

Spreadsheets:

Good practice with lookups



The small print

Prerequisites

Time in the workshop is precious – it is an opportunity for you to interact with the workshop leader and other participants through questions and discussions and to share your experiences and concerns. To make the most of this time we sometimes ask you to carry out learning activities ahead of the workshop so that everyone comes into the class with the same basic knowledge. We keep this prior learning to a minimum and often make use of online videos. Online videos provided through LinkedIn Learning can be accessed free of charge by University members anytime, anywhere, through a browser or app.

Your course booking will tell you if any prior learning activity is required. If you don't have an environment where you can do this learning, you can come along to one of our LinkedIn Learning sessions. These are a quiet space where you can work through videos or other workshop resources.

If you arrive for a workshop without having done the prior learning, the workshop leader may suggest that you come back on another session.

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About the workshop designer

Graham Addis started his first technology role in 1978 and has gathered decades of practical experience in industry. He has always been passionate about passing on his knowledge and undertook his first formal teaching position as a Customer Training Specialist for Intel back in 1984. Since that time his career has combined extensive real world experience with teaching and mentoring. In 2017 he joined the academic world at the University of Oxford and currently specialises in teaching spreadsheets, databases and programming.

Revision history

Version	Date	Author	Comments
3.1	January 2023	Graham Addis	Convert to latest templates
3.0	July 2020	Graham Addis	Add XLOOKUP()
2.0	April 2020	Graham Addis	Convert to online format.
1.2	October 2019	Graham Addis	Update workbook references
1.1	August 2019	Duncan Young	Small print updates
1.0	September 2016	Traci Huggins	

About this workshop

This session will give you an insight into some of the techniques that can be used when dealing with spreadsheet lookups.

We will include pointers to other workshops and further resources that will help you go on later to analyse and organise your data.

What you will learn

You will learn a number of Excel techniques for dealing with lookups in different situations including the functions COUNTIF(), SUMIF(), VLOOKUP(), HLOOKUP(), LOOKUP(), MATCH() combined with INDEX() and XLOOKUP().

What you need to know

The ideas and techniques covered in this workshop will apply to a range of tools. We will demonstrate using *Excel for Windows*, which is widely available. However, the concepts will be the same, whatever spreadsheet software you decide to use.

I will assume that you are reasonably confident in using the tool you have chosen to use to create your spreadsheets. With your chosen tool, you will need to be able to:

- open and navigate around a workbook using the mouse and scrollbars, save a workbook
- add data to cells, and select and amend such data
- create a formula that calculates using values found in other cells
- Navigate the commands and menus, using Help as necessary

If you need to review these activities, LinkedIn Learning is a great place to get guidance. There is an activity with relevant videos in the IT Learning Portfolio: visit skills.it.ox.ac.uk/it-learning-portfolio and search for “Spreadsheets: Good practice with lookups (Activity)”.

The resources you need

Sample documents that you can use to experiment with will be made available, but you may like to bring along your own.

Unless you have been told otherwise, in classroom workshops there will be a computer available for you to use with *Excel for Windows* installed.

You can use your own computer with your preferred app installed if you want to – just bear in mind that I am not an expert in every app (although I am sure that between us we will be able to sort out most problems!).

Learning Objectives

This workshop has the following learning objectives:

Learning Objective One:..... COUNTIF & SUMIF

Learning Objective Two:.....VLOOKUP and HLOOKUP

Learning Objective Three:LOOKUP, MATCH and INDEX

Learning Objective Four:XLOOKUP

Learning Objective Five:XLOOKUP with tables

Learning Objective One: COUNTIF & SUMIF

Often you want to find all the items in a list or table that match some criteria you specify and simply count how many there are (“How many entries mention Scotland?”) or add up some numbers related to those entries (“What’s the total number of visitors for entries that mention Scotland?”).

In these situations, although it may ‘feel’ like a lookup of some kind, the best approach is to use the COUNTIF or SUMIF function as appropriate. Both need to know where your list is and what your criteria are, while SUMIF also needs to know where the related numbers are.

=COUNTIF(range,criteria)

=SUMIF(range,criteria,sum_range)

*Use these techniques to fill in the relevant gold coloured cells in exercise workbook **Lookup Exercises 1.xlsx** worksheets, “**Colours**” and “**Tourism**”.*



Learning Objective Two: VLOOKUP and HLOOKUP

If you want to search a table for a specific number (or piece of text) related to your search criteria you will need a lookup formula of some kind. The most commonly used functions are VLOOKUP and HLOOKUP, which are vertical and horizontal versions of the same thing.

=VLOOKUP(M2,Tourism,3,FALSE)

What are we looking for? (M2 – cell containing the lookup criteria, e.g. “Scotland”)

Which range contains all required columns/rows? (a named range like Tourism or cell references, e.g. \$A\$1:\$D\$25)

Which column of that range do we want if we find a match? (3 – the lookup column itself is always 1)

Is an approximate match allowed? (FALSE – must be an exact match, TRUE – if no exact match select nearest earlier item in sorted list)

*Use these techniques to fill in the relevant gold coloured cells in exercise workbook **Lookup Exercises 1.xlsx** worksheets “**Tourism**”, “**Schools**”, “**Discount**”, “**Populations**”, “**Tourism 2**” and “**Cricket**”.*



Learning Objective Three: LOOKUP, MATCH and INDEX

Sometimes you need to do a lookup where the results you want to retrieve are in a column (or row) to the left of (or above) the lookup column. V/HLOOKUP simply can't do this.

The LOOKUP function is not restricted in the same way and works with individual columns (or rows) instead of a table. The columns can be in the same table as each other, but do not need to be. However, LOOKUP requires the lookup column to be sorted and often this is undesirable.

A combination of MATCH and INDEX can be used to create a lookup unaffected by sort order or the position of the data to be retrieved.

=LOOKUP(criteria,lookup_range,result_range)

=MATCH(criteria,lookup_range,exact?)

=INDEX(lookup_range,row_num,column_num) [can have row & column, or either one]

=INDEX(B3:B27,MATCH(I3,F3:F27,0))

*Use these techniques to fill in the relevant gold coloured cells in exercise workbook **Lookup Exercises 2.xlsx** worksheets “**Mile (Women)**” and “**Mountains**”.*



Learning Objective Four: XLOOKUP

XLOOKUP() is a recent addition to Excel and is intended to replace the existing lookup functions.

The simplest invocation takes 3 parameters and defaults to requiring an exact match.

=XLOOKUP(lookup_value,lookup_array,return_array)

A fourth parameter provides an option for handling the condition where no value is found.

A fifth parameter adjusts the type of matching to allow the matching within a range of values.

*Use these techniques to fill in the relevant gold coloured cells in exercise workbook **Lookup Exercises 2.xlsx** worksheet "**Mile (Women) (2)**".*

Compare the results returned by the LOOKUP() function with those returned by the INDEX()/MATCH() combination.



Learning Objective Five: XLOOKUP with tables

Any form of lookup can be difficult to read but if the data being searched is formatted as an excel table understanding the formula afterwards is much easier.

For this exercise the lookup data is stored in a table, named **Discount** with the lookup range in the column **Lookup** and the result in the column **Rate**.

For this exercise the **Match_mode** is not the default, to mimic the 'approximate match' in H/VLOOKUP() a **Match_mode** of '-1' can be used. To enable this we need to use some of the optional parameters of XLOOKUP()

=XLOOKUP(lookup_value,lookup_array,return_array,if_not_found,Match_mode)

As we are not using the **if_not_found** parameter we can omit it by having nothing between the comments for that parameter.

*Use these techniques to fill in the relevant gold coloured cells in exercise workbook **Lookup Exercises 2.xlsx** worksheet "**Discount (2)**".*



Further information

Getting extra help

The IT Learning Centre offers bookable clinics where you can get pre- or post-course advice. Contact us using courses@it.ox.ac.uk.

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Some courses recommend pre- and/or post-course activities to support your learning. You can watch the online videos anywhere, anytime, and even download them onto a tablet or smartphone for off-line viewing.

About the IT Learning Portfolio online

Many of the resources used in the IT Learning Centre courses and workshops are made available as Open Educational Resources (OER) via our Portfolio website at skills.it.ox.ac.uk/it-learning-portfolio.

Find the pre-course activity for this course in the IT Learning Portfolio: visit skills.it.ox.ac.uk/it-learning-portfolio and search for “Spreadsheets: Good practice with lookups (Activity)”.

About the IT Learning Centre

The IT Learning Centre delivers over 100 IT-related teacher-led courses, which are provided in our teaching rooms and online, and we give you access to thousands of on-line self-service courses through LinkedIn Learning.

Our team of teachers have backgrounds in academia, research, business and education and are supported by other experts from around the University and beyond.

Our courses are open to all members of the University at a small charge. Where resources allow, we can deliver private courses to departments and colleges, which can be more cost-effective than signing up individually. We can also customize courses to suit your needs.

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About IT Customer Services

The IT Learning Centre is part of the Customer Services Group. The group provides the main user support services for the department, assisting all staff and students within the University as well as retired staff and other users of University IT services. It supports all the services offered by IT Services plus general IT support queries from any user, working in collaboration with local IT support units.

The Customer Services Group also offers a data back-up service; an online shop; and a computer maintenance scheme. Customer Services is further responsible for desktop computing services – for staff and in public/shared areas – throughout UAS and the Bodleian Libraries.

Spreadsheets: Good practice with lookups

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Resources for your learning

Activities for you to practice today

In the coursebook

Work at your own pace!

Be selective



Videos with today's topics

LinkedIn Learning

Follow-up work

Continue with exercises after the session

Bookable Course Clinics later

Contents

COUNTIF()

SUMIF()

VLOOKUP()/HLOOKUP()

LOOKUP()

MATCH() & INDEX()

XLOOKUP()

COUNTIF()

“How many cells in my range mention “Scotland”?

`=COUNTIF(A4:A40,"*Scotland*")`

Cornwall and Isles of Scilly
Devon
West Wales and The Valleys
East Wales
Eastern Scotland
South Western Scotland
North Eastern Scotland

	Scotland
COUNTIF	3

\$A\$4 – as you copy: fix column A and row 4

A4 – as you copy: adjust column and row

\$A4 – as you copy: fix column A, adjust row

A\$4 – as you copy: adjust column, fix row 4

SUMIF()

“What’s the score for that area in that year?”

`=SUMIF(A4:A40,"*Scotland*",B4:B40)`

Cornwall and Isles of Scilly	9,660,000
Devon	9,830,000
West Wales and The Valleys	9,880,000
East Wales	2,580,000
Eastern Scotland	7,140,000
South Western Scotland	4,300,000
North Eastern Scotland	1,390,000

	Scotland
SUMIF	12,830,000

Practical Session 1

Learning Objective	Workbook	Worksheet
One	Lookup Exercises 1.xlsx	Colours
One	Lookup Exercises 1.xlsx	Tourism (first exercises)

“What’s the score for that area in one of several years?”

VLOOKUP()

=VLOOKUP(M2,Tourism,3,FALSE)

	2004	2005	2006
Tees Valley and Durham	920,000	1,234,610	747,621
Northumberland and Tyne and Wear	2,780,000	3,923,864	2,685,638
Cumbria	5,560,000	8,177,968	6,876,359
Greater Manchester	3,550,000	3,021,982	2,670,461

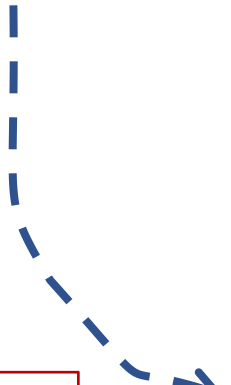
Name the lookup table area to make formula simpler

“MyTable” instead of “NameOfSheet!\$A\$1:\$E\$805”

Value searched for must be in first column

First column in list is number 1

What are we looking for? (M2 – cell containing required area)
Which range contains all required columns? (Tourism)
Which column of that range do we want if we find a match? (3)
Is an approximate match allowed? (FALSE – True by default!)



	VLOOKUP
Cumbria	8177968

HLOOKUP()

Same as VLOOKUP, just horizontal

`=HLOOKUP(B5,DisCalc,2,TRUE)`

Order Discount Calculator					
Discount boundary	£100	£1,000	£2,500	£5,000	£10,000
Discount rate	5%	10%	15%	20%	25%
Order value	1,500.00				
Discount rate	10%				
Discount amount	150.00				

Fourth argument is TRUE

Using boundaries in this range, not exact matches

Practical Session 2

Learning Objective	Workbook	Worksheet
Two	Lookup Exercises 1.xlsx	Discount
Two	Lookup Exercises 1.xlsx	Tourism (second exercises)
Two	Lookup Exercises 1.xlsx	Schools
Two	Lookup Exercises 1.xlsx	Populations
Two	Lookup Exercises 1.xlsx	Tourism 2
Two	Lookup Exercises 1.xlsx	Cricket

LOOKUP

A LOOKUP where the order of columns doesn't matter

`=LOOKUP(I3,F3:F27,B3:B27)`

Fastest Male Mile Runners					
Rank	Time	Place	Date	Nation	Athlete
1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Noureddine Morceli
4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
5	0:03:46.38	ISTAF Berlin	28-Aug-98	Kenya	Daniel Komen

Athlete	Time (Lookup)
Noah Ngeny	0:03:43.40

Search column must be in alphanumeric order

This can be an issue with ALL types of lookup

MATCH()

How far down a list does an item occur?

=MATCH(I3,F3:F27,0)

Fastest Male Mile Runners

Rank	Time	Place	Date	Nation	Athlete
1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Nouredine Morceli
4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
5	0:03:46.38	ISTAF Berlin	28-Aug-98	Kenya	Daniel Komen

Athlete	Match
Steve Cram	4

Final argument '0' means 'exact match required'

-1 allows nearest greater than

1 allows nearest less than

INDEX()

Which item occurs that far down a list?

=INDEX(D3:D27,4)

Fastest Male Mile Runners

Rank	Time	Place	Date	Nation	Athlete
1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Noureddine Morceli
4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
5	0:03:46.38	ISTAF Berlin	28-Aug-98	Kenya	Daniel Komen

Athlete	Match	Index
Steve Cram	4	27-Jul-85

MATCH() & INDEX()

A substitute for LOOKUP

`=INDEX(B3:B27,MATCH(I3,F3:F27,0))`

Fastest Male Mile Runners					
Rank	Time	Place	Date	Nation	Athlete
1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Noureddine Morceli
4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
5	0:03:46.38	ISTAF Berlin	28-Aug-98	Kenya	Daniel Komen

Athlete	Time (Ind/Mat)
Daniel Komen	0:03:46.38

Unaffected by sort order of search column

MATCH() & INDEX() – with wildcard

A substitute for LOOKUP – a ‘contains’ search

`=INDEX(B3:B27,MATCH("*"&I3&"*",F3:F27,0))`

Fastest Male Mile Runners

Rank	Time	Place	Date	Nation	Athlete
1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Nouredine Morceli
4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
5	0:03:46.38	ISTAF Berlin	28-Aug-98	Kenya	Daniel Komen

Athlete	Time (Ind/Mat)
Cram	0:03:46.32

Use “*” and & to make a ‘contains’ search

Practical Session 3

Learning Objective	Workbook	Worksheet
Three	Lookup Exercises 2.xlsx	Mile (Women)
Three	Lookup Exercises 2.xlsx	Mountains

XLOOKUP()

=XLOOKUP(I3,F3:F27,B3:B27)

	A	B	C	D	E	F
1	Fastest Male Mile Runners					
2	Rank	Time	Place	Date	Nation	Athlete
3	1	0:03:43.10	Golden Gala	07-Jul-99	Morocco	Hicham El Guerrouj
4	2	0:03:43.40	Golden Gala	07-Jul-99	Kenya	Noah Ngeny
5	3	0:03:44.39	Rieti Meeting	05-Sep-93	Algeria	Nouredine Morceli
6	4	0:03:46.32	Bislett Games	27-Jul-85	Great Britain	Steve Cram
7	5	0:03:46.38	STAF Berlin	28-Aug-98	Kenya	Daniel Komen

Function Arguments

XLOOKUP

Lookup_value I3 = "Steve Cram"

Lookup_array F3:F27 = {"Hicham El Guerrouj";"Noah Ngeny..."}

Return_array B3:B27 = {0.00258217592592593;0.002585648...}

If_not_found = any

Match_mode = number

= 0.002619444

Searches a range or an array for a match and returns the corresponding item from a second range or array. By default, an exact match is used.

Lookup_value is the value to search for.

Formula result = 0:03:46.32

[Help on this function](#)

OK Cancel

	I	J
2	Athlete	Time (XLOOKUP)
3	Steve Cram	0:03:46.32

XLOOKUP() with tables

=XLOOKUP(E2,Discount[Lookup],Discount[Rate],,-1)

Table:
Discount

	A	B
1	Lookup	Rate
2	£ 100.00	5%
3	£ 1,000.00	10%
4	£ 2,500.00	15%
5	£ 5,000.00	20%
6	£ 10,000.00	25%

Function Arguments

XLOOKUP

Lookup_value: E2 = 100

Lookup_array: Discount[Lookup] = {100;1000;2500;5000;10000}

Return_array: Discount[Rate] = {0.05;0.1;0.15;0.2;0.25}

If_not_found: = any

Match_mode: -1 = -1

= 0.05

Searches a range or an array for a match and returns the corresponding item from a second range or array. By default, an exact match is used.

Match_mode specify how to match lookup_value against the values in lookup_array.

Formula result = 5%

[Help on this function](#)

OK Cancel

	E	F	G	H
1	Value	Rate (XLOOKUP)	Discount	Total
2	£ 100.00	5%	£ 5.00	£ 95.00
3	£ 1,500.00		£ -	£ 1,500.00
4	£ 15,000.00		£ -	£ 15,000.00
5	£ 50.00		£ -	£ 50.00

Practical Session 4

Learning Objective	Workbook	Worksheet
Four	Lookup Exercises 2.xlsx	Mile Women (2)
Five	Lookup Exercises 2.xlsx	Discount (2)

Find the resources for this workshop in our IT Learning Portfolio

Download the files
(and more) from the
IT Learning Portfolio at

skills.it.ox.ac.uk/it-learning-portfolio



The screenshot shows the IT Learning Centre website. The header includes the logo and navigation links: COURSES, TEACHING ROOMS, SERVICES, EVENTS, NEWS, ABOUT US. The main heading is 'IT Learning Portfolio'. Below it, a welcome message states: 'Welcome to the IT Learning Portfolio of self-service resources. Below you will find a range of resources that you can download and use to develop your IT digital skills for study, research and work. This search tool is currently under construction, and is likely to improve soon - please contact us if you can't find what you need.' A section titled 'Using the resources' explains that many resources are publicly viewable and open to all visitors, while others are Oxford-only or require a University of Oxford Single Sign-On. A table of resources is displayed with filters for Audience, Category, Software, and Resource. The table lists various resources such as 3D modelling, Apps for education, AR/VR, Audacity, Beginners IT, Carpentry, Data analysis, Databases, and more, each with a right-pointing arrow icon.

Audience	Category	Software	Resource	
3D modelling: Kick-off AND Blender - Up and running (Activity)			After Effects: Animating texts and graphics (Activity)	➔
Apps for education (Activity)			AR/VR: Augmented Reality for mobile devices (Activity)	➔
AR/VR: Unity - a practical introduction (Activity)			AR/VR: Virtual Reality for desktop or mobile (Activity)	➔
Audacity - Recording your voice (Toolkit Activity)			Audacity: Recording the spoken word (Activity)	➔
Beginners IT: Making the most of single sign on (Course pack)			C++ - A comprehensive introduction (Course pack)	➔
Carpentry - Why would I use a corpus (Toolkit Activity)			Create an online presence with WordPress (Activity)	➔
Data analysis: ATLAS.ti (Activity)			Data analysis: Introduction to working with statistics (Course pack)	➔
Databases: Building a database (Activity)			Databases: Building a database (Course pack)	➔
Databases: Concepts for project managers (Activity)			Databases: Concepts for project managers (Course pack)	➔
Databases: Concepts of database design (Activity)			Databases: Concepts of database design (Course pack)	➔

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