

COMP1022Q
Introduction to Computing with Excel VBA

Cell Formula Basics

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Outcomes

- After completing this presentation, you are expected to be able to:
 1. Understand the basics of using cell formulas
 2. Write cell formulas using appropriate operations and functions
 3. Describe the expected results of some cell formulas

In This Presentation

	A	B
31		
32		=
33		

- We will look at the following topics in this presentation:
 - Some basics of cell formulas
 - Arithmetic + - * / ^
 - Handling numbers
 - Comparing things
 - String concatenation
 - String functions
 - What goes first?
- You are strongly recommended to try out the Excel files in the COMP1022Q web site!
- See how the results of the formulas change when you change inputs

Cell Formulas

- Every formula starts with a =
- Here is a simple formula calculating the average cost of meals:

	A	B	C	D
11				
12	Day	Cost of meal		
13	1	20	=SUM(B13:B17)/5	
14	2	22		
15	3	21		
16	4	27		
17	5	20		
18				

= SUM (B13 : B17) / 5

- SUM is a function
- A range of cells which contains the costs of 5 meals
- / means divide
- The total number of meals

Arithmetic

- In cell formulas you can do basic calculations like those you learned in school:

+ Addition
- Subtraction
* Multiplication
/ Division
^ Power

	A
37	
38	
39	
40	= 3 + 10

Arithmetic

- For example, if you want to add two numbers 3 and 10, you do this:

$$= 3 + 10$$

	A
37	
38	
39	
40	= 3 + 10

- There are only 5 arithmetic operators $+$ $-$ $*$ $/$ $^$ but there are also many *functions* (English words) helping you perform other clever calculations
- For example, you can use
`=AVERAGE (B13 : B17)`
to do the same thing as the formula shown before

Examples Of Arithmetic

- These examples show the use of $+$ $-$ $*$ $/$ $^$ in cell formulas

	A	B	C	D	E	F	G
1	Examples of Arithmetic Operators						
2	<i>These examples show the basic arithmetic operators in cell formulas. The users can enter two numbers in cells B5 and B6. The results of several calculations are shown in cells D9 to D13.</i>						
3							
4	Input From User						
5	Number A	3					
6	Number B	2					
7							
8	Arithmetic Operation, in English		Cell Formula	Result			
9	Addition		= A + B	5			
10	Subtraction		= A - B	1			
11	Multiplication		= A * B	6			
12	Division		= A / B	1.5			
13	Power		= A ^ B	9			
14							

This cell has the name A

This cell has the name B

Some Commonly Used Number Functions

- There are many functions that can be used in cell formulas
- Here we look at 7 common functions for handling numbers:
 - SUM for finding the total of a group of numbers
 - AVERAGE for finding the average of a group of numbers
 - STDEV for finding the standard deviation of a group of numbers
 - MAX for finding the maximum in a group of numbers
 - MIN for finding the minimum in a group of numbers
 - RANK for ranking a number in a group of numbers
 - COUNTIF for counting the number of occurrences of a value
- On the next slide we show an example which uses these
- Remember *Ctrl* ` can be used to show all the formulas

Example of Some Commonly Used Number Functions

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Some Commonly Used Number Functions												
2	<i>This example uses the following 7 cell functions in the cell formulas: SUM, AVERAGE, STDEV, MAX, MIN, RANK, COUNTIF. (In this course, each of the assignments is worth 14% and the final exam is worth 44%.)</i>												
3													
4	Student ID	Student Name	Assignment				Final Exam	Total	Rank	Final Grade		Some Statistics	
5			A1	A2	A3	A4						Mean	68.40
6	09677229	David	100	100	90	0	44	59.96	9	C+		Standard Deviation	17.58
7	09899972	Gigi	80	100	100	0	31.5	53.06	10	C+		Maximum	92.70
8	09959402	Eddie	100	100	100	96	71	86.68	2	A		Minimum	29.24
9	09965977	Chris	95	100	100	100	61	82.14	3	B+			
10	10055430	Alex	100	100	100	95	85	92.70	1	A+		Grade Distribution	
11	10211965	Henry	95	90	60	67	52	66.56	7	B-		Number of students that got an A	2
12	10217107	James	65	100	100	97	60	77.08	4	B+		Number of students that got a B	6
13	10251688	Ken	100	96	75	98	42	70.14	6	B		Number of students that got a C	2
14	10335015	Isaac	98	90	100	91	21	62.30	8	B-		Number of students that failed	1
15	10683708	Felix	100	100	85	95	44	72.56	5	B			
16	10858690	Bonnie	90	0	78	0	13	29.24	11	F			
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													

- Take a look at the example in the web site!

Here are the Formulas Used

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Some Commonly Used Number Functions												
2	<i>This example uses the following 7 cell functions in the cell formulas: SUM, AVERAGE, STDEV, MAX, MIN, COUNTIF, and RANK. In this course, each of the assignments is worth 14% and the final exam is worth 44%.</i>												
3													
4	Student ID	Student Name	Assignment				Final Exam	Total	Rank	Final Grade	Some Statistics		
5			A1	A2	A3	A4					Mean		
6	09677229	David	100	100	90	0	44	59.96	9	C+	Standard Deviation		
7	09899972	Gigi	80	100	100	0	31.5	53.06	10	C+	Maximum		
8	09959402	Eddie	100	100	100	96	71	86.68	2	A	Minimum		
9	09965977	Chris	95	100	100	100	61	82.14	3	B+	Grade Distribution		
10	10055430	Alex	100	100	100	95	85	92.70	1	A+	Number of students that got an A		
11	10211965	Henry	95	90	60	67	52	66.56	7	B-	Number of students that got a B		
12	10217107	James	65	100	100	97	60	77.08	4	B+	Number of students that got a C		
13	10251688	Ken	100	96	75	98	60	70.14	6	B	Number of students that failed		
14	10335015	Isaac	98	90	100	91	60	62.30	8	B-			
15	10683708	Felix	100	100	85	95	44	72.56	5	B			
16								29.24	11	F			
17	Formulas for Total and Rank						Formulas for Statistics and Grade Distribution						
18	Formulas for Total						Formulas for Statistics						
19	Formulas for Rank						Formulas for Grade Distribution						
20	Formulas for Statistics						Formulas for Grade Distribution						
21	Formulas for Grade Distribution						Formulas for Grade Distribution						
22	Formulas for Grade Distribution						Formulas for Grade Distribution						
23	Formulas for Grade Distribution						Formulas for Grade Distribution						
24	Formulas for Grade Distribution						Formulas for Grade Distribution						
25	Formulas for Grade Distribution						Formulas for Grade Distribution						
26	Formulas for Grade Distribution						Formulas for Grade Distribution						
27	Formulas for Grade Distribution						Formulas for Grade Distribution						
28	Formulas for Grade Distribution						Formulas for Grade Distribution						
29	Formulas for Grade Distribution						Formulas for Grade Distribution						
30	Formulas for Grade Distribution						Formulas for Grade Distribution						
31	Formulas for Grade Distribution						Formulas for Grade Distribution						
32	Formulas for Grade Distribution						Formulas for Grade Distribution						
33	Formulas for Grade Distribution						Formulas for Grade Distribution						
34	Formulas for Grade Distribution						Formulas for Grade Distribution						
35	Formulas for Grade Distribution						Formulas for Grade Distribution						
36	Formulas for Grade Distribution						Formulas for Grade Distribution						
37	Formulas for Grade Distribution						Formulas for Grade Distribution						
38	Formulas for Grade Distribution						Formulas for Grade Distribution						
39	Formulas for Grade Distribution						Formulas for Grade Distribution						
40	Formulas for Grade Distribution						Formulas for Grade Distribution						
41	Formulas for Grade Distribution						Formulas for Grade Distribution						
42	Formulas for Grade Distribution						Formulas for Grade Distribution						
43	Formulas for Grade Distribution						Formulas for Grade Distribution						
44	Formulas for Grade Distribution						Formulas for Grade Distribution						
45	Formulas for Grade Distribution						Formulas for Grade Distribution						
46	Formulas for Grade Distribution						Formulas for Grade Distribution						
47	Formulas for Grade Distribution						Formulas for Grade Distribution						
48	Formulas for Grade Distribution						Formulas for Grade Distribution						
49	Formulas for Grade Distribution						Formulas for Grade Distribution						
50	Formulas for Grade Distribution						Formulas for Grade Distribution						
51	Formulas for Grade Distribution						Formulas for Grade Distribution						
52	Formulas for Grade Distribution						Formulas for Grade Distribution						
53	Formulas for Grade Distribution						Formulas for Grade Distribution						
54	Formulas for Grade Distribution						Formulas for Grade Distribution						
55	Formulas for Grade Distribution						Formulas for Grade Distribution						
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57	Formulas for Grade Distribution						Formulas for Grade Distribution						
58	Formulas for Grade Distribution						Formulas for Grade Distribution						
59	Formulas for Grade Distribution						Formulas for Grade Distribution						
60	Formulas for Grade Distribution						Formulas for Grade Distribution						
61	Formulas for Grade Distribution						Formulas for Grade Distribution						
62	Formulas for Grade Distribution						Formulas for Grade Distribution						
63	Formulas for Grade Distribution						Formulas for Grade Distribution						
64	Formulas for Grade Distribution						Formulas for Grade Distribution						
65	Formulas for Grade Distribution						Formulas for Grade Distribution						
66	Formulas for Grade Distribution						Formulas for Grade Distribution						
67	Formulas for Grade Distribution						Formulas for Grade Distribution						
68	Formulas for Grade Distribution						Formulas for Grade Distribution						
69	Formulas for Grade Distribution						Formulas for Grade Distribution						
70	Formulas for Grade Distribution						Formulas for Grade Distribution						
71	Formulas for Grade Distribution						Formulas for Grade Distribution						
72	Formulas for Grade Distribution						Formulas for Grade Distribution						
73	Formulas for Grade Distribution						Formulas for Grade Distribution						
74	Formulas for Grade Distribution						Formulas for Grade Distribution						
75	Formulas for Grade Distribution						Formulas for Grade Distribution						
76	Formulas for Grade Distribution						Formulas for Grade Distribution						
77	Formulas for Grade Distribution						Formulas for Grade Distribution						
78	Formulas for Grade Distribution						Formulas for Grade Distribution						
79	Formulas for Grade Distribution						Formulas for Grade Distribution						
80	Formulas for Grade Distribution						Formulas for Grade Distribution						
81	Formulas for Grade Distribution						Formulas for Grade Distribution						
82	Formulas for Grade Distribution						Formulas for Grade Distribution						
83	Formulas for Grade Distribution						Formulas for Grade Distribution						
84	Formulas for Grade Distribution						Formulas for Grade Distribution						
85	Formulas for Grade Distribution						Formulas for Grade Distribution						
86	Formulas for Grade Distribution						Formulas for Grade Distribution						

Comparing Things

- Sometimes you need to know about the relationship between two things
- For example, you might need to compare whether two values are equal, or if they are different
- You can do that using these:

= equal to

<> not equal to

< smaller than

<= smaller than or equal to

> larger than

>= larger than or equal to

TRUE and FALSE

- The result of a comparison is
TRUE or FALSE
 - In cells these are shown using capital letters
- For example, to test if the value in cell A4 is larger than the value in cell B6, we can write
`=A4 > B6`
- The result won't be a number; it will be either
TRUE or FALSE

Examples Of Comparing Things

- This example shows the most basic ways to compare things

	A	B	C	D	E	F	G	H
1	Examples of Relational Operators							
2	<i>These examples show the most common relational operators in cell formulas. The users can enter two numbers in cells B5 and B6. The results of several comparisons are shown in cells D9 to D14.</i>							
3								
4	Input From User							
5	Number A	3						
6	Number B	2						
7								
8	Relational Operation, in English		Cell Formula	Result				
9	Less than		= A < B	FALSE				
10	Less than or equal to		= A <= B	FALSE				
11	Equal to		= A = B	FALSE				
12	Greater than or equal to		= A >= B	TRUE				
13	Greater than		= A > B	TRUE				
14	Not equal to		= A <> B	TRUE				

This cell has the name A

This cell has the name B

Comparing Things in COUNTIF

- We have seen COUNTIF helps us count the number of occurrences of something, e.g.
`=COUNTIF (J6 : J16 , "A")`
- Instead of using an exact value we can do something like `=COUNTIF (B2 : B6 , "<40")`
- This will count all the numbers less than 40

Example of Using COUNTIF

- This extends a previous example
- It counts the number of students who failed a final exam, which had a pass mark of 40

	A	B	C	D	E	F	G	H	I	J
1	Using COUNTIF with Relational Operators									
2	<i>This example shows the use of relational operators inside the criteria of the COUNTIF function. It uses "<" to find the number of students who failed the final exam.</i>									
3										
4	Student ID	Student Name	Assignment				Final Exam	Total	Rank	Final Grade
5			A1	A2	A3	A4				
6	09677229	David	100	100	90	0	44	59.96	9	C+
7	09899972	Gigi	80	100	100	0	31.5	53.06	10	C+
8	09959402	Eddie	100	100	100	96	71	86.68	2	A
9	09965977	Chris	95	100	100	100	61	82.14	3	B+
10	10055430	Alex	100	100	100	95	85	92.70	1	A+
11	10211965	Henry	95	90	60	67	52	66.56	7	B-
12	10217107	Number of students who failed the exam: =COUNTIF(G6:G16,"<40")								
13	10251688									
14	10335015	Isaac	90	90	100	91	21	82.56	8	B-
15	10683708	Felix	100	100	85	95	44	72.5	5	B
16	10858690	Bonnie	90	0	78	0	13	25	11	F
17										
18		Number of students who failed the exam: 3								

- Take a look at the example in the web site

"<40" means any value smaller than 40

Other Cell Functions with 'IF'

- As well as COUNTIF (B2 : B6, "<40") there's also these cell functions which have 'if' in their name:
- AVERAGEIF (B2 : B6, "<40")
calculate the average for the cells which have values <40
- SUMIF (B2 : B6, "<40")
add up the cells, for the cells which have values <40
- You can use any of these:

=	equal to	<>	not equal to
<	smaller than	<=	smaller than or equal to
>	larger than	>=	larger than or equal to

String Concatenation

- In computer language, 'a string' means 'a piece of text'
- *Concatenate* means putting one string at the end of another string
- In Excel cell formulas, you can concatenate two strings by using & or the CONCATENATE function
- For example, this formula:

`= "Happy" & "Birthday"`

and this formula:

`=CONCATENATE ("Happy", "Birthday")`

both produce the same result: HappyBirthday

String Concatenation

- Here is an example of both:

	A	B	C	D	E	F
1	Example of String Concatenation					
2	<i>This example shows how to concatenate two strings in cell formulas by using & and CONCATENATE. You can enter two strings in cells B5 and B6. The result is shown in cell D9 and D10.</i>					
3						
4	Input From User					
5	String A	David				
6	String B	Rossiter				
7						
8	String Operation, in English		Cell Formula	Result		
9	Concatenation		= A & B	DavidRossiter		
10	Concatenation		= CONCATENATE(A, B)	DavidRossiter		
11						

This cell has the name **A**

This cell has the name **B**

String Concatenation and the COUNTIF Comparison

- When you use COUNTIF with a comparison, the comparison is written as a string, i.e.
COUNTIF (B2 : B6, "<40")
- If you want to include a cell in the comparison, you **cannot** write the cell reference directly inside, i.e. COUNTIF (B2 : B6, "<B8")
- You will need to do this instead: ✗ Wrong!

COUNTIF (B2 : B6, "<" & B8)

Some Commonly Used String Functions

- There are many other functions for strings
- Here we look at some:

LEN	Count the number of characters in a string
UPPER	Convert all letters into upper case letters i.e. ABC
LOWER	Convert all letters into lower case letters i.e. abc
LEFT	Get the first few characters in a string
RIGHT	Get the last few characters in a string
SUBSTITUTE	Substitute (replace) some text in a string

- There are examples of these on the next slide

Example of Some Commonly Used String Functions

4	Input From User		
5	String A	Dave is the best instructor!	This cell has the name A
6	String Old	best	This cell has the name Old
7	String New	most handsome	This cell has the name New
8			
9	What Does the Example Do?	Cell Formula	Result
10	Count how many characters in a string	= LEN(A)	28
11	Convert all the characters into upper case (large letters)	= UPPER(A)	DAVE IS THE BEST INSTRUCTOR!
12	Convert all the characters into lower case (small letters)	= LOWER(A)	dave is the best instructor!
13	Get the first N characters in the string	= LEFT(A, 4)	Dave
14	Get the last N characters in the string	= RIGHT(A, 11)	instructor!
15	Substitute a piece of text with a new piece of text in a string	= SUBSTITUTE(A, Old, New)	Dave is the most handsome instructor!

What Goes First?

- If you enter the following formula
 $=5+2*3$
you may think that the answer is 21
- However, Excel actually gives you the answer of 11
- That is because Excel thinks that multiplication is more important than addition
- Therefore $2*3$ is performed first, before the addition
- We say multiplication has a higher *precedence* than addition

Using Brackets

- Of course, if you use brackets that ensures that part of a formula is evaluated first
- Examples:
 - $=5+2*3$ gives an answer of 11
 - $=(5+2)*3$ gives an answer of 21
- You might think you can always use brackets in your cell formulas, so you don't have to remember which things are calculated first
- That's true – until someone else gives you a formula which doesn't have any brackets in it...

Precedence in Cell Formulas

- The following table shows you the different levels of precedence, most important at the top:

^	Power
* and /	Multiplication and division
+ and -	Addition and subtraction
&	String concatenation
= <> < <= > >=	Comparisons

Precedence Example 1

$$= 20 - 10 / 2 * 3 + 2$$


- $/$ and $*$ have higher precedence than $+$ and $-$, so they are handled first

- $/$ and $*$ have equal precedence, so the one on the left ($/$) is evaluated first, then $*$

- So the answer is:

$$= (20 - ((10 / 2) * 3)) + 2$$

$$= 7$$

- Then $-$ and $+$ are handled
- $-$ and $+$ have equal precedence, so the one on the left ($-$) is evaluated first, then $+$

Precedence Example 2

$$= 10 / 2 * 4 - 3 ^ 3$$


- $^$ has a higher precedence than the others, so it is handled first
- $/$ and $*$ have equal precedence, so the one on the left ($/$) is evaluated first, then the $*$
- The $-$ is handled last

- So the answer is:


$$= ((10 / 2) * 4) - (3 ^ 3)$$

$$= ((10 / 2) * 4) - 27$$

$$= -7$$

Precedence Example 3

	A	B
1	Surname:	Rossiter
2	Firstname:	David
3	Age:	20
4		
5	Good?	= "Rossiter,David,40" = B1 & "," & B2 & "," & B3*2

- The comparison is done last
 - The concatenation is done next
 - The multiplication is done first
- For this situation the result of the formula is: TRUE
- 

Quick List of Cell Things We Looked At

- + - * / ^
- = < > <> <= >=
- SUM
- AVERAGE
- STDEV
- MAX
- MIN
- RANK
- COUNTIF
- AVERAGEIF
- SUMIF
- &
- CONCATENATE
- LEN
- UPPER
- LOWER
- LEFT
- RIGHT
- SUBSTITUTE