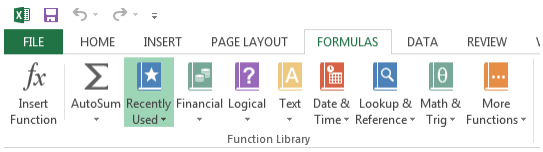
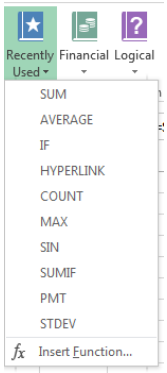
Spreadsheets: Part 2

You will learn about some important features of Excel.

Online MS-Office information source:
https://support.office.com/

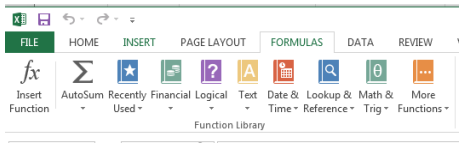
Pre-Created Excel Formulas



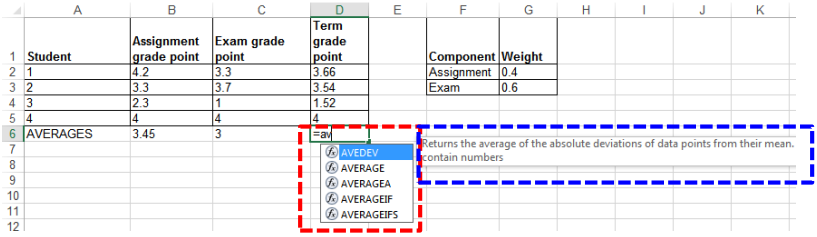


What Function Is Right For Your Situation?

- Excel provides reminders.
- Built in functions are grouped into the 'formulas' tab on the ribbon



- Also Excel provides "name completion" and "tool tips"



Input Format For Excel Functions

- Required input is typically a **range of cells**
  - **Format**:
    `=FUNCTION(<start cell> : <end cell>)`
  - **Example**:
    `=AVERAGE(A1:A3)`
- Alternatively input may be **fixed inputs** (type data directly into the brackets)
  `=AVERAGE(20,30,10)`

For the exam you can see either form

- **Optional function inputs ("arguments")**

  Distinguished by the use of square brackets [**optional argument**]

  `=IF (<condition to check>,`
  `<return value: condition true>,`
  `[<return value: condition false>])`

Basic Statistics

- **Example spreadsheet:**
  - `10_basic_statistics`

- Example formulas: `SUM(), AVERAGE(), MIN(), MAX()`
- General usage:
  - Each formula requires as input a sequence of numbers
  - E.g., formula(1,2,3):
    - `Sum = 6 , =SUM(1,2,3)`
    - `Average = 2 , =AVERAGE(1,2,3)`
    - `Min = 1 , =MIN(1,2,3)`
    - `Max = 3 , =MAX(1,2,3)`

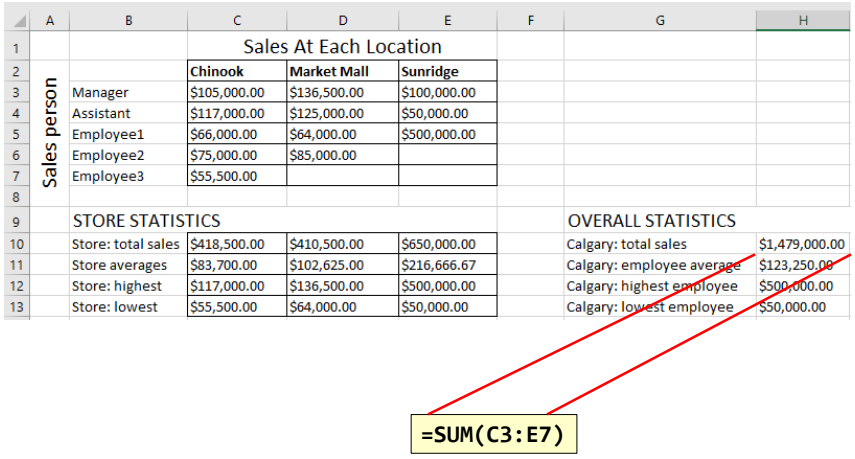
Basic Statistics (2)

- Referring to a range of cells

	A	B	C	
1			Sales	
2			**Chinook**	
3	Sales person	Manager	$105,000.00	
4		Assistant	$117,000.00	
5		Employee1	$66,000.00	
6		Employee2	$75,000.00	
7		Employee3	$55,500.00	
8				
9		STORE STATISTICS		
10		Store: total sales	$418,500.00	`=SUM(C3:C7)`
11		Store averages	$83,700.00	`=AVERAGE(C3:C7)`
12		Store: highest	$117,000.00	`=MAX(C3:C7)`
13		Store: lowest	$55,500.00	`=MIN(C3:C7)`

Basic Statistics (3)

- FYI: Ranges can span multiple rows and columns



	A	B	C	D	E	F	G	H
1			Sales At Each Location					
2			**Chinook**	**Market Mall**	**Sunridge**			
3	Sales person	Manager	$105,000.00	$136,500.00	$100,000.00			
4		Assistant	$117,000.00	$125,000.00	$50,000.00			
5		Employee1	$66,000.00	$64,000.00	$500,000.00			
6		Employee2	$75,000.00	$85,000.00				
7		Employee3	$55,500.00					
8								
9		STORE STATISTICS					OVERALL STATISTICS	
10		Store: total sales	$418,500.00	$410,500.00	$650,000.00		Calgary: total sales	$1,479,000.00
11		Store averages	$83,700.00	$102,625.00	$216,666.67		Calgary: employee average	$123,250.00
12		Store: highest	$117,000.00	$136,500.00	$500,000.00		Calgary: highest employee	$500,000.00
13		Store: lowest	$55,500.00	$64,000.00	$50,000.00		Calgary: lowest employee	$50,000.00

Counting Functions

- All of these functions tally up the number of cells that do or do not contain a certain type of data e.g., numbers, blank cells…
- General usage:

  `FUNCTION(<start cell range> : <end cell range>)`

  – An array (list) of inputs can be the function argument but this is rare except for illustration or examination purposes e.g., `=COUNT(1,"A",2)`

Counting Functions: COUNT( )

- Counts the number of cells within the specified range that contain a numeric value.
- https://support.office.com/en-US/article/COUNT-function-A59CD7FC-B623-4D93-87A4-D23BF411294C

	Col C
13	0
14	2
15	"A"
16	
COUNT	=COUNT(C13:C16)

Q: What is the result?

Counting Functions: COUNTA( )

- Counts the number of cells within the specified range that *aren't empty*
- https://support.office.com/en-US/article/COUNTA-function-7DC98875-D5C1-46F1-9A82-53F3219E2509

	Col C
13	0
14	2
15	"A"
16	
COUNTA	=COUNTA(C13:C16)

Q: What is the result?

Counting Functions: COUNTBLANK( )

- Counts the number of empty cells within the specified range
- https://support.office.com/en-US/article/COUNTBLANK-function-6A92D772-675C-4BEE-B346-24AF6BD3AC22

	Col C
13	0
14	2
15	"A"
16	
COUNTBLANK	=COUNTBLANK(C13:C16)

Counting Functions: Spreadsheet Example

- **Example spreadsheet:** `11_counting_functions`

	B	C	D	E	F
1		Sales At Each Location			
2		**Sunridge**	**Market Mall**	**Chinook**	**Future location**
3	Manager	$100,000.00	$136,500.00	$105,000.00	
4	Assistant	$50,000.00	$125,000.00	$117,000.00	
5	Employee1	$50,000.00	$64,000.00	$66,000.00	
6	Employee2		$85,000.00	$75,000.00	
7	Employee3			$55,500.00	
8					
9	**Counting functions**				
10	Number employees	3	4	5	0
11	Number unstaffed positions	2	1	0	5
12					
13	Employee slots filled	12			
14	Employee slots vacant	3			

=COUNT(C3:E7)

=COUNTBLANK(C3:E7)

- `COUNT( )`: Also used in Row `10`
- `COUNTBLANK( )`: Also used in Row `11`

Counting Functions: Spreadsheet Example (2)

- COUNTA( ): Number of cases where the employee name has been entered into the system.
  - That is, blank cells can be either for unstaffed positions or cases where the name of the staff member has not yet been entered.

	A	B	C	D	E
1		Sales At Each Location			
2		**Sunridge**	**Market Mall**	**Chinook**	**Future location**
3	Manager	Ron Ridge	Dean Perkins	Don Torrie	
4	Assistant		James Tam	2cool Person	
5	Employee1		Dave Meek		
6	Employee2				
7	Employee3				
8					
9	**Counting functions**				
10	Current staffing	1	3	2	0
11	Vacancies	4	2	3	5

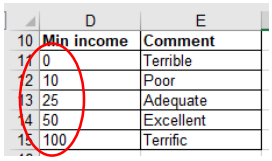
=COUNTA(B3:B7)

Lookup Functions

- One common use of a lookup function is to determine which category that some numeric value resides.
- Membership in a category is often determined by ranges:
  - Mapping raw scores to a letter grade.
  - Determining your 'tax bracket'.
  - Evaluating your "FICO" credit score.

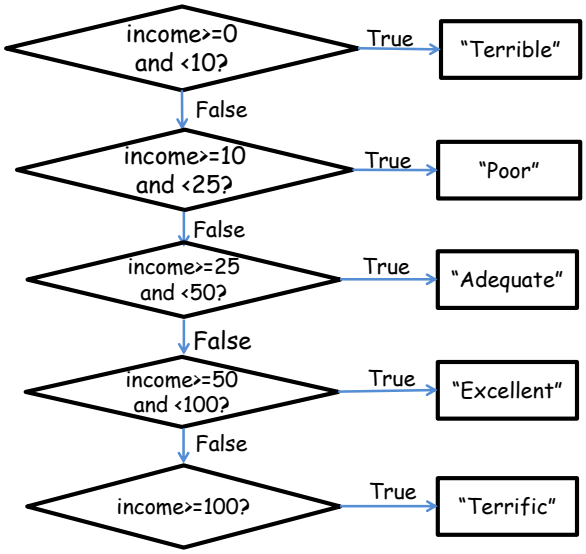
Lookup Tables

- Lookup functions require a 'lookup table' that specifies the ranges.
  - Example: for your given grade in a course, a lookup table specifies the various cutoffs for the different letter grades.
  - Similar to a lookup table containing constants but these examples are for a range of values (there are strict requirements in the format) rather than a single value.
- **Important format requirements** for the **first column** of the lookup table examples covered this term:
  - table values must be in **ascending order**,
  - column values can only be **numeric**.
- In the example the data in cells **D11 – D15** follow these requirements.



	D	E
10	Min income	Comment
11	0	Terrible
12	10	Poor
13	25	Adequate
14	50	Excellent
15	100	Terrific

Example: Specifying Conditions



Min income	Comment
0	Terrible
10	Poor
25	Adequate
50	Excellent
100	Terrific

According to the values in this table: a numeric value<0 is an error condition

VLOOKUP

- Official link for help
- https://support.office.com/en-US/article/VLOOKUP-function-0BBC8083-26FE-4963-8AB8-93A18AD188A1
- **Format**:

```
VLOOKUP(<Lookup value>,
        <Lookup table  Start : End>,
        <Lookup table Column specifying the return value>)
```

- **Example**:

```
=VLOOKUP(B2,          D11:E15,          2)
```

Cell:
Contains value to find in table e.g., a grade point

Lookup table:
Start : End
cell coordinates

Lookup table:
Column value to return, fo
this example:
(1 = first col. = 'D',
2 = second col. = 'E')

VLOOKUP: Investments

- **Example spreadsheet:** 12_vlookup

	A	B	C
1	**Stock**	**Net income (millions of $)**	**Invest?**
2	PEAR	$1,000.00	Terrific
3	TAM	$50.00	Excellent
4	SCAM	$1.00	Terrible

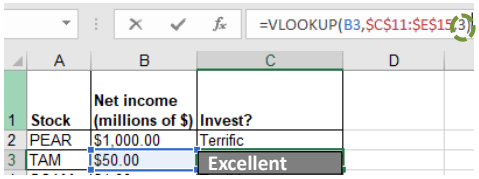
```
=VLOOKUP(B2,D11:E15,2)
```

	Col D (1st)	Col E (2nd)
	Min income	**Comment**
11	0	Terrible
12	10	Poor
13	25	Adequate
14	50	Excellent
15	100	Terrific

VLOOKUP: **Multi-Column** (3+) Lookup Table

- **Name of example spreadsheet**: `13_vlookup_multiple_columns`

Lookup function



	A	B	C	D
1	**Stock**	**Net income (millions of $)**	**Invest?**	
2	PEAR	$1,000.00	Terrific	
3	TAM	$50.00	**Excellent**	

Lookup table

Col 1 **Col 2** **Col 3**

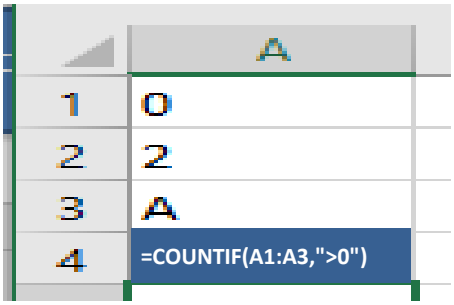
	C	D	E
10	**Min income**	**Max income**	**Comment**
11	0	Less than 10	Terrible
12	10	Less than 25	Poor
13	25	Less than 50	Adequate
14	50	Less than 100	Excellent
15	100	None	Terrific

Conditional Counting Function

- Increases a tally count if one or conditions have been met
- `COUNTIF()`

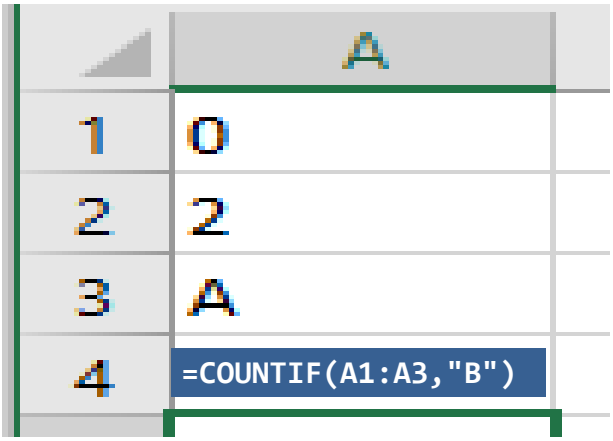
Conditional Counting Function: COUNTIF()

- Counts the number of cells that meets a particular requirement
  - How many employees of a multi-national corporation are Canadian?
  - How many students in a class were awarded an "A+" grade?
  - Example below: Count the number of cells within the range that contain a positive numeric value.



  - https://support.office.com/en-US/article/COUNTIF-function-E0DE10C6-F885-4E71-ABB4-1F464816DF34

Conditional Counting Function: COUNTIF(), 2



COUNTIF(): Full Example

- **Example spreadsheet:** `14_countif`
- Conditions tallied
  - Which employees met quota? (If the cell contains "Yes")
  - Which employees had sales that were deemed as high (above $100,000)

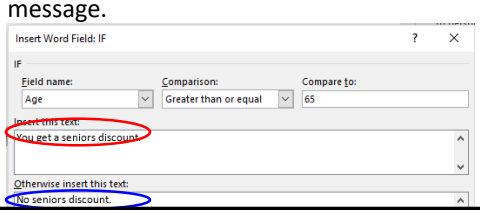
	A	B	C
1	**Employee**	**2017 sales quota met?**	**2017 sales in $**
2	James	Yes	$100,000
3	Dave	Yes	$123,456
4	Ernie		$55,000
5	Ron		$66,000
6	Don	Yes	$118,000
7	Lucie		$75,000

	A	B
9	# Met quota	3
10	High sales	2

```
=COUNTIF(B2:B7,"YES")
=COUNTIF(C3:C8,">100000")
```

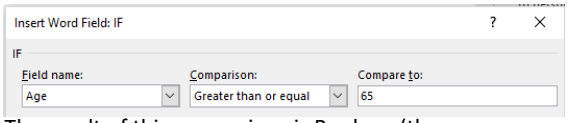
Recall: From Word Mail Merge Filters

- Example Mail merge filters covered previously
  - Filter rule based on age:
    - 65 and over: "You get a seniors discount."
    - Under 65: "No seniors discount."
- The `If-Then-Else` filter checks if a condition has been met e.g. a field in the spreadsheet data source was equal to some value.
  - If the condition has been met (**condition = true**) then display a message.
  - If the condition has not been met (**condition = false**) then display another message.



New Terminology

- **A Boolean expression** takes a condition (a comparison such as degree being equal to 'B.Sc.'') as input and returns a Boolean value.
  - The conditions must be specified to yield either a Boolean result.
- **Boolean / Boolean value**: must be either true or false



The result of this comparison is Boolean (the condition can only be met or not met).

  - Examples of statements that must be true or false:
    - A job applicant has been awarded a B.A. degree.
    - The customer is a senior citizen.
    - It is below freezing [freezing point of water] today.

Format: IF-ELSE

- **Format**:

```
=if (<Boolean expression>,
      <Boolean return value: condition true>,
      [<Boolean return value: condition false>])
```

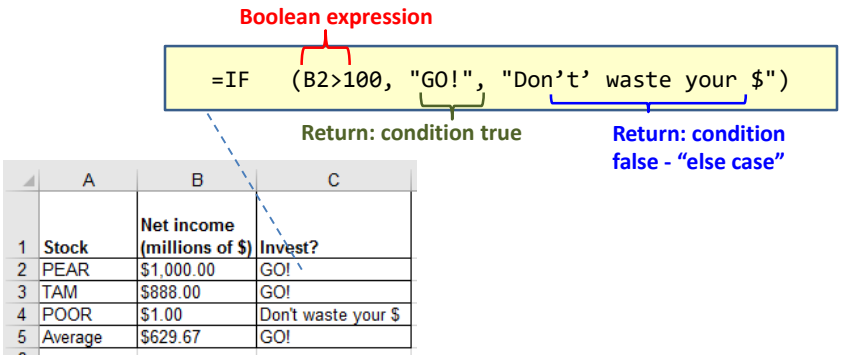
  - Reminder: square brackets [] is the notation used by Microsoft for optional arguments
- **Example**:

```
=IF (B2>=100,"GO!","Don't' waste your $")
```

- Official help link
- https://support.office.com/en-US/article/IF-function-69aed7c9-4e8a-4755-a9bc-aa8bbff73be2?CorrelationId=6aeb3056-a94b-47ac-af6e-90dff250a029

Excel IF-Function: Investing Example

- In column 'C' the sheet will display "GO!" if net income is 100 (millions of $) or greater "Don't waste your $" otherwise.
  - **Example spreadsheet:** `15_if_invest_or_not`



	A	B	C
1	Stock	Net income (millions of $)	Invest?
2	PEAR	$1,000.00	GO!
3	TAM	$888.00	GO!
4	POOR	$1.00	Don't waste your $
5	Average	$629.67	GO!

Comparators

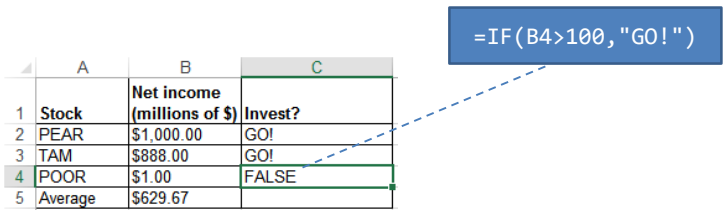
Mathematical representation	Excel representation	Meaning
<	<	Less than
>	>	Greater than
=	=	Equal to
≤	<=	Less than, equal to
≥	>=	Greater than, equal to
≠	<>	Not equal to

Example **Return Values**

Type of return value	Example return value	Example use
Text	*"GO"*	`=IF (B2>100,"GO!", "No go")`
Numeric	4, 4.0	`=IF (C3="A+",4.3, -1)`
Cell reference	A2, A3	`=IF(A1>0,A2,A3)`
Boolean	True, False	`=IF(1>2,True,False)`

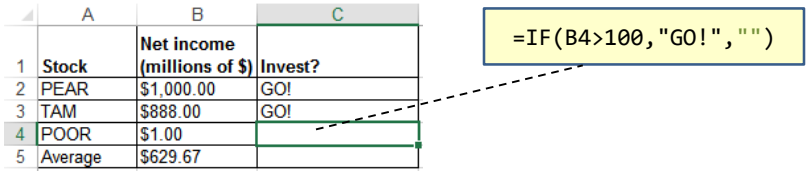
IF: Specifying Only The True Case (Poor Approach)

- **Example spreadsheet:**
  16_if_else_invest_or_not_NO_FALSE_return
- If only a return value for the true case has been specified:
  - When the condition has not been met (False result from the Boolean expression)…literally the text "FALSE" will be displayed.



IF: Specifying Only The True Case (**Better Approach**)

- **Example spreadsheet:** 17_if_else_invest_or_not_ammended
- Consequently:
  - When a message is desired only when the 'if condition case' is true then something, even an **empty message**, should be specified for the 'else return case' (false that the condition has been met).



	A	B	C
1	**Stock**	**Net income (millions of $)**	**Invest?**
2	PEAR	$1,000.00	GO!
3	TAM	$888.00	GO!
4	POOR	$1.00	
5	Average	$629.67	

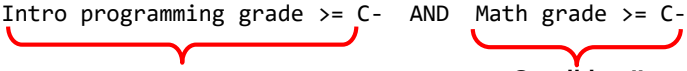
```
=IF(B4>100,"GO!","")
```

Logic: What You Learned

- You were informally taught the **AND** as well as the **OR** logical operations in the section covering Internet searches.
- Example:
  - `"James Tam" Calgary` Logical **AND** (default)
  - Vs.
  - `"James Tam" OR Calgary` Logical **OR**
- More formally: AND, OR are logical operators
- Mathematical operators take numbers as input and return a number
- **New term: Logical operators** take a Boolean as input and return a Boolean value.
  - Logical operators can connect compound (2+) Boolean expressions.
  - (Boolean expression) Logical operator (Boolean expression) etc.

Logical AND: All Restrictions

- Used when **all conditions** / Boolean expressions (BE) must be true
- Example:
  - Prerequisites for CPSC 233: Introductory programming course as well as discrete math ("as well as" = AND in this case).
  - `Intro programming grade >= C-  AND  Math grade >= C-`



Condition 1 / BE 1

Condition II / BE 2

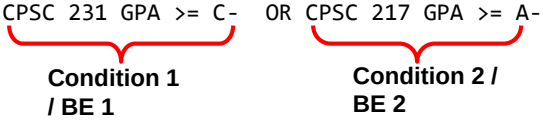
  - If either course grade is not satisfactory it's false that the requirement is met.
    - With Logical-**AND** if *any* **Boolean Expression is false** then the **entire compound condition is made false**.
  - Only if all course grades satisfactory will it be true that the pre-requisites have been met.
    - With Logical-**AND** only if *all* **conditions are true** will the entire **compound condition be true.**

Logical AND: Many Conditions

- To evaluate the result just extend the general rule:
  - Multiple AND-expressions **must all be true** for the overall **result** to be **true**.
  - If **at least one** expression is **false** then the overall **result** is **false**.
- Example:
  - Internet search: **"James Tam" CPSC Calgary**
    - Before a webpage appears as a search result, all three conditions must be met (the three text phrases must appear in that page).
      - The more search phrases that you include, the more narrow will be your results (fewer).
  - A course with 3 or more prerequisites.
  - Job applicants must meet 3 or more requirements e.g. Applicant must be an adult, awarded a university undergraduate degree (or a superior degree), overall grade point from that degree must be at least 3.0.

Logical OR: At least One Restriction

- Used when **at least one** condition / Boolean expression (BE) must be met (true).
- Example:
  - Prerequisites for CPSC 233: One of CPSC 217 or 231
  - `CPSC 231 GPA >= C-  OR CPSC 217 GPA >= A-`



  - If at least one of: CPSC 217, 231 was completed satisfactorily, then the intro programming requirement was met.
    - With Logical-OR if *any* condition / Boolean Expression is true then the **entire compound condition is made true**.
  - Only if no courses were completed satisfactorily then the programming requirement has not been met.
    - With Logical-OR only if *all* conditions are false will the **entire compound condition be false**.

Logical OR: Many Conditions

- As was the case with Logical-AND to evaluate the result just extend the general rule:
  - If **at least one** expression is true then the overall **result** is **true**.
  - Multiple OR-expressions **must all be false** for the overall **result** to be **false**.
- Example:
  - Internet search: "Wayne Gretzky" **OR** "The Great One" **OR** "Number 99" **OR** "Number ninety nine"
    - A website that includes at least one of the text phrases will be shown as a search result.
      - Increasing the number of OR-expressions will broaden (increase) the number of search results.
  - A course with a choice of prerequisites.
  - Job applicants can be awarded one of a number of degrees e.g. B.A., B.Comm, B.Sc. etc.

Mixed Logical Expressions

- AND, OR conditions can be combined in actual usage.
- Example:
  - Internet search: "Wayne Gretzky" **OR** "The Great One" **OR** "Number 99" **OR** "Number ninety nine" **AND** "Edmonton Oilers"
    - A website will show as a search result if it contains at least one of the three 'names' as well as containing the text "Edmonton Oilers".
  - Course prerequisites: CPSC 233 requires one of: CPSC 217, 231 as well as Math 271
    - In actual usage logical operators may be implicit so you should be able to interpret plain English descriptions in an assignment or during an examination.
    - CPSC 217 OR CPSC 231 AND MATH 271
    - With logic and software 'AND' is a higher order precedence than OR so the above is not evaluated left-right, the above is the same as:
      - CPSC 217 OR (CPSC 231 AND MATH 271)
    - (CPSC 217 OR CPSC 231) AND MATH 271 (To avoid confusion bracket expressions to make things explicit).

Logical Functions In Excel

- The basic logical operations: AND, OR can be invoked as functions in Excel
  - Similar to evaluating logical expressions on paper, all Excel logical function inputs can only be a `True` or `False` value.
  - Function inputs can be:
    - Boolean **constant** e.g. AND(`True`,`False`,`False`)
    - Boolean **expression** e.g. OR(`A1>0`,`A2>0`,`3>2`)
    - A **cell** that contains a Boolean value e.g. AND(`A1`,`A2`), OR(`B1`,`Z2`)
- **Format**:

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

  OR(<*True or False*>,<*True or False*>...)

Types Of Inputs: Logic Functions

- **Examples** (spreadsheet name: 18_logic)

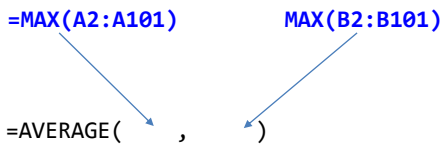
```
AND(C1>=45,D1="John Smith")
OR(C1>=0,D2>=0)
```

New Terminology: **Nested Calculation**

- Nested calculation: one calculation is nested within another second calculation when the **result of the first calculation is used to determine the result of the second calculation**.
- Simple example:
  - *Calories expended* = (**height + 7**) * 100
- More complex example:
  - First calculation: determine the total cost of salaries and other expenditures for each Canadian province.
  - Second calculation: determine total for all sources of revenue for each province.
  - Third calculation: calculate the surplus (of deficit) for each province
    = (**sum all provincial revenues**) – (**total provincial expenditures**)
  - The calculations for revenues and expenditures are nested within (part of) the calculation for the surplus (or deficit)

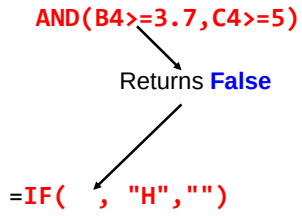
Nested Functions

- The return **result of one function is used as an argument for another function**.
- Example:
  - Find the maximum grade for each lecture section.
  - Example:
    - Lecture 01: =MAX(A2:A101)
    - Lecture 02: =MAX(B2:B101)
  - Calculate the average of the lecture maximums
    - Average of the maximum scores: = AVERAGE(**MAX(A2:A101)**, **MAX(B2:B101)**)



Using One Function's Return Value As Input For Another Function (Nesting Functions: Logic, IF)

- Breaking down the process into parts
  1. **Call a function** and that function **returns** a value e.g. B4 = 3.7, C4 = 4
  2. Use the return value of the first function as part/all of the **input** of a second function
     - The first function is *nested* within the second function.



Actual formulation of the function

```
IF(AND(B4>=3.7,C4>=5), "H","")
```

Logic And IF's: Example

- Being on the Dean's list requires: a grade point of 3.7 or higher and a full load 5 or more courses.
- AND Excel example: Dean's list
  - Signify when a student has made the Dean's list requirements with an "D", blank cell otherwise.

```
=IF(AND(B4>=3.7,C4>=5),"D","")
```

	A	B	C	D
2	Student	Overall GPA	Number courses	Dean's list
3	1	4	1	
4	2	3.9	5	D
5	3	2.3	5	
6	4	3.7	5	D

- **Example spreadsheet:** `19_if_with_logic`

Logic And IF's: Example (2)

- OR Example: Hired if at least one requirement has been met:
  - work experience of 5+ years,
  - grade 3.7 or higher
  - (Same spreadsheet as previous example)

E12

Total work experience
7

G16

Overall GPA
3.6

```
=IF(OR(E12>=5,G16>=3.7),"1+ requirement met","")
```

Conditional Formatting

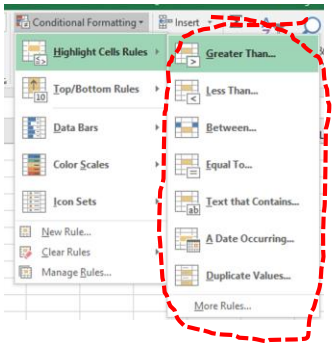
- **Example spreadsheet:** `20_conditional_formatting`
- It can be used to visually highlight data which has met a certain condition.

	A	B
1	**Employee**	**2017 sales in $**
2	James	$100,000
3	Dave	$123,456
4	Ernie	$55,000
5	Ron	$66,000
6	Don	$118,000
7	Lucie	$75,000

Highlight if sales exceeds 100,000

Setting Conditional Formatting

- Home Tab-> (Styles group: Conditional formatting)



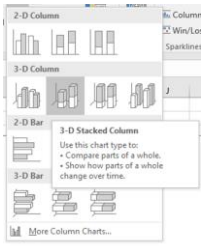
If you don't know much about visual design then keep it simple, stick to the basics!

- With the previous example select:
  - "`Greater Than`"
  - Enter 99999.99 with "Light Red Fill with Dark Red Text"

Ways Of Graphically Representing Information

- Pie chart

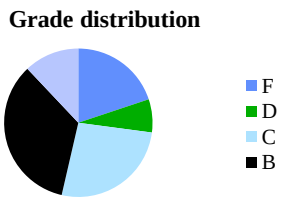
- Bar graph
  - Excel: Column (vertical), bar (horizontal)



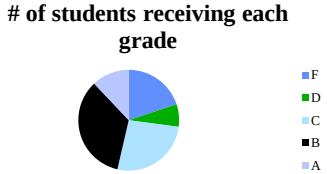
- Line graph

Pie Charts

- Good for showing proportions, how much of the whole does each item contribute.

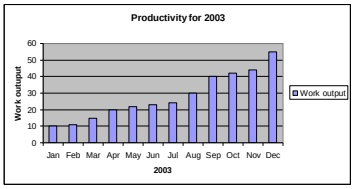


- It's poor for showing exact numeric values.

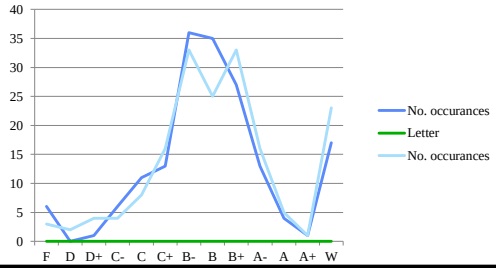


Bar And Line Graphs

- For showing trends



- Comparing functions



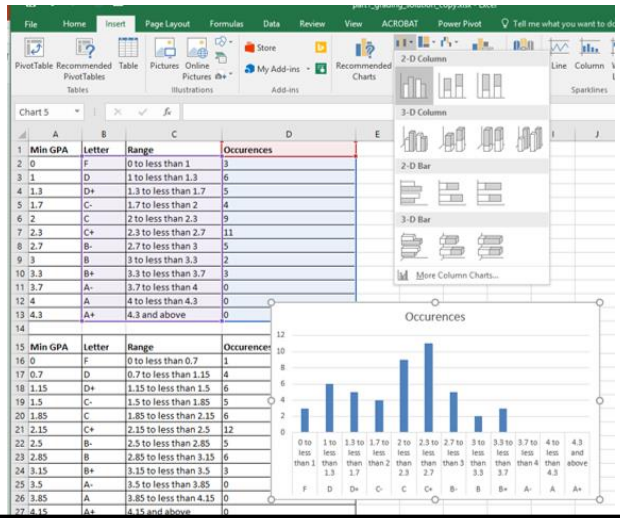
Creating Graphs Using Excel: Specifying Data

- Select the range of cells

	B	C	D
	Letter	**Range**	**Occurences**
	F	0 to less than 1	3
	D	1 to less than 1.3	6
	D+	1.3 to less than 1.7	5
	C-	1.7 to less than 2	4
	C	2 to less than 2.3	9
	C+	2.3 to less than 2.7	11
	B-	2.7 to less than 3	5
	B	3 to less than 3.3	2
	B+	3.3 to less than 3.7	3
	A-	3.7 to less than 4	0
	A	4 to less than 4.3	0
	A+	4.3 and above	0

Creating Graphs Using Excel: Inserting Graph

- Insert-> (Charts Group: Type of graph e.g. 2D Column)

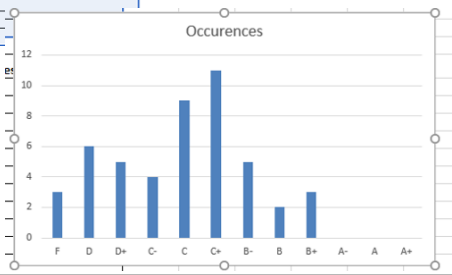


	A	B	C	D
1	Min GPA	Letter	Range	Occurences
2	0	F	0 to less than 1	3
3	1	D	1 to less than 1.3	6
4	1.3	D+	1.3 to less than 1.7	5
5	1.7	C-	1.7 to less than 2	4
6	2	C	2 to less than 2.3	9
7	2.3	C+	2.3 to less than 2.7	11
8	2.7	B-	2.7 to less than 3	5
9	3	B	3 to less than 3.3	2
10	3.3	B+	3.3 to less than 3.7	3
11	3.7	A-	3.7 to less than 4	0
12	4	A	4 to less than 4.3	0
13	4.3	A+	4.3 and above	0
14				
15	Min GPA	Letter	Range	Occurences
16	0	F	0 to less than 0.7	1
17	0.7	D	0.7 to less than 1.15	4
18	1.15	D+	1.15 to less than 1.5	6
19	1.5	C-	1.5 to less than 1.85	5
20	1.85	C	1.85 to less than 2.15	6
21	2.15	C+	2.15 to less than 2.5	12
22	2.5	B-	2.5 to less than 2.85	5
23	2.85	B	2.85 to less than 3.15	6
24	3.15	B+	3.15 to less than 3.5	3
25	3.5	A-	3.5 to less than 3.85	0
26	3.85	A	3.85 to less than 4.15	0
27	4.15	A+	4.15 and above	0

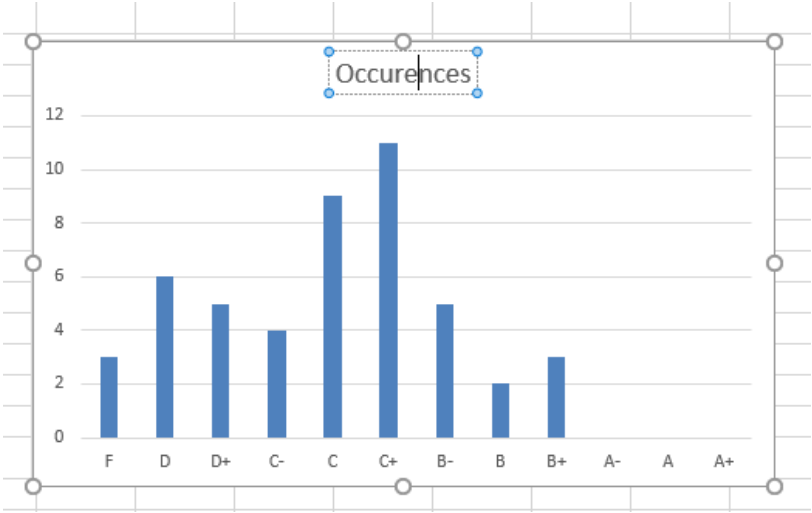
Creating Graphs Using Excel: Choosing Specific Data

- To select non-adjacent columns select the first column, press and don't release control and then select the next column.

	A	B	C	D
1	Min GPA	Letter	Range	Occurences
2	0	F	0 to less than 1	3
3	1	D	1 to less than 1.3	6
4	1.3	D+	1.3 to less than 1.7	5
5	1.7	C-	1.7 to less than 2	4
6	2	C	2 to less than 2.3	9
7	2.3	C+	2.3 to less than 2.7	11
8	2.7	B-	2.7 to less than 3	5
9	3	B	3 to less than 3.3	2
10	3.3	B+	3.3 to less than 3.7	3
11	3.7	A-	3.7 to less than 4	0
12	4	A	4 to less than 4.3	0
13	4.3	A+	4.3 and above	0



Editing The Graph Title (And Other Parts)



Rules Of Thumb For Graphs

1. What type of graph to use:
   a) Bar graphs are used to plot non-continuous data e.g., the number of patients that go to different hospitals.
   b) Line graphs are used to plot continuous data e.g., mortality trends over time.
2. JT: Avoid or minimize the use 3D graphics! Keep things simple.

After This Section You Should Now Know

- How to use basic statistical formulas: `sum()`, `average()`, `min()`, `max()`
- How to use counting functions: `count()`, `counta()`, `countblank()`,`countif()`
- How to use the lookup function: `vlookup()` and how to properly define lookup tables
- A conditional counting function: `countif()`
- The '`if-else`' function
- Logic functions: `and`, `or`

After This Section You Should Now Know (2)

- What is a nested function: Using the output of one function become the input of another function, example: `and`, `or` in conjunction with `if-else`
- How to apply conditional formatting to a spreadsheet
- When to use pie charts vs. bar graphs vs. line graphs
- How to use graphs in Excel

Images

- “Unless otherwise indicated, all images were produced by James Tam