1. **Basics of formulas and functions**
   1. **Formula vs Function**
   2. **Basic arithmetic**
   3. **Comparison operators**
   4. **Working with text**
   5. **Elements of a function** 
      1. **RAND()**
      2. **FORMULATEXT()**
      3. **VLOOKUP()**
      4. **SUMIFS()**
   6. **Cell references**
2. Working with named ranges and tables
   1. Formula manager
   2. Benefits of named ranges
   3. Working with tables – Table time!
      1. Power Query vs formulas
3. Let’s get logical: IF(), SUMIF() and more
   1. IF() statement
   2. AND/OR/NOT
   3. Conditional IF statements
   4. IFS()
4. Dynamic arrays
   1. What are they?
   2. Some examples
   3. XLOOKUP() is the duct tape of Excel
   4. Dynamic plots with dynamic arrays
5. **Formula design & audit**
   1. **Building more readable functions**
      1. **White space!**
      2. **Do not repeat yourself**
      3. **Ditch nested Ifs()**
      4. **Don’t fear the helper column**
      5. **No hard codes**
   2. Ways to audit formulas
      1. Ctrl + `
      2. Formulatext
      3. Trace dependents
      4. Ctrl + Enter
      5. Partially evaluate with F9
6. LET(), LAMBDA() and the future of Excel
   1. You can build anything! It’s not going away

## Named ranges and tables

How can we fill this in?

Graphical user interface, application, table

Description automatically generated

* Option A: One-at-a-time add the formula
* Option B: Used absolute references and drag the formulas over
* Option C: Give everything a name and operate on those names
  + Use either Formulas > Name Manager or the upper-left hand cell reference
  + Start typing the formula and hit tab to complete the desired object name
  + We will now have fixed\_cost + (variable\_cost \* units\_sold) and complete the entire analysis in one swoop:

Table

Description automatically generated with medium confidence

### Excel tables

What are some reasons to love Excel tables?

1. You **must** have column headers
   1. Ctrl + T to insert a table
   2. Table does NOT have headers
   3. You can dynamically refer to the headers. For example, let’s see how we could automatically convert these all to upper-case:

=UPPER(Table1[#Headers])

* 1. Or maybe we want to know the column position of the “island” variable:

=MATCH("island", Table1[#Headers], 0)

1. You must have a table name
   1. Go to the name manager and rename to penguins
   2. And now these references will point to penguins not Table1
2. They look good
   1. Table Design > Table Styles
   2. Also Table Style options, we will work on Totals later
   3. Everything is formatted for you – and it stays that way!
3. You can add and delete data easily
   1. Go ahead and add and delete some rows and columns, look how everything is expanded
      1. Do a RANDBETWEEN() to see how easy that was for a new column
      2. Manually insert a row and see how that is updated instantly
4. No rewriting formulas
   1. Take the sum of one of the columns and see how it doesn’t move! Even when we add new rows
5. We can point to data by name, not location
   1. Divide one of the columns by the other – how does this work?
6. We can easily work with totals
   1. Play around with the totals and see how easy it is
   2. Also show how this is NOT going to mess up other formulas
   3. Change different summary methods at the bottom
7. Portal into PivotTables & Power Query
   1. Let’s quickly demonstrate how to get in there

### IF() statements

Let’s practice on the commissions worksheet

* Column D: We can find which rep has >50 clients with a simple IF() statement: =IF(C2>50,"Yes","No")
* Column F: We want to basically “back out” the region from the District. If region is 1, 3 or 5, it’s District A, otherwise B.
  + This is like an IF() statement but with one more layer:
  + =IF(OR(E2=1, E2 = 3, E2 = 5),"A", "B")
* We could also combine this with a NOT() statement to find which stores are new, i.e. NOT old:
  + =IF(NOT(OR(E2=1,E2=2)),"X","")
* Finally, we could use an AND() statement to meet multiple criteria:
  + Column I: =IF(AND(B2>75000,H2>4.75),"X","")
  + Let’s practice on Column J: How can we flag which reps have fewer than 40 clients and a satisfaction score of <4?
    - =IF(AND(C2<40,H2<4),"X","")
* Return to slides to cover IFS()
* Let’s calculate the commission using the commission schedule over to the side. Based on a certain satisfaction score the rep gets a certain commission
  + We can do this gracefully with IFS():

=IFS(H2>4.5,0.1,

H2>4.25,0.05,

H2>4,0.03,

TRUE,0)

### IFS() and conditional aggregation

* =SUMIF(F2:F16,"A",B2:B16)
* =COUNTIF(C2:C16,">50")
* =AVERAGEIF(H2:H16,"> 4.7",L2:L16)
* =AVERAGEIF(H2:H16,">= 4.7",L2:L16)
* =COUNTIFS(L2:L16,">5000",H2:H16,">4.5",C2:C16,">50")
* =SUMIFS(L2:L16,E2:E16,4,B2:B16,">50000")
* =AVERAGEIFS(L2:L16,C2:C16,"<50",H2:H16,">4.0")

### LET(), LAMBDA() and the future of Excel

Let’s write the quadratic formula using 3 options in Excel.

1. Using formulas alone. The {-1, 1} is used to multiply by both -1 and 1 at the same time:

= (-$B$2 - {-1,1} \* SQRT($B$2^2 - 4 \* $B$1\* $B$3)) / (2 \*$B$1)

Not every elegant, right?! Let’s try NOT repeating ourselves with the LET() function:

=LET(a,B1,

b,B2,

c,B3,

(-b - {-1,1} \* (SQRT(b^2- 4\*a\*c)))/(2\*a))

Definitely getting better! Also we should definitely be including whitespace like this eh? 😊

Let’s see if we can do one better and actually create a new FUNCTION that we can reuse and get this stuff.

=LAMBDA(a,b,c,

(-b+{-1,1}\*SQRT(b^2-4\*a\*c))/

(2\*a))

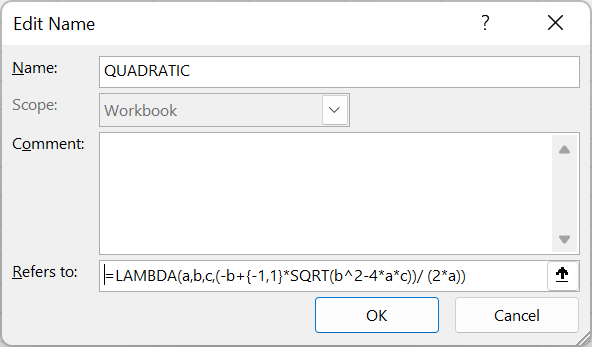
We can evaluate it on our data like so:

=LAMBDA(a,b,c,

(-b+{-1,1}\*SQRT(b^2-4\*a\*c))/

(2\*a))(B1,B2,B3)

It’s a little counterproductive to write this function and then have to keep copy-pasting it every time we want to use it, so to get around this we can actually save our LAMBDA() function in the Name Manager!



Ifs statements – resources

* <https://corporatefinanceinstitute.com/resources/excel/ifs-function-in-excel/>