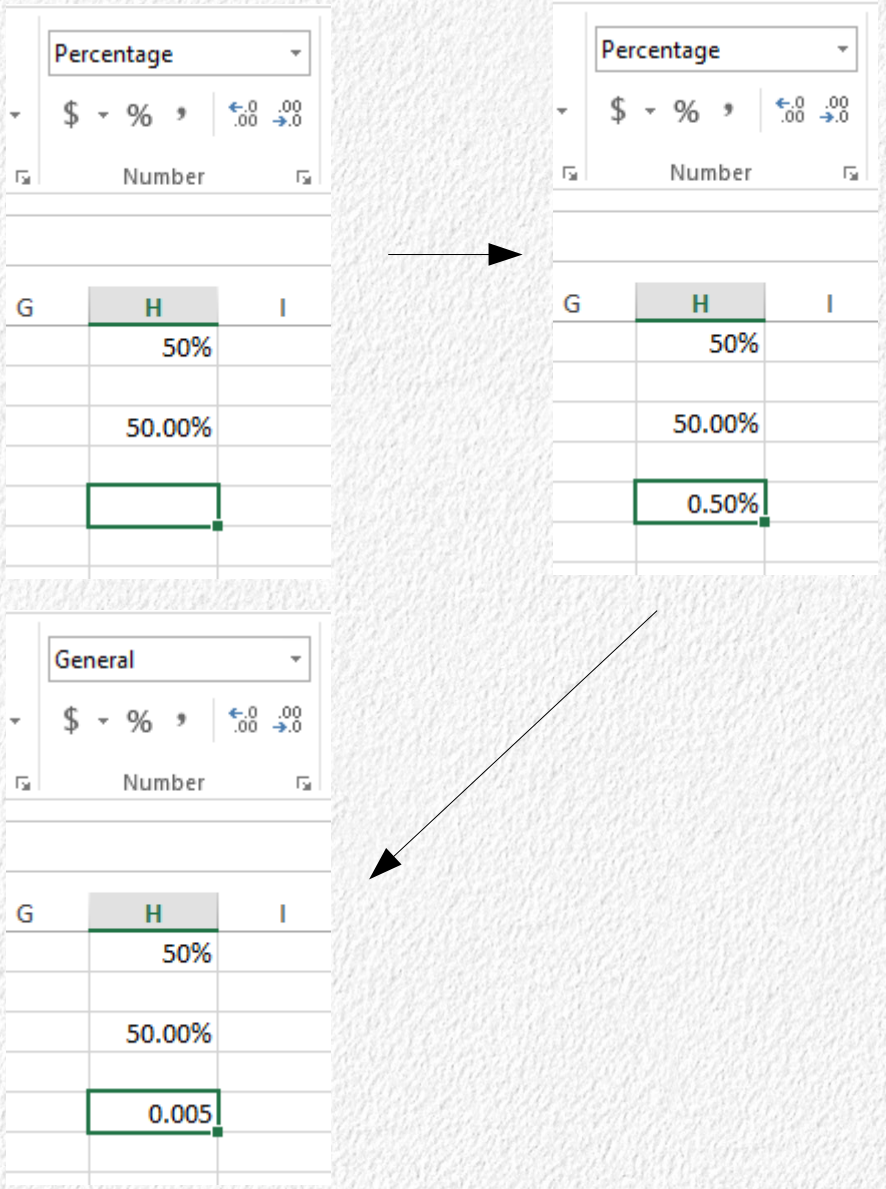
Percents are stored as proportions

- Entering 50% causes Excel to:
  - Store the value 0.5
  - Set the cell type to Percentage
  - Display 50%
- Entering 0.5 and then setting the display type to Percentage gives same result



Setting the display type to percent before enterint data

- Setting the cell type to Percentage and then entering 0.5 gives 0.5%
- Changing this back to General shows the number stored is 0.005



Text

- Any non-numeric entries are stored as text
  - Mixes of numbers and letters (24 g) stored as text
- Text entries won't be used in calculations, but don't cause error messages
  - Text skipped over
- Various text functions
  - len() - length of a text string
  - lower() - converts to lower case
  - proper() - converts to sentence case (first letter capitalized)
  - Substring functions for extracting parts of strings by position
  - trim() - removes extra spaces from text

Sort order of mixed text and numbers

- We alphabetize words starting with the first letter, then moving to the second when the first ties, etc.
  - Aardvark before Adam
- When you mix letters an numbers, Excel considers the entry to be text, and sorts it by this rule
  - a1, a10, a2 instead of a1, a2, a10
  - What about 1a, 2a, 10a?
- If you want to sort identifiers by numeric order, keep letters and numbers separate

Dates and times

- The following will be identified by Excel as a date
  - 1/1/16
  - Jan1
  - January 1, 2016
- Excel guesses that you are intending to enter a date, and all are converted internally to a number
  - Excel uses 1/0/1900 as the “epoch”
  - All dates stored as number of days since this date
  - Internally, 1/1/16 is 42370
  - Displayed as 1/1/2016
- Be careful, because:
  - What is recorded is not the same as what is displayed
  - What is displayed is not the same as what is entered
  - What if Jan1 refers to the first measurement you made on Jan?

Time

- Time is recorded as a fraction of a day
- If the time recorded is 2:00 pm, this is converted as:
  - 1400/2400 = 0.583333333333333
- If a date is given as well, it is assigned to the whole number
  - 2:00 pm on 1/1/16 is 42370.5833333333
  - Note: total of 15 decimal places, so storing a date means dropping some decimal places on the time
  - Not a huge problem... 1 milliscond is 1/86400000 = 0.000000011574, so enough decimals stored to be accurate beyond 1 ms

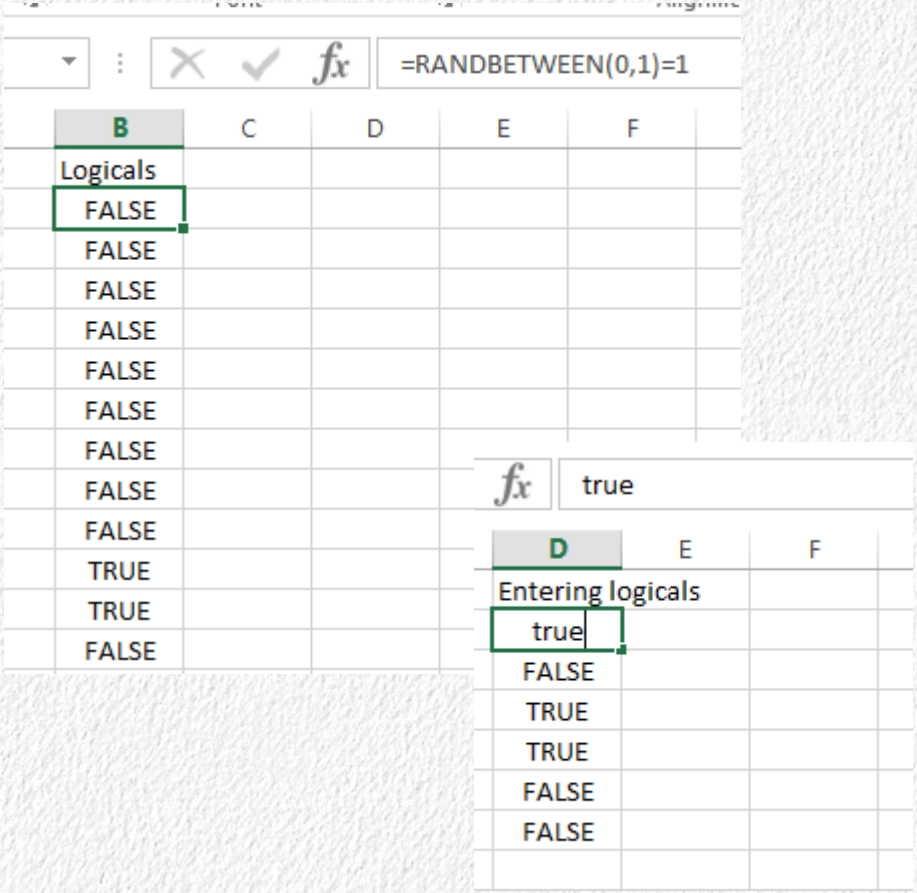
Advantage of storing dates/times as numbers

- Can do math on them
  - Days, time elapsed easy to calculate
  - Sequences of days easy to generate
- As date/time data types there are special functions that can be applied to them
  - Extracting portions: month(date), day(date), year(date), hour(time), minute(time), second(time)
  - Calculate the weekday, week number of any date: weekday(date), weeknum(date)

Logical

- Logical data types can only take one of two values, TRUE or FALSE
- True is treated as equal to 1, false is equal to 0
- Displayed as text (TRUE or FALSE), internally represented as numbers (1 or 0)
- Logicals are centered in the cell, not left-justified like text, or right-justified like numbers
- Can do math with them (but functions may not work properly with them)
- Comparisons produce logicals

Logicals in a spreadsheet



	Logicals		Add zero	
	TRUE		1	
	FALSE		0	
	TRUE		1	
	TRUE		1	
	FALSE		0	
	FALSE		0	
	Text			
	TRUE		#VALUE!	
	FALSE		#VALUE!	
	TRUE		#VALUE!	
	TRUE		#VALUE!	
	FALSE		#VALUE!	
	FALSE		#VALUE!	

Can do math with them!