Programming IV

Making decisions in code

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: cross-tabulating the caterpillar data

- To get the counts of butterflies that chose clean or EA air based on their training we need to count the combinations of treatment and response
- That is, how we count the adult response depends on what the caterpillar treatment was
- How do we do this in code?

	A	B	C	
1	Moth ID	Treatment	Adult responses	Ra
2	1	Trained to avoid EA	Chose clean air	
3	2	Trained to avoid EA	Chose clean air	
4	3	Trained to avoid EA	Chose clean air	
5	4	Trained to avoid EA	Chose clean air	
6	5	Trained to avoid EA	Chose clean air	
7	6	Trained to avoid EA	Chose clean air	
8	7	Trained to avoid EA	Chose clean air	
9	8	Trained to avoid EA	Chose clean air	
10	9	Trained to avoid EA	Chose clean air	
11	10	Trained to avoid EA	Chose clean air	
12	11	Trained to avoid EA	Chose clean air	
13	12	Trained to avoid EA	Chose clean air	
14	13	Trained to avoid EA	Chose clean air	
15	14	Trained to avoid EA	Chose clean air	
16	15	Trained to avoid EA	Chose clean air	
17	16	Trained to avoid EA	Chose clean air	
18	17	Trained to avoid EA	Chose clean air	
19	18	Trained to avoid EA	Chose clean air	
20	19	Trained to avoid EA	Chose clean air	
21	20	Trained to avoid EA	Chose clean air	
22	21	Trained to avoid EA	Chose clean air	
23	22	Trained to avoid EA	Chose clean air	
24	23	Trained to avoid EA	Chose clean air	

If...then...end if statements – making decisions in code

- If...then...end if statements evaluate if a condition is true
  - If the condition is true the code between then and end if is executed
  - If it is not nothing is done
- We can use this to work our way through the rows, and for each animal check if it was trained to avoid EA or was a control

Example: using If...then...end if

```
If Range("B" & i).Value = "Trained to avoid EA" Then
    adClean_trEA = adClean_trEA + 1
End If
```

Check the treatment type

Do a thing if it's a Trained to Avoid EA animal

Variables

- In addition to using spreadsheet cells we can define variables in code
- For example, to count how many of the animals that chose clean air had been trained to avoid EA air we could define an variable to hold this value:

  Dim adClean_trEA As Integer

  defines a variable and assigns it a data time
- We can only assign data of the correct type to this variable
  - Assigning floating point number will drop the decimal
  - Assigning text will result in an error message

Assignment to variables

- Just like with Excel cells, we can assign values to variables using =

  adClean_trEA = adClean_trEA + 1

  takes the current value of adClean_trEA and adds 1 to it, then assigns it back into adClean_trEA
- This adds 1 to the count

To get a count of every combination of training type and adult choice...

- We need a variable for each choice:

  Dim adClean as Integer

  Dim adEA as Integer
- We need a count of how many of the adults that chose clean air were trained to avoid EA

  Dim adClean_trEA as Integer
- We need a count of how many of the adults that chose EA air were trained to avoid EA air

  Dim adEA_trEA as Integer
- We can get the other combinations by subtracting
  - Number that chose clean air in the control group is adClean – adClean_trEA
  - Number that chose EA air in the control group is adEA – adEA_trEA

Initialize the variables

- When you define a variable you can't be certain of what its value is initially
- After defining a variable, it's best to assign it a starting value

  adClean = 0
  adEA = 0
  adClean_trEA = 0
  adEA_trEA = 0

- Now we can work through the data and count up these variables

First If – check if the adult decision was “Chose clean air”

```
For i = 2 To 88
    If Range("C" & i).Value = "Chose clean air" Then
        adClean = adClean + 1
        If Range("B" & i).Value = "Trained to avoid EA" Then
            adClean_trEA = adClean_trEA + 1
        End If
    Else
        adEA = adEA + 1
        If Range("B" & i).Value = "Trained to avoid EA" Then
            adEA_trEA = adEA_trEA + 1
        End If
    End If

Next i
```

If it chose clean air add 1 to the count

If it was trained to avoid EA add 1 to the count

Second (“nested”) If – check if it also was trained to avoid EA

```
For i = 2 To 88
    If Range("C" & i).Value = "Chose clean air" Then
        adClean = adClean + 1
        If Range("B" & i).Value = "Trained to avoid EA" Then
            adClean_trEA = adClean_trEA + 1
        End If
    Else
        adEA = adEA + 1
        If Range("B" & i).Value = "Trained to avoid EA" Then
            adEA_trEA = adEA_trEA + 1
        End If
    End If

Next i
```

First If – check if the adult decision was “Chose clean air”

Else – executed if the If… returns FALSE (and thus chose EA)

If it chose EA add 1 to the count

If trained to avoid EA add 1 to the count

Second (“nested”) If – check if it also was trained to avoid EA

Recording the results back to Excel

- We can assign the counts to Excel cells
- adClean – adClean_trEA is the number that chose clean air that were in the control group
- adEA – adEA_trEA is the number that chose EA that were in the control group

```
Range("I18") = adClean - adClean_trEA
Range("J18") = adClean_trEA
Range("K18") = adClean
Range("I19") = adEA - adEA_trEA
Range("J19") = adEA_trEA
Range("K19") = adEA
```

25	32
21	9

Add some labeling, row and column totals…

```
Range("I17") = "Control"
Range("J17") = "Trained to avoid EA"
Range("K17") = "Total"
Range("H17") = "Adult choices:"
Range("H18") = "Chose clean air"
Range("H19") = "Chose EA air"

Range("I20") = Range("I18").Value + Range("I19").Value
Range("J20") = Range("J18").Value + Range("J19").Value
Range("K20") = Range("K18").Value + Range("K19").Value

End Sub
```

Completed table

Moth ID	Treatment	Adult responses	Random numbers	Bootstrap sample
1	Trained to avoid EA	Chose clean air	1	Chose clean air
2	Trained to avoid EA	Chose clean air	38	Chose EA air
3	Trained to avoid EA	Chose clean air	14	Chose clean air
4	Trained to avoid EA	Chose clean air	39	Chose EA air
5	Trained to avoid EA	Chose clean air	9	Chose clean air
6	Trained to avoid EA	Chose clean air	13	Chose clean air
7	Trained to avoid EA	Chose clean air	36	Chose EA air
8	Trained to avoid EA	Chose clean air	29	Chose clean air
9	Trained to avoid EA	Chose clean air	1	Chose clean air
10	Trained to avoid EA	Chose clean air	13	Chose clean air
11	Trained to avoid EA	Chose clean air	13	Chose clean air
12	Trained to avoid EA	Chose clean air	2	Chose clean air
13	Trained to avoid EA	Chose clean air	20	Chose clean air
14	Trained to avoid EA	Chose clean air	15	Chose clean air
15	Trained to avoid EA	Chose clean air	17	Chose clean air
16	Trained to avoid EA	Chose clean air	35	Chose EA air
17	Trained to avoid EA	Chose clean air	17	Chose clean air
18	Trained to avoid EA	Chose clean air	6	Chose clean air
19	Trained to avoid EA	Chose clean air	22	Chose clean air
20	Trained to avoid EA	Chose clean air	12	Chose clean air
21	Trained to avoid EA	Chose clean air	29	Chose clean air

Count of Bootstrap sample	Column Labels		
Row Labels	Control	Trained to avoid EA	Grand Total
Chose clean air	32	26	58
Chose EA air	14	15	29
Grand Total	**46**	**41**	**87**

Odds of choosing clean air	2.285714286	1.733333333
Odds ratio	0.758333333	
Lower	1.254901961	
Upper	9.743589744	

Since the lower limit is greater than 1 butterflies remember what they learn as caterpillars

↑Pivot table counts match the macro's counts↓

Adult choices:	Control	Trained to avoid EA	Total
Chose clean air	25	32	57
Chose EA air	21	9	30
	46	41	87

Your turn

- You will write this macro in your bootstrap Excel sheet