Excel: Tutorial Week 3

- Branching and logic
- Logic and web searches: AND, OR, NOT (subtraction)
- Cell references: more advanced examples, transposing their use

Official resource for MS-Office products: https://support.office.com

Second Tutorial

The IF( ) Function

- It operates in a similar fashion to conditional formatting and the COUNTIF( ) function: is it true that some condition has been met.
- Unlike the formatting feature and the COUNTIF( ) function the return value can be specified:
  - A constant e.g. number, text string, Boolean (12, -12, 1.5, "Pass", True etc.)…any value that be typed into an Excel cell can be the specified constant.
  - A reference to a cell (and that cell can then contain one of the above values).
  - An expression that evaluates to any one of the above values e.g. 2*3, "hi"&"there"

Structure Of The IF( ) Function

- **Format** (the function should be all on one line, it's shown on multiple lines to allow details to be specified).
  - IF (<*Boolean value*>[1],
    <*return value if Boolean is true*>,
    <*return value if Boolean is false*>)

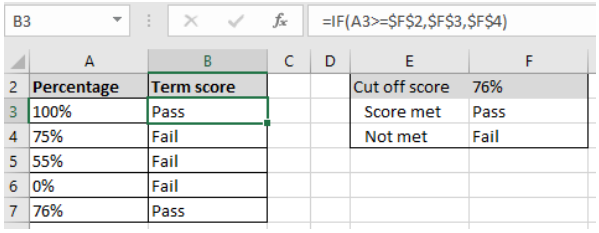
- **Example**:
  =IF(A3>=$F$2,$F$3,$F$4)

- **Note**
  - The Boolean can be a constant (True, False), a reference to a cell that contains a Boolean or an expression that evaluates to a Boolean result (e.g. A3 >= 2.0)

1 A Boolean is either the value True or the value False, a Boolean expression (works out to a Boolean) is allowable e.g. A2 > 50 etc.

IF Example: Pass/Fail Clinical Coursework

- Nursing students must earn a grade of 76% or higher in order to pass their clinical course work.
- **Example spreadsheet:** `if_example_clinical_example`



	A	B	C	D	E	F
2	**Percentage**	**Term score**			Cut off score	76%
3	100%	Pass			Score met	Pass
4	75%	Fail			Not met	Fail
5	55%	Fail				
6	0%	Fail				
7	76%	Pass				

- Note the use of the dollar sign
  - F2: A lookup table with the cut off value used in the Boolean expression.
  - F3, F4: Return values for the respective true/false cases (each student will always refer to these cells so the references must include the dollar sign).

MS-Excel tutorial notes by James Tam

Review: Logic

- AND:
  - Used when all conditions must be true
  - The typical default when entering parameters into a search website e.g. `CPSC 203` will return as search results pages that contain 'CPSC' and '203'.
- OR:
  - Used when at least one condition is true
  - (Variant of the example from lecture), Internet search: "Bruce Lee" **OR** "Little Dragon" will return as search results pages that contain either one (or both) of these names.

MS-Excel tutorial notes by James Tam

Logical ‘AND’ & Web Searches: Student Exercise

- **Search case #1**, type the following into a search site:
  - coronavirus cases
  - Note the number of search results
- **Search case #2**, type the following into a search site:
  - coronavirus cases Canada
  - Note the number of search results (increased or decreased?)

MS-Excel tutorial notes by James Tam

Logical ‘OR’ & Web Searches

- **Search case #1**, type the following into a search site:
  - “Calgary headlines" “Edmonton headlines”
  - Note the number of search results
- **Search case #2**, type the following into a search site:
  - “Calgary headlines" OR “Edmonton headlines” (OR is case sensitive)
  - Note the number of search results (increased or decreased?)
- **Search case #3**, type the following into a search site:
  - “Calgary headlines" or “Edmonton headlines” (OR is case sensitive)
  - Note the number of search results (increased or decreased?)

MS-Excel tutorial notes by James Tam

New: Logical Not

- Negates or reverses the logic (`true` becomes `false`, `false` becomes `true`).
- Excel NOT function
  - **Usage**: `NOT(<Boolean expression>)`
  - **Examples**: `NOT(True)`, `NOT(False)`, `NOT(A1)`, `NOT(2>1)`
- Negation in terms of web searches:
  - The negation operator is also known as the 'subtraction' operator.
  - Explanation in terms of 'subtraction': Search results that would normally appear are subtracted from the list of results displayed.
  - Alternatively in terms of 'negation' or 'not': When it's true that a web page meets the search criteria adding a negation will make it false (i.e. that page won't appear as a search result).
  - Web search subtraction/negation operator: - ('minus')

MS-Excel tutorial notes by James Tam

Logical Not: Web Search Student Exercise

- Your name is Justin and you are tired of seeing search results displaying 'Bieber' web pages whenever you "Google yourself".[1]
- **Search case #1**, type the following into a search site:
  - Justin
  - Note the number of search results and if any search results return pages that contain the text "Justin Bieber".
- **Search case #2**, type the following into a search site:
  - Justin -Bieber
  - Note the number of search results and if any search results return pages that contain the text "Justin Bieber".

1 This example was chosen for teaching purposes simply because of the large number of results that return pages containing "Justin Bieber" when the search criteria is 'Justin'. Apologies to any one that happens to be hard core *Beliebers*.
https://www.urbandictionary.com/define.php?term=Belieber

MS-Excel tutorial notes by James Tam

Interested In Advanced Web Searches?

- For more information:
  - https://pages.cpsc.ucalgary.ca/~tamj/2020/203W/notes/pdf/Internet_searching.pdf

Using The Logical Functions (AND, OR) In Excel

- **Format**:

  `AND(<True or False>,<True or False>...)`

  `OR(<True or False>,<True or False>...)`
- **Types of inputs**:
  - A constant value (False, True)
  - A cell reference (e.g. A2, BB64 etc.)
  - An expression that evaluates to True or False result (e.g. `3 > 2`, `A2 >= 50` etc.)
- **Examples**:
  - `AND(False,True,False)`
  - `AND(B1,True)`
  - `OR(False,False,True)`
- **Exercise**: what does this function return?
  - `OR(B1>B2,B2>B1)`

Using Logic In Conjunction With The IF Function

- **Example spreadsheet**: logic_if

	A	B	C	D	E	F
2	**Name**	**University grad (Yes?)**	**Overall GPA**	**Citizen (Yes?)**	**Years of work XP**	**Job1**
3	James Tam	Yes	2.01	No	55	
4	Smith Jones	No		Yes	10	
5	Jessica Jones	Yes	3.99	Yes	0	Hired
6	Tara Chan	Yes	3.29	Yes	2	Hired
7	Foo Bar	No		Yes		

- Job 1 Requirements (matched to the applicant on a row by row basis)
  - `=IF(AND(B3="Yes",D3="Yes"),"Hired","")`
- Results? (Why?)

Using Logic In Conjunction With The IF Function

- **Example spreadsheet**: logic_if

	A	B	C	D	E	G
2	**Name**	**University grad (Yes?)**	**Overall GPA**	**Citizen (Yes?)**	**Years of work XP**	**Job2**
3	James Tam	Yes	2.01	No	55	Hired
4	Smith Jones	No		Yes	10	Hired
5	Jessica Jones	Yes	3.99	Yes	0	Hired
6	Tara Chan	Yes	3.29	Yes	2	
7	Foo Bar	No		Yes		

- Job 2 Requirements (matched to the applicant on a row by row basis)
  - `IF(OR(AND(B3="YES",C3>=3.3),E3>=10),"Hired","")`
- Results?

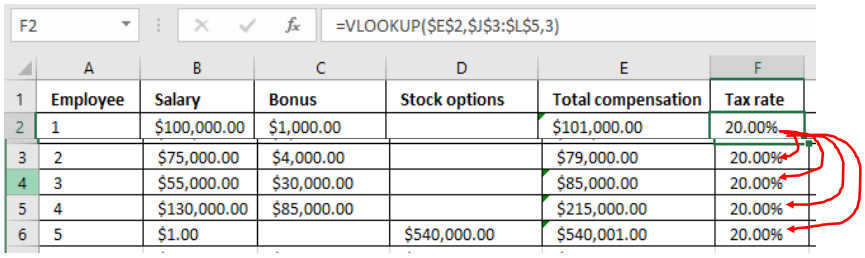
Absolute Vs. Relative Cell References

- Absolute $: cell reference does not change regardless how far formula is cut-pasted or copy-pasted.
  - The dollar sign $ can be in front of either the column or row coordinate for that coordinate value to be absolute.
  - E.g. =$C$3 (absolute row & column), =$C3 (absolute column), =C$3 (absolute row)
- Relative: cell reference changes depending upon far formula is moved.
- When should each one be employed?
  - Absolute for constants (lookup table values) e.g. cut off to pass/fail a course because the cut off is always the same.
  - Relative for variables e.g. student grades.

MS-Excel tutorial notes by James Tam

Mixing Up Absolute And Relative Cell References

- **Example spreadsheet**: `absolute_income_lookup`
  - First argument (total income) is absolute rather than relative.



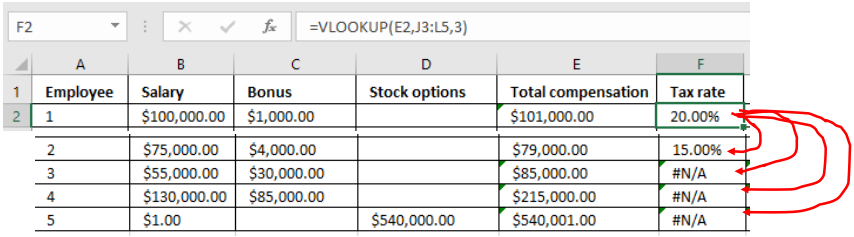
	A	B	C	D	E	F
1	Employee	Salary	Bonus	Stock options	Total compensation	Tax rate
2	1	$100,000.00	$1,000.00		$101,000.00	20.00%
3	2	$75,000.00	$4,000.00		$79,000.00	20.00%
4	3	$55,000.00	$30,000.00		$85,000.00	20.00%
5	4	$130,000.00	$85,000.00		$215,000.00	20.00%
6	5	$1.00		$540,000.00	$540,001.00	20.00%

  - The second argument in Column F is unchanged `$J$3:$L$5`: `=VLOOKUP($E$2,$J$3:$L$5,3)`
  - (Absolute means that when the formula is copied **all pasted lookups refer to Cell E2** – everyone's taxes are based on the income of one person!)

MS-Excel tutorial notes by James Tam

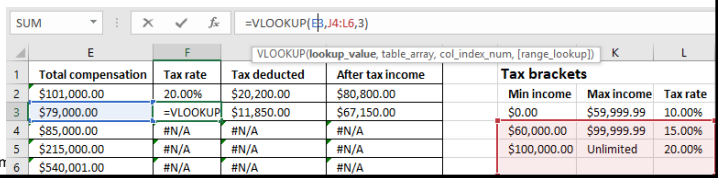
Mixing Up Absolute And Relative Cell References (2)

- **Example spreadsheet**: `relative_tax_rate_lookup`
  - Second argument (tax rate lookup) is now relative.



	A	B	C	D	E	F
1	Employee	Salary	Bonus	Stock options	Total compensation	Tax rate
2	1	$100,000.00	$1,000.00		$101,000.00	20.00%
	2	$75,000.00	$4,000.00		$79,000.00	15.00%
	3	$55,000.00	$30,000.00		$85,000.00	#N/A
	4	$130,000.00	$85,000.00		$215,000.00	#N/A
	5	$1.00		$540,000.00	$540,001.00	#N/A

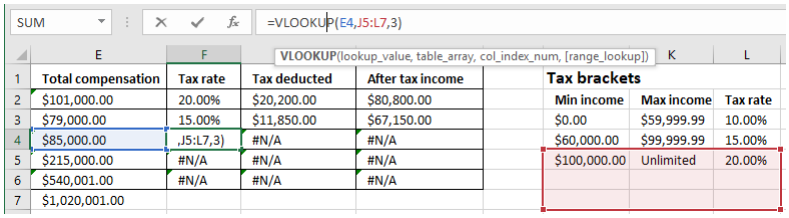
  - Original value in Cell F2: `=VLOOKUP(E2,J3:L5,3)`
  - Formula copied down 1 row to Cell F3: `=VLOOKUP(E3,J4:L6,3)`



	E	F			K	L
1	Total compensation	Tax rate	Tax deducted	After tax income	Tax brackets	
2	$101,000.00	20.00%	$20,200.00	$80,800.00	Min income	Max income	Tax rate
3	$79,000.00	=VLOOKUP	$11,850.00	$67,150.00	$0.00	$59,999.99	10.00%
4	$85,000.00	#N/A	#N/A	#N/A	$60,000.00	$99,999.99	15.00%
5	$215,000.00	#N/A	#N/A	#N/A	$100,000.00	Unlimited	20.00%
6	$540,001.00	#N/A	#N/A	#N/A			

Mixing Up Absolute And Relative Cell References (3)

  - Copied down 2 rows to Cell F4: `=VLOOKUP(E4,J5:L7,3)`



	E	F			K	L
1	Total compensation	Tax rate	Tax deducted	After tax income	Tax brackets	
2	$101,000.00	20.00%	$20,200.00	$80,800.00	Min income	Max income	Tax rate
3	$79,000.00	15.00%	$11,850.00	$67,150.00	$0.00	$59,999.99	10.00%
4	$85,000.00	,J5:L7,3)	#N/A	#N/A	$60,000.00	$99,999.99	15.00%
5	$215,000.00	#N/A	#N/A	#N/A	$100,000.00	Unlimited	20.00%
6	$540,001.00	#N/A	#N/A	#N/A			
7	$1,020,001.00						

  - The lookup income value is $85,000 which is below the first value in the lookup table (=$100,000) so #N/A is returned (the lookup value doesn't fit into any of the ranges because it's below the boundary of the lowest range in the lookup table from J5 – L7).

Other Excel Resources

- Online training resources created by Microsoft:
  - Tutorials
    - https://support.office.com/en-us/article/excel-for-windows-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb
  - A MAC specific resource
    - https://support.office.com/en-us/article/excel-2016-for-mac-help-2010f16b-aec0-4da7-b381-9cc1b9b47745

MS-Excel tutorial notes by James Tam