## **Commercial Greenhouse**

# **Data Analysis Practical**



Brought to you in partnership with CQUniversity Australia and Rabobank







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### **Option 1 - Primary school activity**





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QUESTION: What day had the highest temperature recorded in the greenhouse?

#### QUESTION: What day had the lowest temperature recorded in the greenhouse?

QUESTION: Which was the x-axis (horizontal axis) and what did you label it?

#### Sample data

Date	Time	Humidity	Temperature (inside)
25/06/2017	12:00:00	75.9	17.7
25/06/2017	12:05:00	77.0	17.4
25/06/2017	12:10:00	77.0	17.3
25/06/2017	12:15:00	78.0	16.9
25/06/2017	12:20:00	78.0	17.0
25/06/2017	12:25:00	78.0	16.9
25/06/2017	12:30:00	79.0	16.7
25/06/2017	12:35:00	78.1	16.5
25/06/2017	12:40:00	78.0	16.7

QUESTION: How frequently was data being recorded in the greenhouse?

QUESTION: Write down what observations the farmer was making in the greenhouse?





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There are ideal conditions for growing Oriental lilies. When those conditions are not met, the farmer receives an alert

Date	Humidity alert	Temperature alert
25-Jun	okay	okay
26-Jun	okay	okay
27-Jun	okay	ALERT
28-Jun	okay	okay
29-Jun	okay	okay
30-Jun	okay	okay
01-Jul	ALERT	ALERT
02-Jul	ALERT	ALERT
03-Jul	okay	okay
04-Jul	okay	okay
05-Jul	okay	okay
06-Jul	okay	okay
07-Jul	okay	okay
08-Jul	okay	okay
09-Jul	okay	okay
10-Jul	okay	ALERT

QUESTION: How many days had a "Humidity alert"?

QUESTION: How many days had a "Temperature alert"?

QUESTION: What should happen when there is an alert?





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### **Option 2 - High school activity**

1. Open up the "Avonlea Greenhouse dataset" in Excel and select the "Data" tab.

In this tab is all of the greenhouse data for growing oriental lilies.

#### Creating a Pivot Table

A **pivot table** is a table of statistics that summarize the data of a more extensive table. This summary might include sums, averages, or other statistics, which the pivot table groups together in a meaningful way. For this data set, we are after the average of each variable per day.

- 2. Add a new blank tab by selecting the button next to the "Data" tab at the bottom of your workbook.
- **3.** Insert a pivot table.

To do this, select the "Insert" tab, then select "Pivot table" and press "OK"

AutoSa	ive 💽 Off		୯					
File	Home	Insert	Page La	yout	Formula	as Data	a Revie	w View
PivotTabl	e Recomm PivotTa	nended Table	Picture	s Online Picture	e Shapes	lcons Mc	3D 3D odels ▼	martArt creenshot <del>•</del>
	Tables	;			I	llustrations		
A1	Ŧ	: ×	$\checkmark f_x$					
4	A	в	C   1	0	E	F	G	н
1								
2								

A pop up box will appear called "Create PivotTable"



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7.5	217.0	
4	217.0	
7.5	217.0	Create PivotTable ? X
.6	217.0	Choose the data that you want to analyze
.6	217.0	Select a table or range
6	217.0	Table/Range: Sheet1/\$4\$1/\$G\$4322
7.5	217.0	
7.4	217.0	
7.4	217.0	choose connection
7.5	217.0	Connection name:
7.5	217.9	O USE LINS WORKDOOK S Data MOUER
.4	218.0	Choose where you want the PivotTable report to be placed
.3	218.0	O New Worksheet
.6	218.0	Existing Worksheet
.6	218.0	Location: 'Pivot Table'!\$A\$1
7.7	218.0	Choose whether you want to analyze multiple tables
7.8	218.0	Add this data to the Data <u>M</u> odel
7.8	218.0	OK Cancel
7.8	218.0	
7.9	218.0	

Click the arrow at the end of the box next to "Table/Range".

#### A new pop up box will appear.



Now, select all the data in the "Data" tab





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On the right hand side of your screen, the "PivotTable Fields" table appears as below

PivotTable Fields		- ×
Choose fields to add to report:		<⊘> ▼
Search		ρ
Date Time Humidity Temperature (inside) Light Light Accumulation (sum) More Tables		
<b>T</b> Filters	III Columns	
Rows	$\Sigma$ Values	
Defer Layout Update		Update





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4. Create your pivot table

In the top section, check the boxes next to "Date", "Month", "Humidity" and "Temperature (inside)".

Make sure all the others are unchecked.

✓ Date
✓ Time
✓ Humidity
✓ Temperature (inside)
🗌 Light
Light Accumulation (sum)
Months
Hours
More Tables

For the four fields in the bottom section make sure your categories are as follows

Drag fields between areas be	low:
▼ Filters	III Columns
	∑ Values 💌
■ Rows	$\Sigma$ Values
Months 🔻	Average of Humidity 🔻
Date 🔻	Average of Temperatu 🔻

#### Notes:

You can move selection criteria to another field by dragging and dropping the selection criteria from one field to another.

You can also have a selection criteria in more than one field by clicking on the criteria in the top box (with check marks) and dragging it down to the second field box you want it in.

You will notice that when you check humidity and temperature Excel will automatically put them in to the "Values" field as "Sum of Humidity", etc.

For this analysis we do not want "Sum of..." but rather "Average of..."





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#### To update the variable from Sum to Average.

Select the arrow next to the selection criteria (eg. "Sum of Humidity")



#### Select "Value Field Settings" at the bottom of the list.



A pop up window will appear. Select "Average" in the list, then "OK"







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Your excel worksheet will now look like this

	А	В	С	D	
1	Row Labels 💌	Average of Humidity	Average of Temperature (inside)		
2	<b>⊞ Jun</b>	82.15295718	18.42810764		
3	∎Jul	77.25586194	18.47193984		
4	Grand Total	79.2142467	18.45441102		
5					
6					
7					
0					

To view all of the dates, select the "+" sign to the left of "Jun" and "July"

Now you can visualise the average humidity and temperature recordings for each of the days recorded.

	А	В	С	D
1	Row Labels 🔻	Average of Humidity	Average of Temperature (inside)	
2	■Jun	82.15295718	18.42810764	
3	25-Jun	78.06253472	18.68159722	
4	26-Jun	77.468125	18.05850694	
5	27-Jun	78.62892361	17.13902778	
6	28-Jun	77.68854167	18.169375	
7	29-Jun	99.788125	19.32815972	
8	30-Jun	81.28149306	19.19197917	
9	■Jul	77.25586194	18.47193984	
10	01-Jul	71.26357639	17.28309028	
11	02-Jul	69.5109375	16.76128472	
12	03-Jul	74.24288194	19.3225	
13	04-Jul	81.43006944	19.52461806	
14	05-Jul	82.0853125	19.38104167	
15	06-Jul	80.33743056	17.99375	
16	07-Jul	79.07420139	19.01979167	
17	luL-80	80.15715278	18.23486111	
18	09-Jul	77.19194444	18.73052083	
19	10-Jul	79.92	17.32	
20	Grand Total	79.2142467	18.45441102	
21				
22				



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Note:

If your data does not look like this, your "**Rows**" in the "**PivotTable Fields**" may be around the wrong way. Make sure that "**Months**" is above "**Date**" and if not drag one above or below the other.

5. Open and label a new tab (for your pivot table data) called "Summary data"

Highlight all the data in your pivot table, copy and "paste as values" into your new tab



(right click and select "paste as values")

6. Remove the rows "Jun", "Jul" and "Grand Total"

#### Note:

Delete multiple rows by clicking the row number for each row you want to delete. You can select multiple rows by holding down "**Ctrl**" as you select them. Once selected, **right click** your mouse and select "**Delete**"

								2	lun			82.152957
								з 🗸	( (	Cu <u>t</u>		78.062534
								4 [[	<u>}</u>	ору		77.468
A20 *	X V fx	Grand Total						5 🖻	h	Paste Op	tions:	78.62892
A	В	с	D	E	F	G	н	6				77.68854
1 Row Labels Av	erage of Humidity Av	verage of Temperature (inside)						-	- L			00 700
2 Jun	82.15295718	18.42810764								_		55.700
3 25-Jun 4 26-Jun	77.468125	18.68159722						8	F	Paste <u>S</u> pe	cial	81.28149
5 27-Jun	78.62892361	17.13902778										
6 28-Jun	77.68854167	18.169375						9		nsert		77.25586
7 29-Jun	99.788125	19.32815972										71 26257
8 30-Jun	81.28149306	19.19197917								<u>)</u> elete		/1.2033/
9 Jul	77.25586194	18.47193984										69.5109
10 01-Jul	71.26357639	17.28309028						_	(	Clear Co <u>n</u>	tents	
11 02-Jul	69.5109375	16.76128472						1.				74.24288
12 03-Jul	74.24288194	19.3225						1	: F	Format Ce	ells	01 40000
13 04-Jul	81.43006944	19.52461806							-			81.43000
15 06-Jul	80 33743056	17 99375						1.	F	Row Heig	ht	82,0853
16 07-Jul	79.07420139	19.01979167						-	-			02.0000
17 08-Jul	80.15715278	18.23486111						1.	H	lide		80.33743
18 09-Jul	77.19194444	18.73052083							-			70.07400
19 10-Jul	79.92	17.32						1	1	Inhide		/9.0/420
0 Grand Total	79.2142467	18.45441102						1	2			80 15715
21									00 5	un		00.13713.
22								10 /	na i	l.		77 1010/



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#### Graphing your data

Next we will **create a scatter with straight line and markers graph** plotting temperature and humidity over time.

1. Insert a scatter graph

Select all the data in your new tab.

Then select "Insert" and click on the Line Graph icon



Then select the "Line with markers" option



2. Add a secondary axis

We want the humidity data to be on a different axis to the temperature data.

To do this click on your graph and select the humidity data line so that it is highlighted.

Then, select the "Design" tab and select "Change Chart Type"

File Home	Insert Page Layout Formulas Data Review View Help Acrobat Design Format 🔎 Search			
Add Chart Quick		Switch Row/ Select	Change Chart Type	Move
Chart Layouts	Chart Styles	Data	Туре	Location





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A pop up window will appear. Check the "Secondary Axis" check box next to "Average of Humidity"

Change Chart Type		? >	×			
Recommended Charts All	I Charts					
Recommended Charts     All <ul> <li>Recent</li> <li>Templates</li> <li>Column</li> <li>Line</li> <li>Pie</li> <li>Bar</li> <li>Area</li> <li>X Y (Scatter)</li> <li>Map</li> <li>Stock</li> <li>Surface</li> <li>Radar</li> </ul>			-			
Treemap	ины плин					
🕲 Sunburst	Sunburst Choose the chart type and axis for your data series:					
Histogram	Series Name Chart Type S	econdary Axis	5			
야면 Box & Whisker [편] Waterfall 당 Funnel	Average of Humidity       Scatter with Straight         Average of Temperature (       Scatter with Straight					
	ОК	Cancel				

#### Select "OK"

Your graph should look similar to this.





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**3.** Add axis titles to graph

To add axis titles to your graph, click on your graph, select the + symbol at the top right corner.





Give your "Chart", "X" and "Y" axes appropriate titles.

Hint: Think about what your column names are and what you have graphed.





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#### Identifying imperfect growing conditions

Humidity and temperature are controlled in the greenhouse in order to grow oriental lilies.

The ideal growing conditions for oriental lilies are

- Humidity: 70-80%, max of 95%
  - We are going to create an alert if the humidity is < 72%
- Temperature: 18-21°C, min of 15°C, max of 26°C
  - We are going to create an alert if the temperature < 17.5C

Using the ideal conditions above, we can create some alerts in Excel to advise us when these conditions were not met.

1. Add new columns

For our graphed dataset, add two column headings

Column D = "Temperature Alert"

Column E = "Humidity Alert"

Also, rename Column A from "Row Labels" to "Date"

2. Calculate an alert for Temperature

To do this we need to create an equation which can identify when the temperature falls below 17.5C.

These statements are called "**IF**" **statements** and allow us to make a comparison between a value and what that value actually means.





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#### How do IF statements work?

An IF statement is like a yes/no or TRUE/FALSE question.

They are known as a type of 'logical formula':

#### IF, then, else

**IF** something is true, **THEN** do this, **ELSE** do that.

In Microsoft Excel, IF statements are made up of three parts: the statement, a value to return if TRUE, and a value to return if FALSE

In our example above,

#### =IF(C3=C2, "",C3)

We are comparing one value in the 'hour' column (cell C2) to the value in the row above it (cell C3).

IF the values are the same, THEN the formula will return a blank cell (designated as "").

IF the values are different, ELSE the formula will return the hour value in cell C2.

Another example of an "IF" statement is marking an assessment where a student either gets less than 50 and they fail, or higher than 50 and they pass.

C2	<b>*</b>	:	×	f <sub>x</sub>	=IF(B2<=	50,"Fai	I","Pass") <	
		A		В	С	D	E	F
1	Student Nam	ne		Scores	Result			
2	BRUCE GEYER	2		37	Fail	-		
3	ELIZABETH ST	FERN		73	Pass		Criteria	Result
4	MASATOSHI	HEND	DERSON	62	Pass		Below or Equal to 50	Fail
5	CHRISTINE YO	OSHIN	MURA	43	Fail		Above 50	Pass
6	JOHN ADAMS	SON		35	Fail			
7	<b>IRVING PIAN</b>	KA		86	Pass			
8	EILEEN HAAS			81	Pass			
9	VINCENZO K	WAN		50	Fail			
10								
11								



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In regard to the temperature of our greenhouses we expect that if temperature is below 17.5C then this is not an ideal growing conditions for Oriental lilies.

Our alert with the "IF" statement, will tell us on which days temperature was "okay" and which days the temperature was not and the farmer should be alerted to go and check on the greenhouse.

```
In Cell D2 type =IF(B2<17.5,"ALERT", "okay")
```

After typing in the formula in cell D2, press enter and copy the formula into the remaining cells.

You can copy a formula by clicking on the cell, then clicking on the green square in the bottom right hand corner of the cell and dragging down to the last cell you want to copy the formula to (in our case cell D17).

You should have something that looks like Column D below.

$\therefore$ $\checkmark$ $\checkmark$ $f_x$	=IF(B17<)	L7.5,"ALERT","Okay")		
В		с	D	
Average of Temperatur	e (inside)	Average of Humidity	Temp alert	Η
1	8.68159722	78.06253472	Okay	
1	8.05850694	77.468125	Okay	
1	7.13902778	78.62892361	ALERT	
	18.169375	77.68854167	Okay	
1	9.32815972	99.788125	Okay	
1	9.19197917	81.28149306	Okay	
1	7.28309028	71.26357639	ALERT	
1	6.76128472	69.5109375	ALERT	
	19.3225	74.24288194	Okay	
1	9.52461806	81.43006944	Okay	
1	9.38104167	82.0853125	Okay	
	17.99375	80.33743056	Okay	
1	9.01979167	79.07420139	Okay	
1	8.23486111	80.15715278	Okay	
1	8.73052083	77.19194444	Okay	
	17.32	79.92	ALERT	







3. Calculate an alert for humidity

Repeat for humidity where

#### In cell E2 type =IF(C2<72,"ALERT", "okay")

After typing in the formula in cell E2, press enter and copy the formula into the remaining cells in column E.

E2	E2 • : × ✓ f <sub>x</sub> =IF(C2<17.5, "ALERT", "okay")				
	А	В	С	D	E
1	Date	Average of Humidity	Average of Temperature (inside)	Humidity alert	Temperature alert
2	25-Jun	78.06253472	18.68159722	okay	okay
3	26-Jun	77.468125	18.05850694	okay	okay
4	27-Jun	78.62892361	17.13902778	okay	ALERT
5	28-Jun	77.68854167	18.169375	okay	okay
6	29-Jun	99.788125	19.32815972	okay	okay

Have a look at your data and identify if there were any days were temperature or humidity were not at the ideal growing conditions.





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#### Data analysis questions

QUESTION: How frequently was data being recorded in the greenhouse?

#### QUESTION: Write down what day/s received an "alert"

Temperature alert

QUESTION: How many days had a "Humidity alert"?

QUESTION: How many days had a "Temperature alert"?

**QUESTION:** Where there any days that look abnormal on your day (Hint: see if there were any days with a high or low humidity or temperature reading). If so, when?

**QUESTION:** Did these days match your "alerts"?

**QUESTION:** How can data and alerts be used to assist producers manage their crop or flower production?



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**QUESTION:** List all of the applications or potential experiments you could conduct with soil, temperature and humidity sensors:

•	
•	
•	
•	
•	





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