

Logic in Excel

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Pilot version

Welcome

- this session is for 🎯🎯🎯 advanced Excel users, who are confident writing formulas
- if you can't access the chat, you might need to join our Teams channel:
tinyurl.com/kindnetwork
- you can find session materials at tinyurl.com/kindtrp

The KIND network

- a social learning space for staff working with knowledge, information, and data across health, social care, and housing in Scotland
- we offer social support, free training, mentoring, community events, ...
- Teams channel / mailing list

Session outline

- intro to logic in Excel
 - five minutes of Boolean algebra
 - basic logical functions (**NOT**, **AND**, **OR**)
 - putting logical functions to work with **IF** and **IFS**
- using logic in Excel
 - dealing with errors and missing values (**IFERROR**, **IFNA**, and friends)
 - managing different data types (**ISNUMBER** and friends)
 - conditional summarising (**SUMIF**, **COUNTIFS**, and friends)
 - nesting **IF** statements and future-proofing your work

Pilot version

Boolean algebra

- the standard way of working with truth-values
 - found all over mathematics, logic, computer science...
- think of a statement like "my cat is blue"
 - call that **P** to save writing it every time
- assume that **P** is either completely **TRUE** or completely **FALSE**

NOT

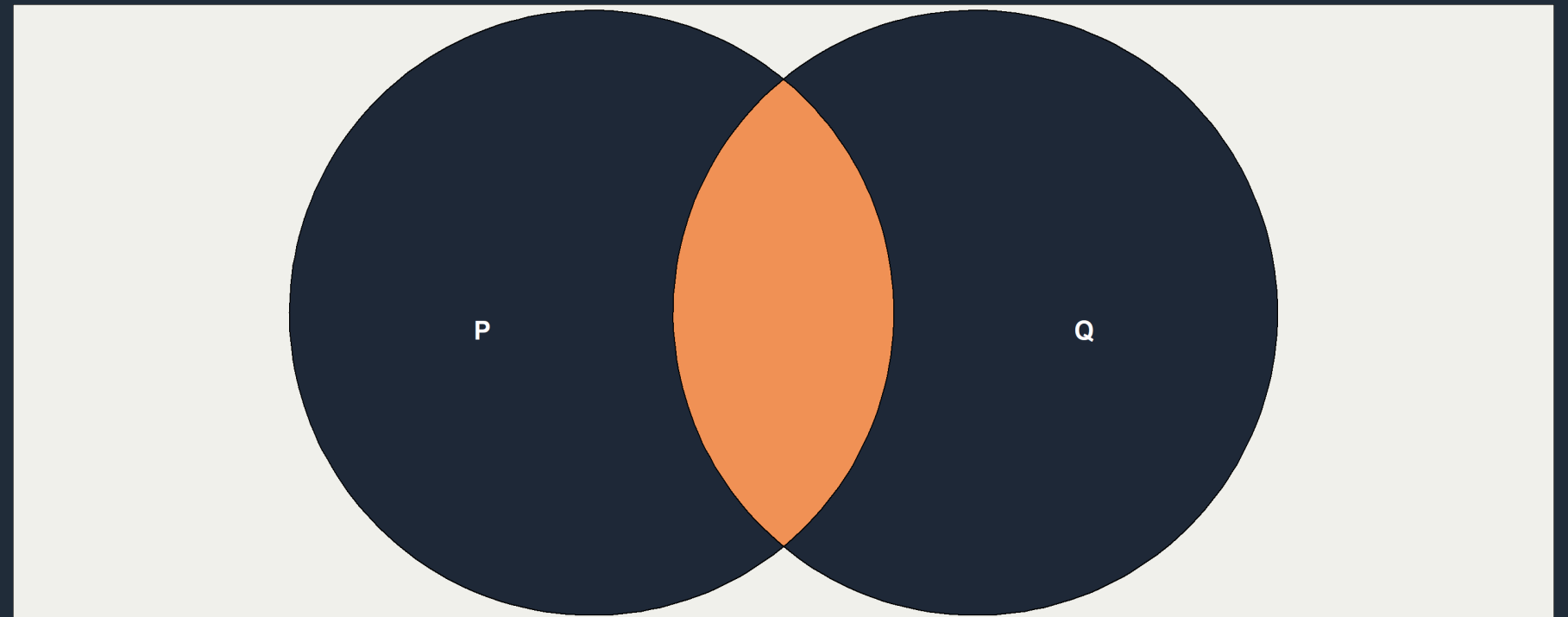
- **NOT** gives us the opposite truth-value
- if **P** is **FALSE**, then **NOT P** is **TRUE**
- a useful shorthand: the **truth table**:

P	NOT P
TRUE	FALSE
FALSE	TRUE

AND

- we also have functions to understand what happens when we're dealing with two statements
- **AND** is a great example - it's **TRUE** when both the statements are **TRUE**

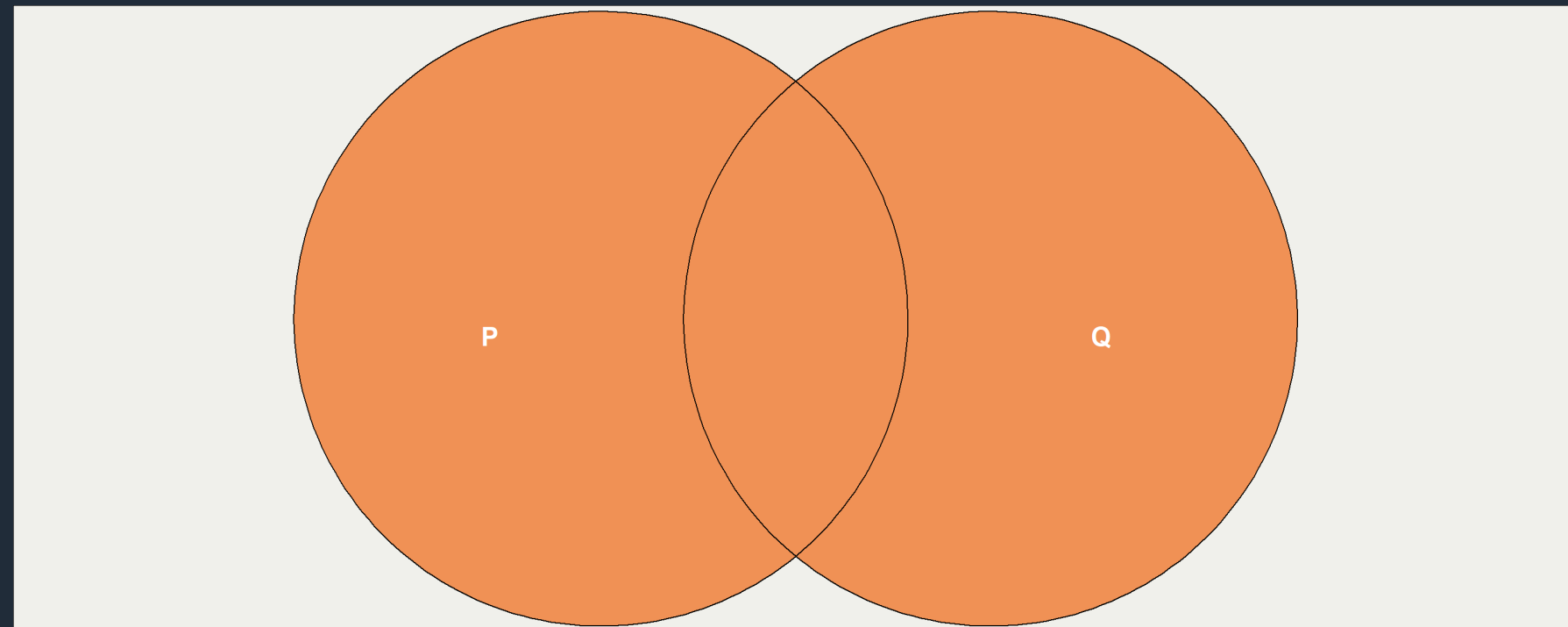
P	Q	P AND Q
TRUE	TRUE	TRUE
TRUE	FALSE	FALSE
FALSE	TRUE	FALSE
FALSE	FALSE	FALSE



OR

- **OR** is **TRUE** when either of the statements are **TRUE**

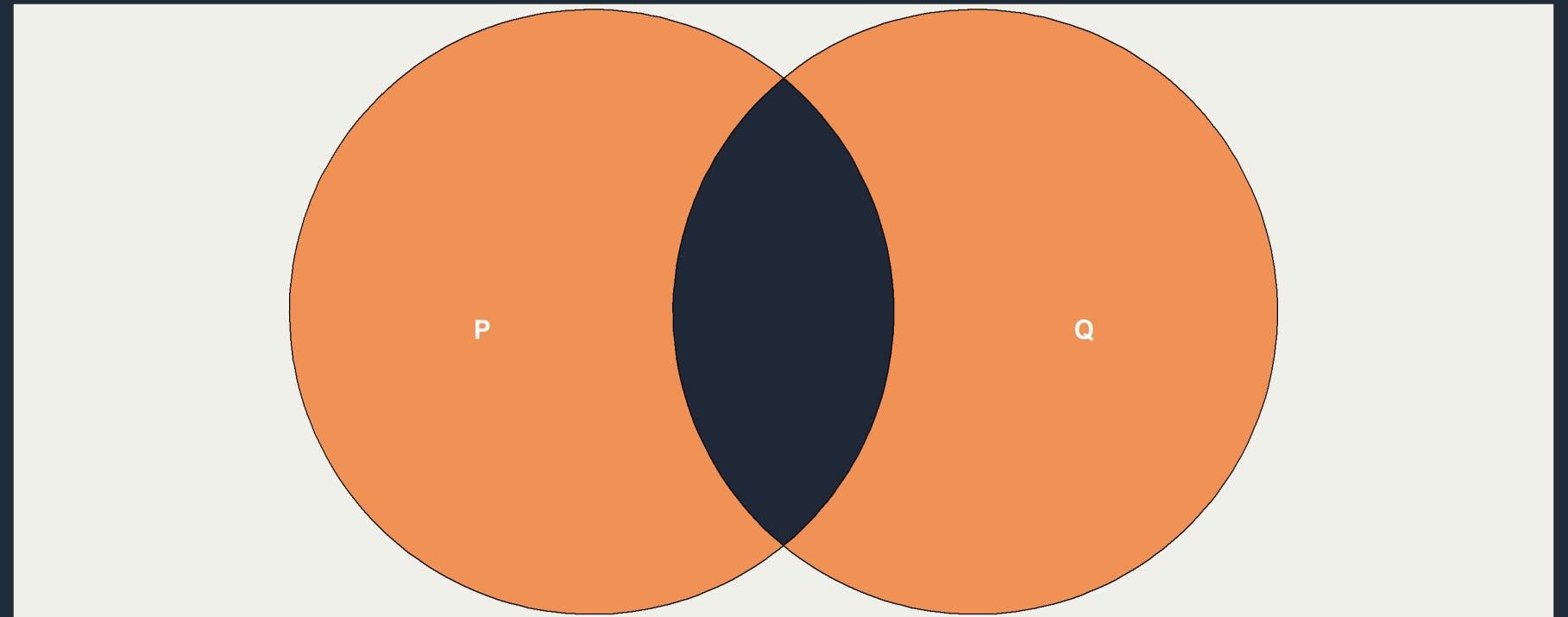
P	Q	P OR Q
TRUE	TRUE	TRUE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE



XOR

- For completeness, we should also talk about **XOR**
- **XOR** is **TRUE** when either of the statements - but not both - are **TRUE**

P	Q	P XOR Q
TRUE	TRUE	FALSE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE



NOT in Excel

- sweet relief: please open the sample workbook for this session in Excel
- have a look at the NOT worksheet
 - NOT() function inputs in the truth-table
 - example use about inhalers
 - note that NOT() will treat any number as TRUE, and 0 as FALSE

Task

- please add a formula to decide whether a person is a non-user of inhalers or not
- it should return TRUE/FALSE based on the number of inhalers used

AND and OR in Excel

- have a look at the **AND / OR** worksheet
 - have a look at the truth-table for **AND** and **OR**
 - specifically, look at the formulas and the way they use **AND()** and **OR()**

Task

- in the hypertension/diabetes table, you've got several rows of data where each represents a person. Please write two formulas:
 - for diet and lifestyle, you'll want to return **TRUE** if a person has either hypertension and/or diabetes
 - for statins, you'll want to return **TRUE** if a person has both hypertension and diabetes

IF

- unfortunately our data usually doesn't come neatly coded into **TRUE** and **FALSE**
- that mean we'll usually need to use our basic logical functions in combination with other functions
- **IF** is a great example of a function that helps you convert to logical values
- here's an example formula: `=IF(B3 > 150, "Hypertension", "No hypertension")`
 - if the value in B3 is over 150, the formula returns "Hypertension"
 - otherwise it returns "No hypertension"

IF

- this is useful in its own right, but gets even more powerful when you return logical values
- have a look at the top table on the **IF** worksheet

Task

- in the **IF** worksheet, there's an incomplete table of blood pressure values
- please write a formula to return **TRUE** if those values are over 150, and **FALSE** otherwise
- there's a named cell on this sheet called **Cutoff** - please now change that 150 in your **IF** formula to use the value of the named cell

TRUE and FALSE are 1 and 0

- many other tools let you add up TRUE/FALSE values as if they were 1s and 0s
- this can be very useful - say, to quickly count matching values
- Excel needs a minor workaround: add -- before a logical value to treat it as a number:
`=SUM(--Table1[Hypertension?])`

IFS

- **IFS** allows you to check for the presence of several conditions fairly concisely
- an example: `=IFS(B4 = TRUE, "High", C4 = "CRD", "High", D4 > 20, "High", TRUE, "Low")`
 - read this horror as pairs of arguments, like `B4 = TRUE, "High"`
 - each pair contains
 - a logical test - like `B4 = TRUE`
 - a return value if that test is `TRUE` - like `"High"`
 - the final pair of arguments are a catch-all to pick up all non-matched values

Public service announcement

- just because you can, doesn't mean you should
- **IFS** get pathologically complicated
- pivot tables might be better for more complicated cases

IFNA, IFERROR, and friends

- these functions are great for dealing with errors and missing values
- that's useful, because (understatement of the decade) Excel isn't very good at consistently dealing with errors and missing values

IS and IF functions

- **IS****** functions detect errors and missing values and return **TRUE/FALSE**
- **IF****** functions detect, and then:
 - if an error is found display a message of your choice
 - otherwise just repeat the value they refer to

What do they detect?

The image shows a screenshot of an Excel spreadsheet. In the top-left cell, the formula bar contains the text "=IS". A dropdown menu is open below the formula bar, listing various Excel functions. The function "ISBLANK" is highlighted in blue. To the right of the dropdown menu, a tooltip box contains the text: "Checks whether a reference is to an empty cell, and returns TRUE or FALSE".

Function	Description
ISBLANK	Checks whether a reference is to an empty cell, and returns TRUE or FALSE
ISERR	
ISERROR	
ISEVEN	
ISFORMULA	
ISLOGICAL	
ISNA	
ISNONTTEXT	
ISNUMBER	
ISODD	
ISOMITTED	
ISOWEEKNUM	

The important ones

- BLANK = “There’s no value in that cell”
- ERROR = “This formula doesn’t work properly”
- #N/A = “I can’t find what I was asked to find”
- ERR = “A non-N/A error has happened”

SUMIF and COUNTIF

- basically, **IF** plus summary functions
- three simple-ish examples to see

Real life examples

Sincere thanks and appreciation to people who volunteered formulas for this section:

- Gail Young (NHS Greater Glasgow & Clyde)
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- Irene Ventura (NHS Lanarkshire)
- Peter Wild (NHS Ayrshire & Arran)
- Chris Spratt (NHS National Services Scotland)

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