COMP1022Q
Introduction to Computing with Excel VBA

Lookup Techniques

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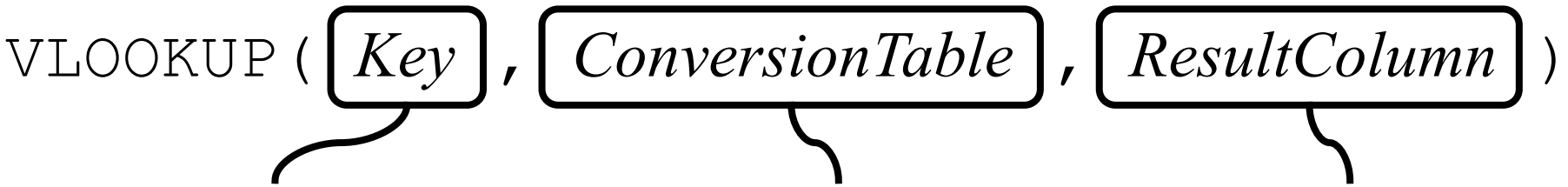
Outcomes

- After completing this presentation, you are expected to be able to:
  1. Use the `VLOOKUP`/`HLOOKUP` formula functions to look for information in a worksheet
  2. Understand the differences between searching for information with or without approximate matching
  3. Handle the error returned by the lookup functions

The VLOOKUP Function

- The general idea of `VLOOKUP` is to find something inside an area of data and then return the corresponding ‘answer’
- Here is the function:



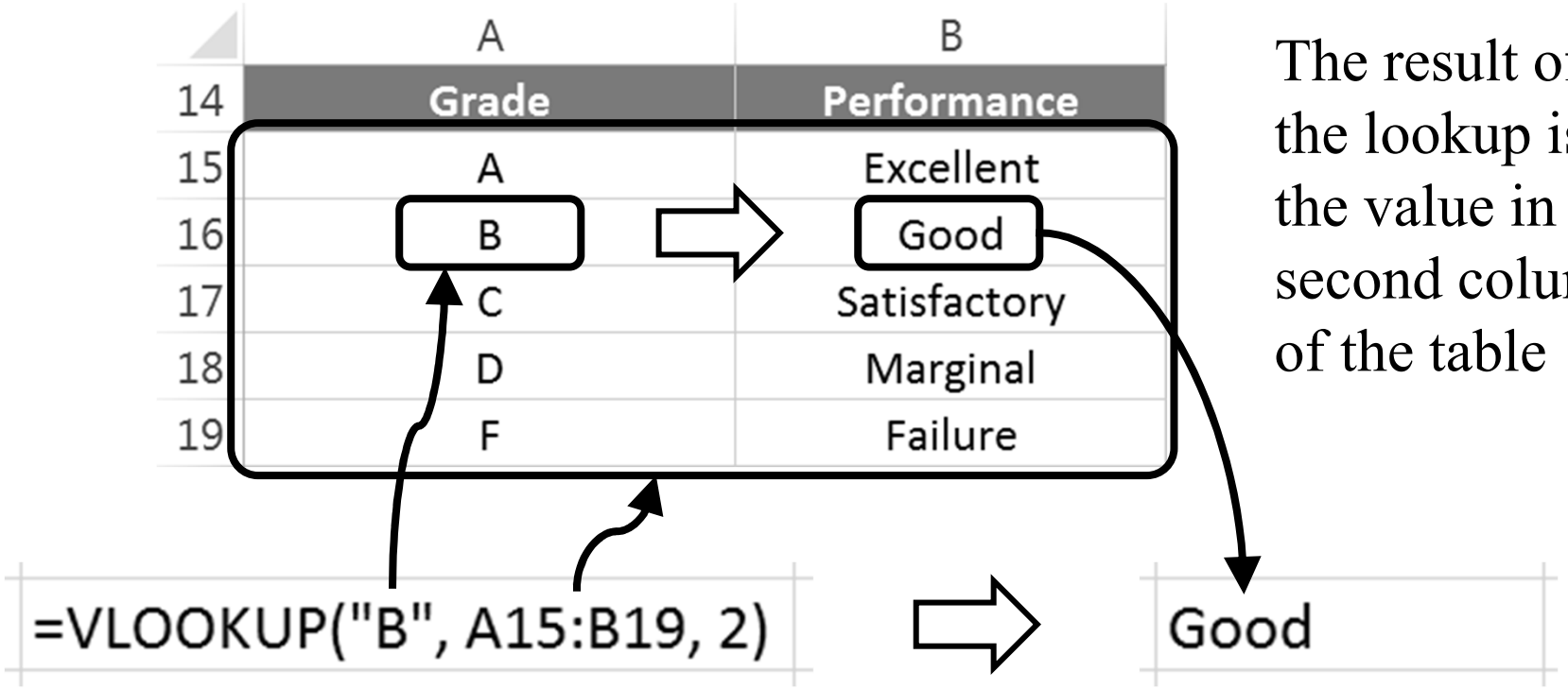
The value, we call it the *key*, you want to find in the **first column** of the *conversion table*

The area of data, we call it the *conversion table*, you want to find the value in

The column number of the value you want to return from the *conversion table*

A Simple Example

- For example, you can use `VLOOKUP` to find the performance definition of a grade using this table:



The result of the lookup is the value in the second column of the table

The Grade Performance Example 1/3

- Let's say we need to find the grade performance of a list of subject grades, like this:

	A	B	C
4	**Subject**	**Grade**	**Performance**
5	**English**	B	
6	**Chinese**	B	
7	**Mathematics**	A	
8	**Physics**	B	
9	**Biology**	F	
10	**Chemistry**	F	
11	**Computer Science**	A	

We want to put the grade performance in the column here

- One way to do this is to fill in the formula in cell C5 and then copy and paste it to the rest of the column, as shown in the following slides

The Grade Performance Example 2/3

- We first enter the formula using `VLOOKUP` in the first row of the subject list, like this:

	A	B	C
4	**Subject**	**Grade**	**Performance**
5	**English**	B	=VLOOKUP(B5, $A$15:$B$19, 2)

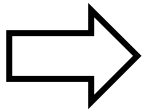
- Note that we need to use absolute reference for the conversion table because we don't want it to change when the formula is copied and pasted later

	A	B
14	**Grade**	**Performance**
15	A	Excellent
16	B	Good
17	C	Satisfactory
18	D	Marginal
19	F	Failure

The Grade Performance Example 3/3

- Then we copy and paste the formula from the first row to the rest of the column

	A	B	C
4	Subject	Grade	Performance
5	English	B	Good
6	Chinese	B	
7	Mathematics	A	
8	Physics	B	
9	Biology	F	
10	Chemistry	F	
11	Computer Science	A	

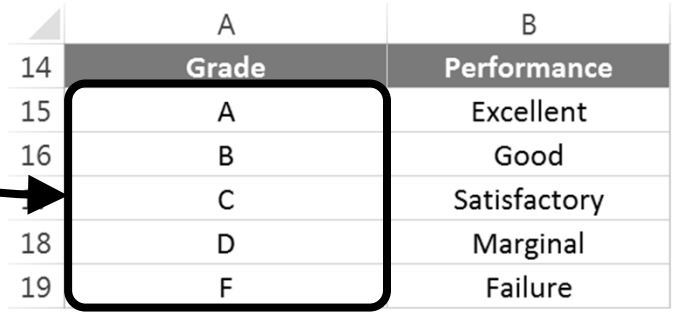


B	C
rade	Performance
B	Good
B	Good
A	Excellent
B	Good
F	Failure
F	Failure
A	Excellent

- The grade performance will be shown correctly for each subject in the list

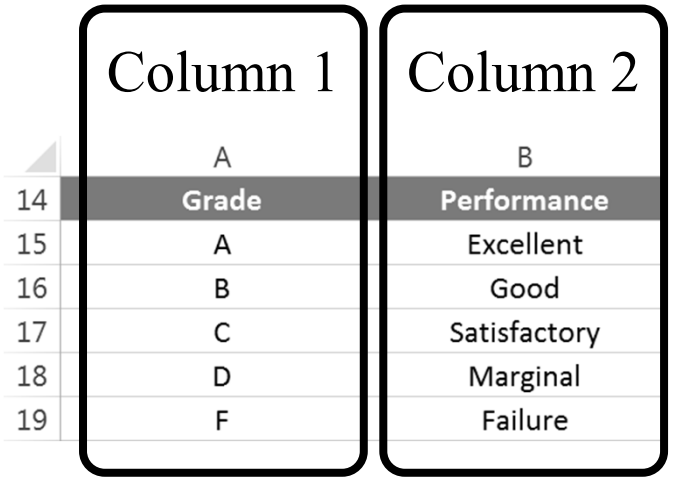
A Couple of Things to Remember When Using VLOOKUP

1. `VLOOKUP` always searches in the **first column** of the conversion table only



	A	B
14	Grade	Performance
15	A	Excellent
16	B	Good
17	C	Satisfactory
18	D	Marginal
19	F	Failure

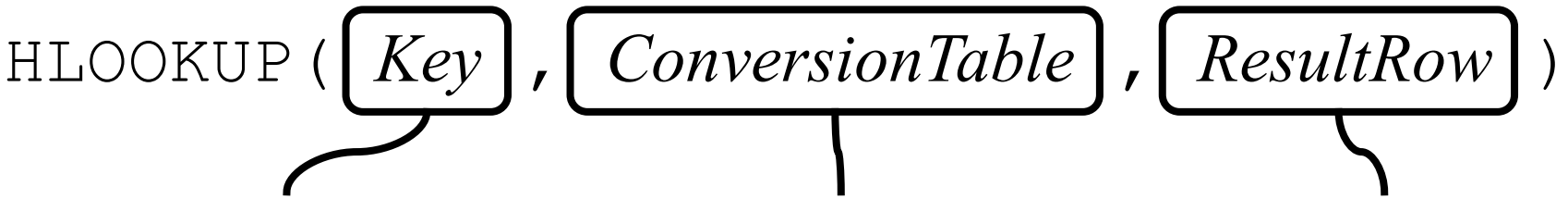
2. The column number of the result is the **relative column number** within the conversion table, i.e. the first column is column 1, the second column is 2 and so on



	A	B
14	Grade	Performance
15	A	Excellent
16	B	Good
17	C	Satisfactory
18	D	Marginal
19	F	Failure

The HLOOKUP Function

- `HLOOKUP` is very similar to `VLOOKUP`
- The only difference is that `HLOOKUP` has a conversion table which is organised horizontally
- The function looks like this:



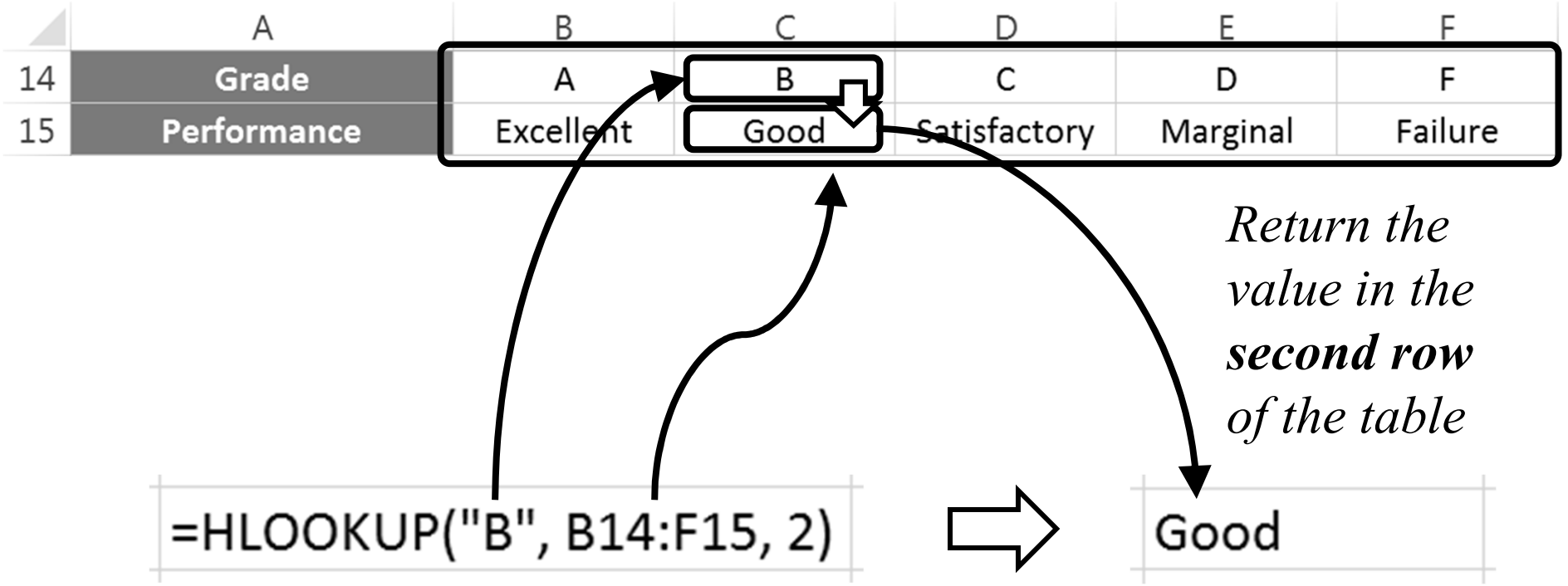
The key you want to find in the **first row** of the *conversion table*

The *conversion table* you want to find the key in

The **row number** of the value you want to return from the *conversion table*

A Simple Example Using HLOOKUP

- Let's use the same grade example for `HLOOKUP` with a different conversion table

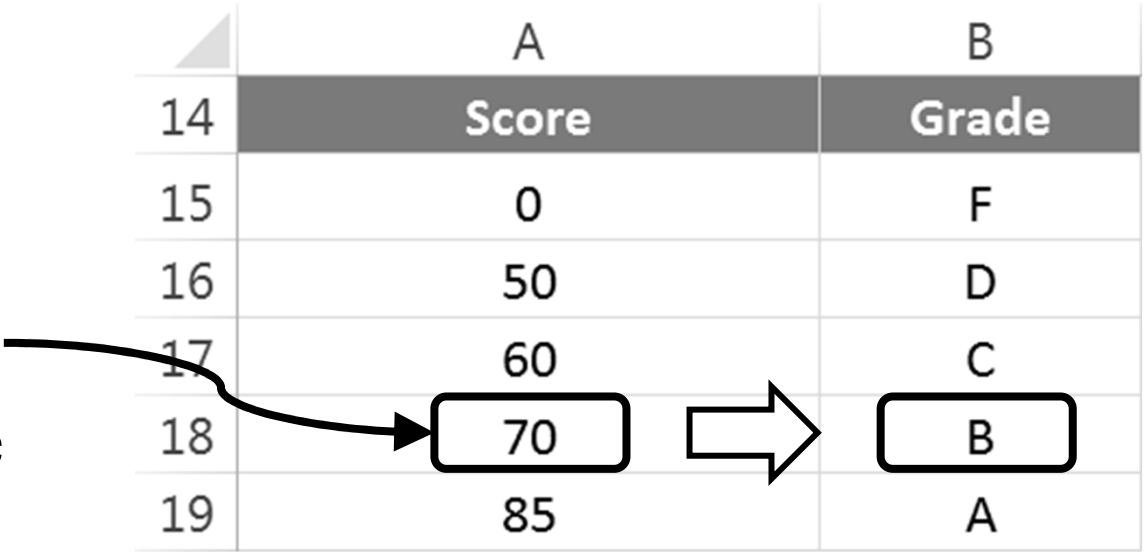


Approximate Matching

- Sometimes the key may not exist in the conversion table and you need the *closest* match
  - The closest match means returning a result with the closest value **smaller than or equal to** the value being looked up
  - If there isn't a value smaller than or equal to the value being looked up, then an error is returned
- This is called *approximate matching*
- An example is shown on the next slide

A Example Using Approximate Matching

- Let's look at an example with approximate matching
- The conversion table in the example is used to determine a letter grade based on the score of a course, which is shown below:
- For example, if the key value is *73,* the highest score less than key is 70, so 'B' is returned as the grade



	A	B
14	Score	Grade
15	0	F
16	50	D
17	60	C
18	70	B
19	85	A

Approximate Matching in VLOOLUP and HLOOKUP

- By default, both `VLOOKUP` and `HLOOKUP` use approximate matching
- You can optionally turn off approximate matching using an additional fourth parameter, like this:

`VLOOKUP(`*Key*`,` *ConversionTable*`,` *ResultColumn*`,` *Approximation*`)`

If this is TRUE, an approximate match is made;
otherwise an exact match is made

`HLOOKUP(`*Key*`,` *ConversionTable*`,` *ResultRow*`,` *Approximation*`)`

The Fourth Parameter

`VLOOKUP(`*Key*`,` *ConversionTable*`,` *ResultColumn*`,` *Approximation*`)`

`HLOOKUP(`*Key*`,` *ConversionTable*`,` *ResultRow*`,` *Approximation*`)`

- If this fourth parameter is missing, Excel assumes you want approximate matching anyway
- However, if this parameter is `FALSE` then an approximate match is not made, and an error message will be produced if you try to look up something which isn't in the conversion table
- We call it *exact matching* if the fourth parameter is `FALSE`

For Approximate Matching, Conversion Table Must Be Sorted

- There is one very important thing to remember if you want to use approximate matching:

  The data in the conversion table ***must be sorted***

- That means, if the conversion table uses numbers, those numbers must be in increasing order
- Similarly, if the conversion table uses words, those words must be in alphabetical order

(If you do exact matching, you do not need to sort the conversion table)

A Grading Example 1/2

- Let's use approximate matching to find the grades of a list of subjects using the conversion table shown in the previous example

	A	B	C
4	**Subject**	**Score**	**Grade**
5	**English**	80	
6	**Chinese**	83	
7	**Mathematics**	90	
8	**Physics**	70	
9	**Biology**	48	
10	**Chemistry**	43	
11	**Computer Science**	100	

We want to put the grades of the subjects here

We will find the grade of the subjects using this conversion table:

	A	B
14	**Score**	**Grade**
15	0	F
16	50	D
17	60	C
18	70	B
19	85	A

A Grading Example 2/2

- We use formulas which explicitly turn on approximate matching using the fourth parameter

	A	B	C
4	**Subject**	**Score**	**Grade**
5	**English**	80	=VLOOKUP(B5, $A$15:$B$19, 2, TRUE)
6	**Chinese**	83	=VLOOKUP(B6, $A$15:$B$19, 2, TRUE)
7	**Mathematics**	90	=VLOOKUP(B7, $A$15:$B$19, 2, TRUE)
8	**Physics**	70	=VLOOKUP(B8, $A$15:$B$19, 2, TRUE)
9	**Biology**	48	=VLOOKUP(B9, $A$15:$B$19, 2, TRUE)
10	**Chemistry**	43	=VLOOKUP(B10, $A$15:$B$19, 2, TRUE)
11	**Computer Science**	100	=VLOOKUP(B11, $A$15:$B$19, 2, TRUE)

Each subject has been assigned a grade based on the conversion table

The conversion table

	A	B
14	**Score**	**Grade**
15	0	F
16	50	D
17	60	C
18	70	B
19	85	A

	B	C
	Score	**Grade**
	80	B
	83	B
	90	A
	70	B
	48	F
	43	F
	100	A

What Happens If We Turn off Approximate Matching?

- Let's turn off approximate matching, i.e. let's use exact matching, in the previous example by changing the formulas so they look like this:
- The result is shown on the next slide

C
Grade
=VLOOKUP(B5, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B6, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B7, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B8, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B9, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B10, $A$15:$B$19, 2, FALSE)
=VLOOKUP(B11, $A$15:$B$19, 2, FALSE)

Using `FALSE` to turn off approximate matching

The #N/A Error

- If we use exact matching any subject score which does not exist in the conversion table gives you a result of `#N/A`

	A	B	C
4	**Subject**	**Score**	**Grade**
5	**English**	80	#N/A
6	**Chinese**	83	#N/A
7	**Mathematics**	90	#N/A
8	**Physics**	70	B
9	**Biology**	48	#N/A
10	**Chemistry**	43	#N/A
11	**Computer Science**	100	#N/A

The conversion table

	A	B
14	**Score**	**Grade**
15	0	F
16	50	D
17	60	C
18	70	B
19	85	A

In this example, the subject score of 70 exists in the conversion table so only the grade of that subject can be shown

- `#N/A` means ‘not available’, i.e. the key that we look for is not available in the conversion table

Handling the #N/A Error

- You can handle the ‘not available’ error using the `ISNA` function
- The `ISNA` function will return `TRUE` if a lookup function generates the ‘not available’ error; otherwise, it will return `FALSE`
- Typically, you combine the `IF` function and the `ISNA` function if you don’t want to show the error
- The next few slides show an example

Comparing Drink Prices

- An Excel worksheet has been created to show the price comparison of drinks between Starbucks and Pacific Coffee, the two main coffee companies in Hong Kong
- For example, this data would be very useful if you were planning on opening your own coffee shop

	Hot Beverage	Starbucks			Pacific Coffee		
		tall	grande	venti	tall	grande	alto
7	Dark Caramel	HK$39	HK$42	HK$45	-	-	-
8	Caramel	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41
9	Mocha	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41
10	Hazelnut	-	-	-	HK$35	HK$38	HK$41
11	Vanilla	-	-	-	HK$35	HK$38	HK$41
12	Hazelnut Cappuccino	-	-	-	HK$35	HK$38	HK$41
13	Latte	HK$33	HK$36	HK$39	HK$32	HK$35	HK$38
14	Cappuccino	HK$33	HK$36	HK$39	HK$32	HK$35	HK$38
15	Americano	HK$29	HK$32	HK$35	HK$27	HK$30	HK$33
16	Espresso	HK$17	HK$20	-	-	-	-
17	Colombian Decaf	-	-	-	HK$22	HK$26	HK$29
18	Hot Chocolate	HK$33	HK$36	HK$39	HK$30	HK$33	HK$36
19	Green Tea Latte	HK$33	HK$36	HK$39	-	-	-
20	English Breakfast Tea Latte	HK$33	HK$36	HK$39	-	-	-
21	Full-Leaf Brewed Tea	HK$22	HK$23	HK$27	-	-	-
22	Steamed Milk	-	-	-	HK$22	HK$26	HK$30
23	English Breakfast	-	-	-	HK$21	HK$24	HK$25
24	Earl Grey	-	-	-	HK$21	HK$24	HK$25

Beverage Prices

- The drink prices are stored in two other separate worksheets for each of Starbucks and Pacific Coffee

	A	B	C	D
1	**Beverage**	**tall**	**grande**	**venti**
2	Dark Caramel	HK$39	HK$42	HK$45
3	Caramel	HK$36	HK$39	HK$42
4	Mocha	HK$36	HK$39	HK$42
5	Latte	HK$33	HK$36	HK$39
6	Cappuccino	HK$33	HK$36	HK$39
7	Americano	HK$29	HK$32	HK$35
8	Espresso	HK$17	HK$20	-
9	Hot Chocolate	HK$33	HK$36	HK$39
10	Green Tea Latte	HK$33	HK$36	HK$39
11	English Breakfast Tea Latte	HK$33	HK$36	HK$39
12	Full-Leaf Brewed Tea	HK$22	HK$23	HK$27
13				
14				
15				

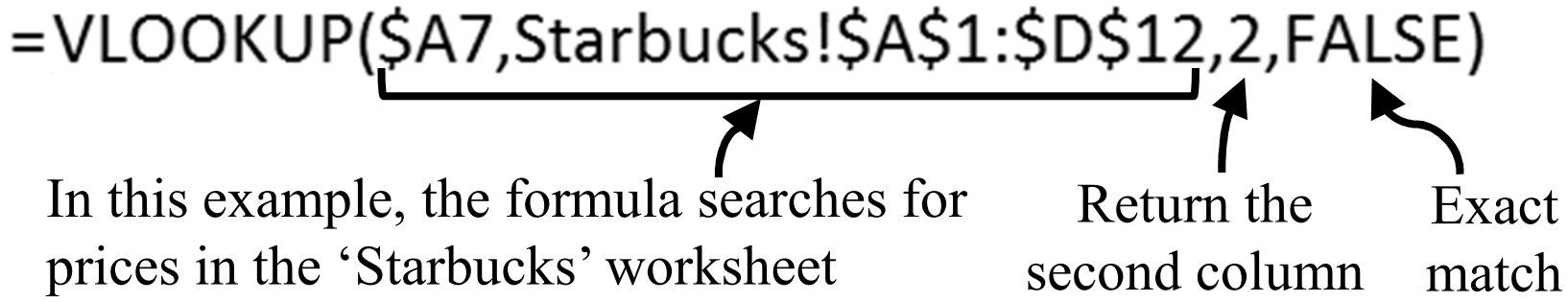
Coffee Comparison | **Starbucks** | Pacific Coffee

	A	B	C	D
1	**Beverage**	**tall**	**grande**	**alto**
2	Latte	HK$32	HK$35	HK$38
3	Cappuccino	HK$32	HK$35	HK$38
4	Mocha	HK$35	HK$38	HK$41
5	Caramel	HK$35	HK$38	HK$41
6	Hazelnut	HK$35	HK$38	HK$41
7	Vanilla	HK$35	HK$38	HK$41
8	Hazelnut Cappuccino	HK$35	HK$38	HK$41
9	Mocha	HK$35	HK$38	HK$41
10	Americano	HK$27	HK$30	HK$33
11	Colombian Decaf	HK$22	HK$26	HK$29
12	Hot Chocolate	HK$30	HK$33	HK$36
13	Steamed Milk	HK$22	HK$26	HK$30
14	English Breakfast	HK$21	HK$24	HK$25
15	Earl Grey	HK$21	HK$24	HK$25

Coffee Comparison | Starbucks | **Pacific Coffee**

Looking Up the Prices

- The prices of the drinks are then searched in the corresponding company's worksheet using `VLOOKUP`, like this:



- However, if the drink is not found, `#N/A` will be generated:

5		Starbucks			Pacific Coffee		
6		tall	grande	venti	tall	grande	alto
7	Dark Caramel	HK$39	HK$42	HK$45	#N/A	#N/A	#N/A
8	Caramel	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41
9	Mocha	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41

Using ISNA

		Starbucks			Pacific Coffee		
		tall	grande	venti	tall	grande	alto
7	Dark Caramel	HK$39	HK$42	HK$45	-	-	-
8	Caramel	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41
9	Mocha	HK$36	HK$39	HK$42	HK$35	HK$38	HK$41

- To avoid showing `#N/A`, the formula is changed so that a dash (a hyphen) is shown instead
- We can use `ISNA` together with `IF`, like this:

Show a dash if the drink does not exist

```
=IF(ISNA(VLOOKUP($A7,Starbucks!$A$1:$D$12,2,FALSE)), "-",
                 VLOOKUP($A7,Starbucks!$A$1:$D$12,2,FALSE))
```

If the drink exists, show the lookup result

Combining IF and ISNA

- In the previous formula, the `VLOOKUP` function has been entered twice, which is not very efficient

```
=IF(ISNA(VLOOKUP($A7,Starbucks!$A$1:$D$12,2,FALSE)), "-",
                VLOOKUP($A7,Starbucks!$A$1:$D$12,2,FALSE))
```

- Excel gives you an alternative to write the formula efficiently using `IFNA`, as shown below:

```
=IFNA(VLOOKUP($A7, Starbucks!$A$1:$D$12, 2, FALSE), "-")
```

Show this when everything is fine

Show this if the lookup has an error

ISERROR and IFERROR

- In addition to `ISNA` and `IFNA`, you can also use `ISERROR` and `IFERROR` to handle the `#N/A` returned by the lookup functions
- `ISERROR` and `IFERROR` work in a similar way to the ones we have learned for `#N/A`
- The difference is that `ISERROR` and `IFERROR` can handle all kinds of Excel formula errors
- You may use them if your formula generates errors other than the ‘not available’ error