More programming

Decision structures, controlling flow

More complex algorithms: actions that depend on decisions

- The simple algorithms we've learned so far just do the same thing repeatedly, regardless of the result
- We can implement more complicated programs if we are able to have the program do different things depending on what is happening
- Also useful for checking for error conditions

If...then

- If...then statements allow you to execute different commands depending on a logical test
- We've seen these as functions in Excel

  =if(a2=b2, c2*d2, 2*c2*d2)
- In a macro, we embed the actions if true and actions if false between an “If...End if” statement
- Anything between the If and the End If will only be calculated if the If is true

Example: calculate the mean head length for male bears

- First as pseudo-code: a set of instructions that describe the procedure that you program will use
  - English, human-readable
  - Focus on the design, not the implementation

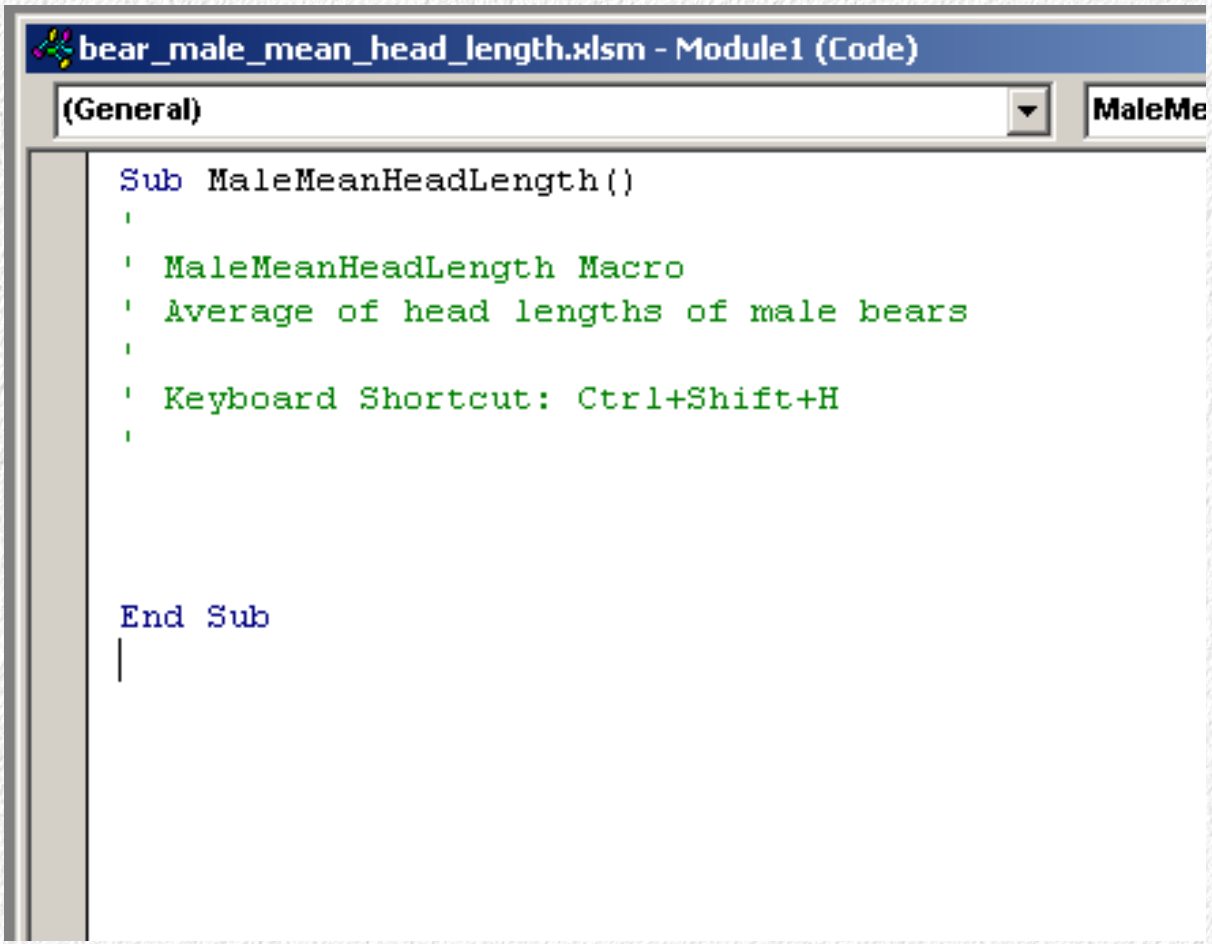
- Check if the bear is a male
- If yes, add the head length
- Add one to the counter
- Divide the head length total by the counter

	A	B	C	D	E	F	G	H	I	J	K	L
1	ID	Age	Month	Sex	Head.L	Head.W	Neck.G	Length	Chest.G	Weight	Obs.No	Name
2	39	19	7	Male	10	5	15	45	23	65	1	Allen
3	41	19	7	Female	11	6.5	20	47.5	24	70	1	Berta
4	41	20	8	Female	12	6	17	57	27	74	2	Berta
5	41	23	11	Female	12.5	5	20.5	59.5	38	142	3	Berta
6	41	29	5	Female	12	6	18	62	31	121	4	Berta
7	43	19	7	Male	11	5.5	16	53	26	80	1	Clyde
8	43	20	8	Male	12	5.5	17	56	30.5	108	2	Clyde
9	45	55	7	Male	16.5	9	28	67.5	45	344	1	Doc
10	45	67	7	Male	16.5	9	27	78	49	371	2	Doc
11	48	81	9	Male	15.5	8	31	72	54	416	1	Quincy
12	69		10	Male	16	8	32	77	52	432	1	Kooch
13	83	115	7	Male	17	10	31.5	72	49	348	1	Charlie
14	83	117	9	Male	15.5	7.5	32	75	54.5	476	2	Charlie
15	83	124	4	Male	17.5	8	32	75	55	478	3	Charlie
16	83	140	8	Male	15	9	33	75	49	386	4	Charlie
133	677	83	11	Male	15.5	8	30.5	75	54	514	1	Ian
134	679		11	Male	15.5	7.5	25.5	73.5	43	324	1	Larry
135	681		11	Male	14.5	7	22	67.5	38	196	1	Scott
136	683	18	6	Male	12.5	8.5	18	57.3	32.8	140	1	Grizz
137	909		8	Female	12	5	18	56	32.5	114	1	Sara
138	911		8	Male	12	5.5	15	51	24	82	1	Lou
139	907		8	Female	13	6	22	61	40	230	1	Molly
140	555	31	7	Male	15.5	6	23	69	42.5	290	4	Gary
141	555	31	7	Male	15.5	6	23	69	42.5	289	5	Gary
142	692		7	Male	12	4	17.5	59	28.5	128	1	Graham
143	694		7	Male	13.5	6	20	62	32.5	156	1	Jeffrey
144	657		8	Male	16.5	6.5	30	72	49	398	2	Curt
145												

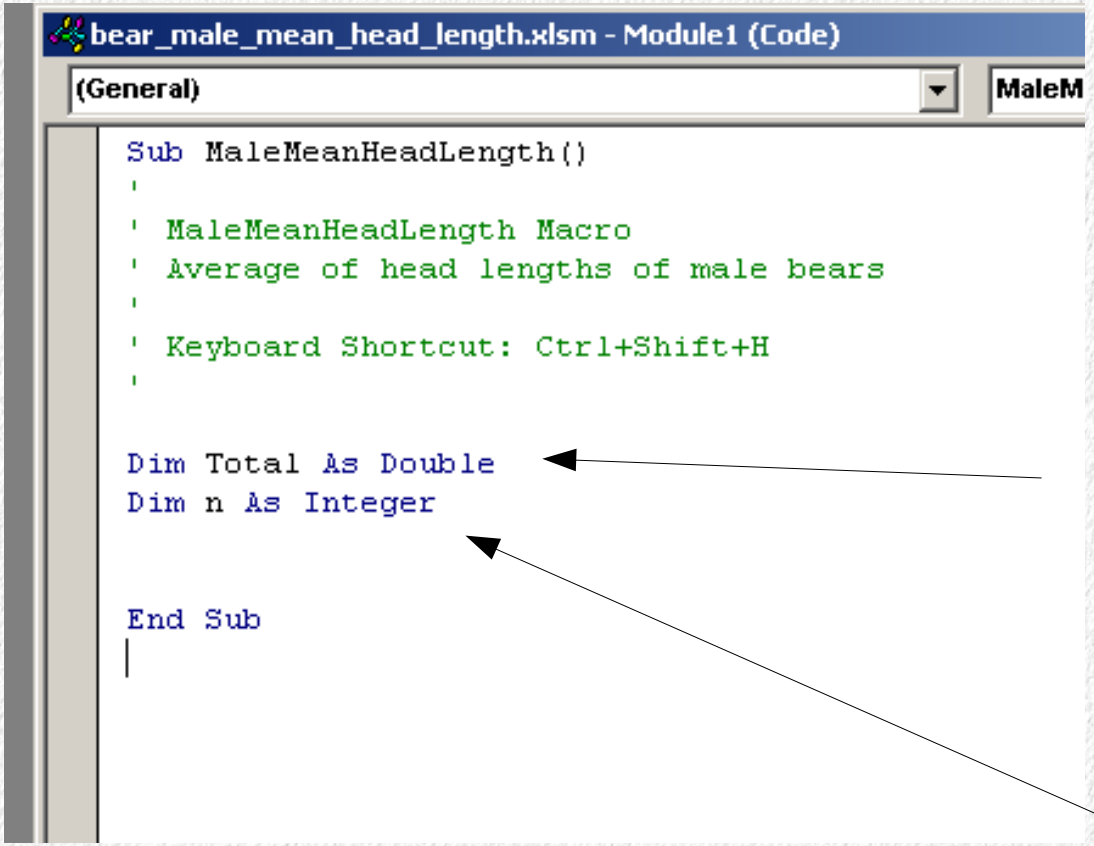
Implementing the macro

- In Excel, open the file
- Note the column with sex and head length
- Note the rows that start and end the data
- Start the macro recorder, give the macro a name and shortcut key, then stop the recorder
- Open the macro, and write...

Macro with no code



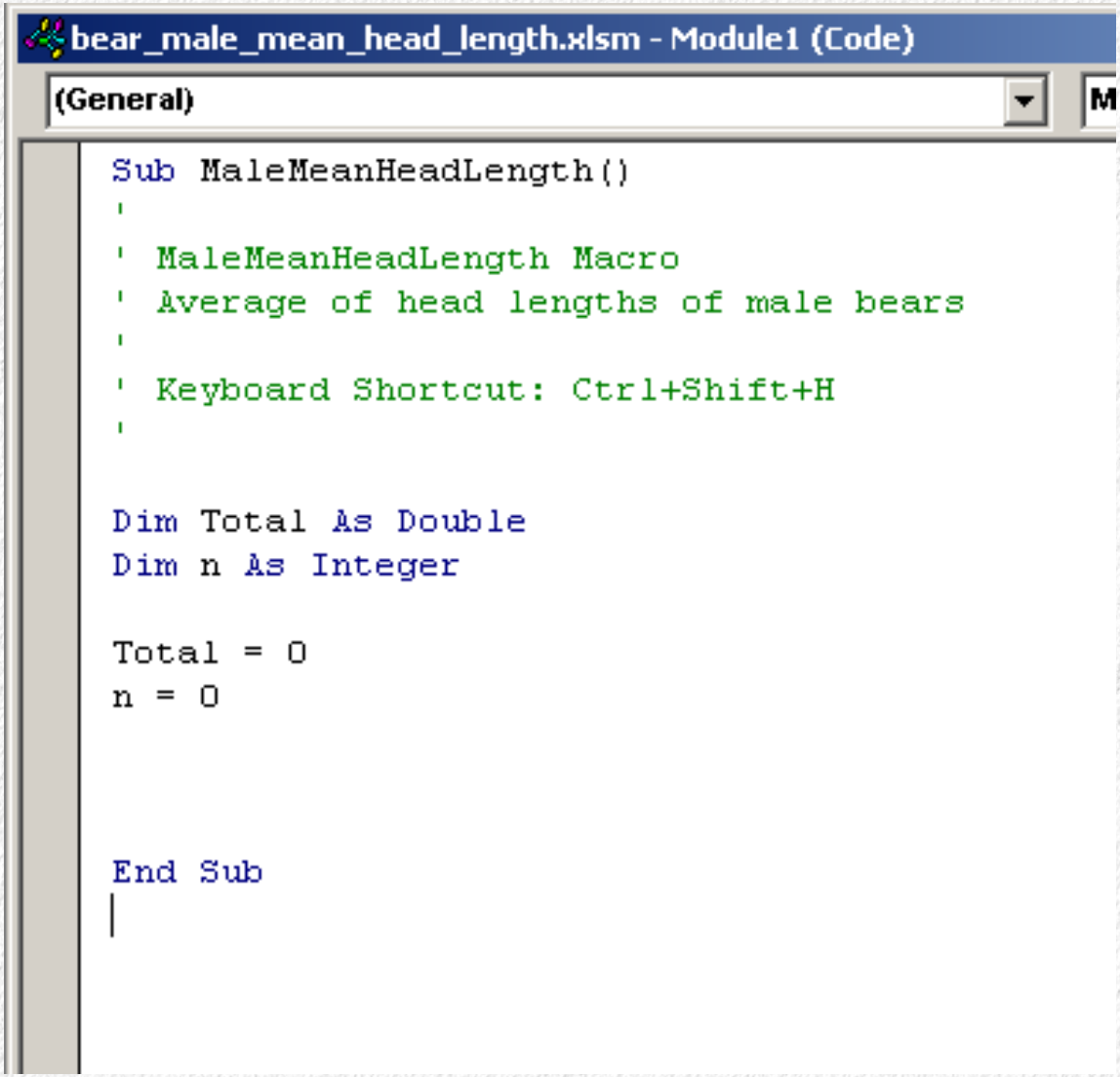
Need a place for the sum and count



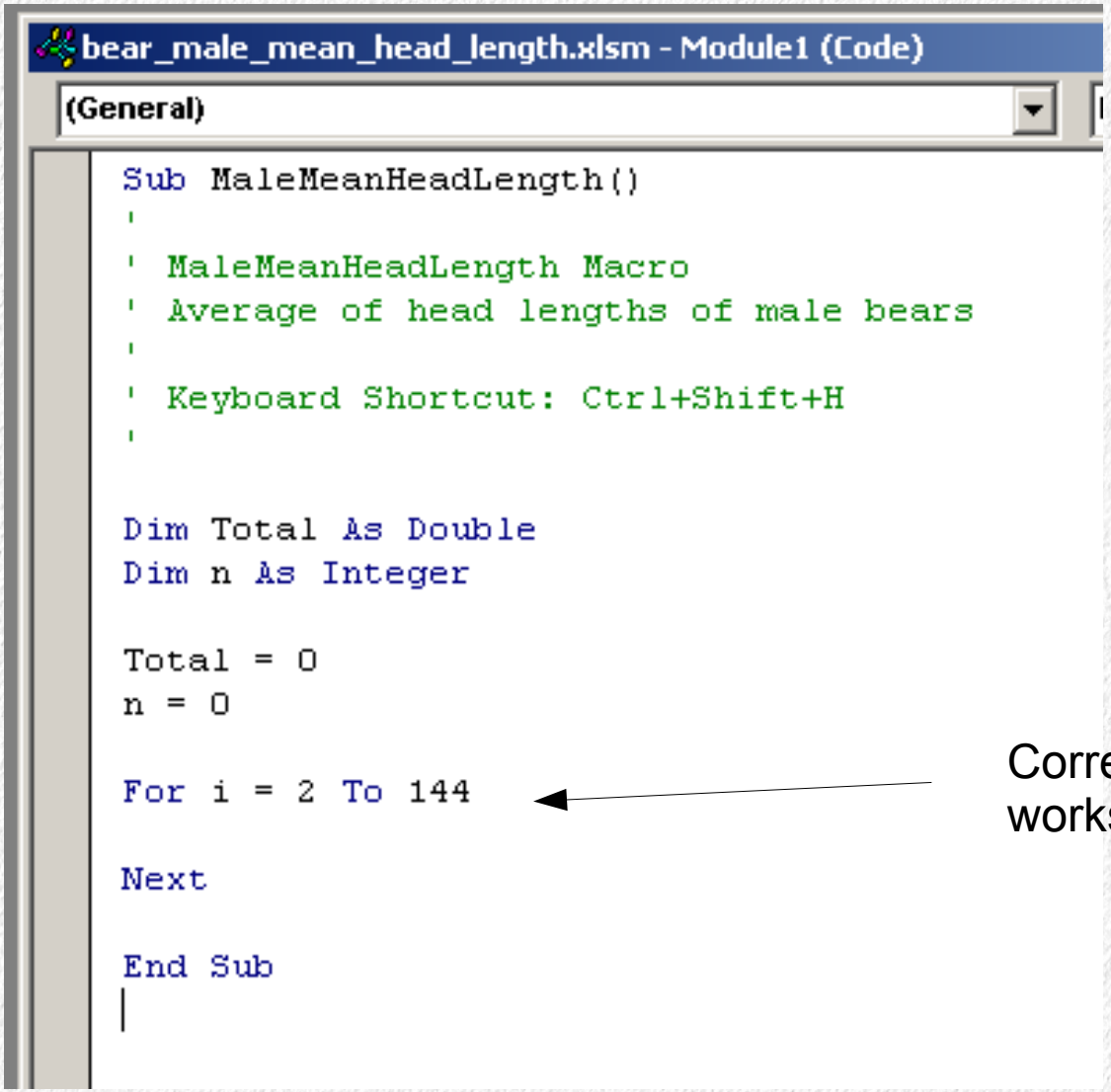
Total – the total of head lengths
Dim = “dimension” - names a variable and defines its data type
As Double = the variable will be a double-precision floating point number

n = sample size of males
This will be a count, so data type can be integer

Set the sum and count to 0 to start



Add a loop



Corresponds with the rows in the worksheet with data

Add to total and n only if it's a male

bear_male_mean_head_length.xlsm - Module1 (Code)

(General) MaleMeanHea

```
Sub MaleMeanHeadLength()
'
' MaleMeanHeadLength Macro
' Average of head lengths of male bears
'
' Keyboard Shortcut: Ctrl+Shift+H
'

Dim Total As Double
Dim n As Integer

Total = 0
n = 0

For i = 2 To 144
    If Range("D" & i).Value = "Male" Then
        Total = Total + Range("E" & i).Value
        n = n + 1
    End If
Next

End Sub
```

Calculate the mean, report the result

bear_male_mean_head_length.xlsm - Module1 (Code)

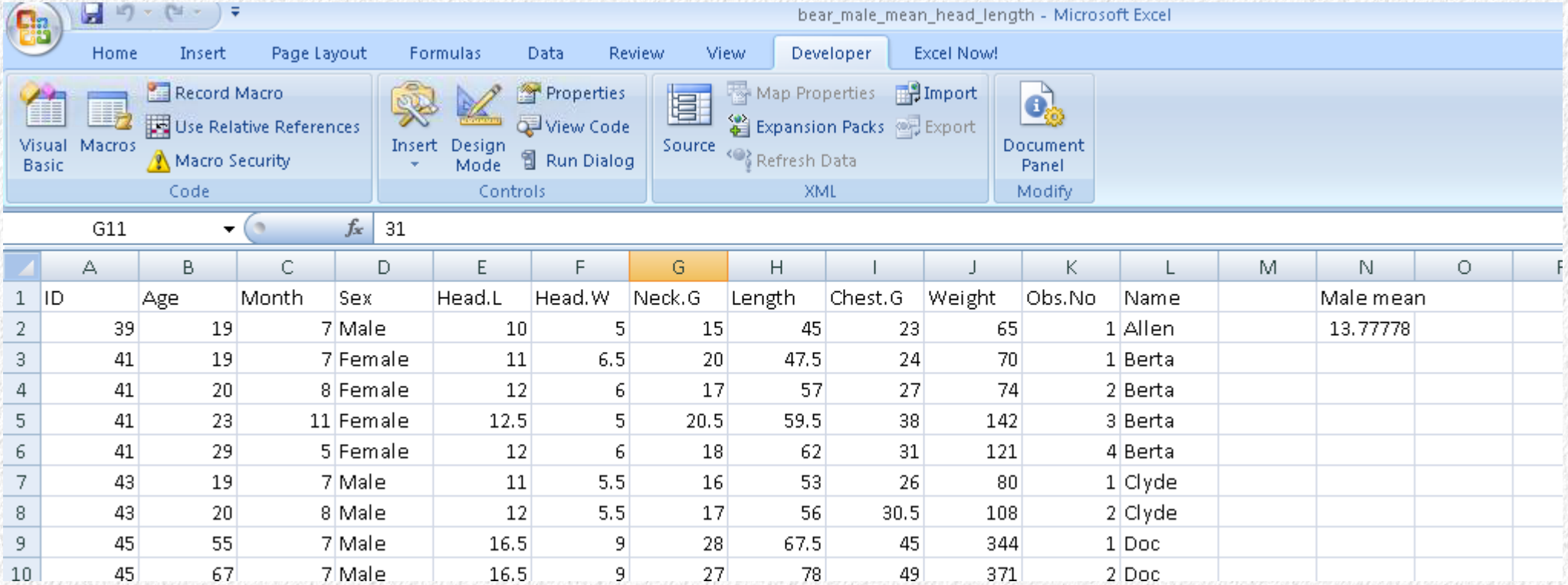
(General) MaleMeanHe

```
Sub MaleMeanHeadLength()
'
' MaleMeanHeadLength Macro
' Average of head lengths of male bears
'
' Keyboard Shortcut: Ctrl+Shift+H
'

Dim Total As Double
Dim n As Integer

Total = 0
n = 0

For i = 2 To 144
    If Range("D" & i).Value = "Male" Then
        Total = Total + Range("E" & i).Value
        n = n + 1
    End If
Next

Range("N1").Value = "Male mean"
Range("N2").Value = Total / n

End Sub
```

Label the output in cell N1

Calculate and assign the mean to cell N2

Run it ...



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID	Age	Month	Sex	Head.L	Head.W	Neck.G	Length	Chest.G	Weight	Obs.No	Name		Male mean	
2	39	19	7	Male	10	5	15	45	23	65	1	Allen		13.77778	
3	41	19	7	Female	11	6.5	20	47.5	24	70	1	Berta			
4	41	20	8	Female	12	6	17	57	27	74	2	Berta			
5	41	23	11	Female	12.5	5	20.5	59.5	38	142	3	Berta			
6	41	29	5	Female	12	6	18	62	31	121	4	Berta			
7	43	19	7	Male	11	5.5	16	53	26	80	1	Clyde			
8	43	20	8	Male	12	5.5	17	56	30.5	108	2	Clyde			
9	45	55	7	Male	16.5	9	28	67.5	45	344	1	Doc			
10	45	67	7	Male	16.5	9	27	78	49	371	2	Doc			

Step through the code – debugging

- To see what it's doing, we'll add a couple of pieces of “debugging code” - things that help you figure out what the program is doing, but that aren't needed if everything is working okay
  - We'll report Total, n, and i for each run through the loop
- Then, we'll use F8 to step through the lines of code one at a time and see how these values change as we move through

Debugging code

```
Dim Total As Double
Dim n As Integer

Total = 0
n = 0

Range("N5").Value = "Total"
Range("N6").Value = "n"
Range("N7").Value = "i"

For i = 2 To 144
    Range("D" & i).Select
    If Range("D" & i).Value = "Male" Then
        Total = Total + Range("E" & i).Value
        n = n + 1
    End If
    Range("O5").Value = Total
    Range("O6").Value = n
    Range("O7").Value = i
Next

Range("N1").Value = "Male mean"
Range("N2").Value = Total / n

End Sub
```

Label the outputs
Once, before the loop

Select the cell being tested
Each time through the loop

Put the values in the spreadsheet
Each time through the loop

```
Range("N5").Value = "Total"
Range("N6").Value = "n"
Range("N7").Value = "i"

For i = 2 To 144
    Range("D" & i).Select
    If Range("D" & i).Value = "Male" Then
        Total = Total + Range("E" & i).Value
        n = n + 1
    End If
    Range("O5").Value = Total
    Range("O6").Value = n
    Range("O7").Value = i
Next

Range("N1").Value = "Male mean"
Range("N2").Value = Total / n

End Sub
```

What's the difference between these?

Let's walk through this in Excel...

If...then...else

- If's can be made more flexible with an “Else” statement
- Currently, we have a single operation that's done if the If condition is true
- We can have another operation that executes if the If condition is false
- We can do the female mean at the same time

```
Dim MTotal As Double
Dim Mn As Integer
Dim FTotal As Double
Dim Fn As Integer

MTotal = 0
Mn = 0
FTotal = o
Fn = 0

For i = 2 To 144
    If Range("D" & i).Value = "Male" Then
        MTotal = MTotal + Range("E" & i).Value
        Mn = Mn + 1
    Else
        FTotal = FTotal + Range("E" & i).Value
        Fn = Fn + 1
    End If
Next

Range("N1").Value = "Male mean"
Range("N2").Value = MTotal / Mn
Range("O1").Value = "Female mean"
Range("O2").Value = FTotal / Fn

End Sub
```

Male and female versions of total and n

Initialize all to 0

Will this always work???

What to do if the If is FALSE

Male and female means labeled, calculated, and reported

```
Dim MTotal As Double
Dim Mn As Integer
Dim FTotal As Double
Dim Fn As Integer

MTotal = 0
Mn = 0
FTotal = o
Fn = 0

Range("O4").Value = "Male"
Range("P4").Value = "Female"
Range("N5").Value = "Totals"
Range("N6").Value = "n's"
Range("N7").Value = "i"

For i = 2 To 144
    Range("D" & i).Select
    If Range("D" & i).Value = "Male" Then
        MTotal = MTotal + Range("E" & i).Value
        Mn = Mn + 1
    Else
        FTotal = FTotal + Range("E" & i).Value
        Fn = Fn + 1
    End If
    Range("O5").Value = MTotal
    Range("O6").Value = Mn
    Range("O7").Value = i
    Range("P5").Value = FTotal
    Range("P6").Value = Fn

Next

Range("O1").Value = "Male mean"
Range("O2").Value = MTotal / Mn
Range("P1").Value = "Female mean"
Range("P2").Value = FTotal / Fn

End Sub
```

With debugging code

Let's see how it works...

If...then...elseif

- Can use this structure for cases in which we have more than one If criteria
  - In Excel, we did this by using an additional “if()” in place of the “else”
  - In VBA, we will add an “Elseif” statement after the first “If”
- Example: add a column for season of observation to bear data

Seasons

- We only have months, not dates
- Need to check each month, and set the "Season" column to:
  - Winter if Month = 1,2,3
  - Spring if Month = 4,5,6
  - Summer if Month = 7,8,9
  - Fall if Month = 10,11,12
  - Blank if Month is blank

The code

```
Sub Seasons()
'
' MaleMeanHeadLength Macro
' Average of head lengths of male bears
'
' Keyboard Shortcut: Ctrl+Shift+H
'
Dim m As Integer

Range("M1").Value = "Season"

For i = 2 To 144
    Range("C" & i).Select
    m = Range("C" & i).Value
    If m >= 1 And m <= 3 Then
        Range("M" & i).Value = "Winter"
    ElseIf m >= 4 And m <= 6 Then
        Range("M" & i).Value = "Spring"
    ElseIf m >= 7 And m <= 9 Then
        Range("M" & i).Value = "Summer"
    ElseIf m >= 10 And m <= 12 Then
        Range("M" & i).Value = "Fall"
    Else
        Range("M" & i).Value = ""
    End If

Next


End Sub
```

For debugging

Makes the code easier to read

This will work as long as there are no months below 1 or greater than 12

Let's see how it works...

Select case

- When you have a series of conditions to check, with different operations for each, you can use “Select Case” as an alternative to “If...then...elseif”
- The season example as a “Select Case”

Seasons with select case

```
Sub Seasons()
'
' MaleMeanHeadLength Macro
' Average of head lengths of male bears
'
' Keyboard Shortcut: Ctrl+Shift+H
'
Dim m As Integer

Range("M1").Value = "Season"

For i = 2 To 144
    Range("C" & i).Select
    m = Range("C" & i).Value
    Select Case m
        Case Is >= 10
            Range("M" & i).Value = "Fall"
        Case Is >= 7
            Range("M" & i).Value = "Summer"
        Case Is >= 4
            Range("M" & i).Value = "Spring"
        Case Is >= 1
            Range("M" & i).Value = "Summer"
        Case Else
            Range("M" & i).Value = ""
    End Select

Next


End Sub
```

For debugging

Makes the code easier to read

Try it out...