

## Using Scatter Plots in Microsoft Excel® (See Fig 10.17 in book)

Scatter plots can be used to show possible correlations between 2 sets of continuous variables graphically. Paired sets of values (e.g. representing 2 variables from the same respondent in a questionnaire) are plotted on the **x-axis (horizontal)** and **y-axis (vertical)**. This gives a series of plotted values represented as (x,y). See textbook for example (Fig 10.17) which is shown below:

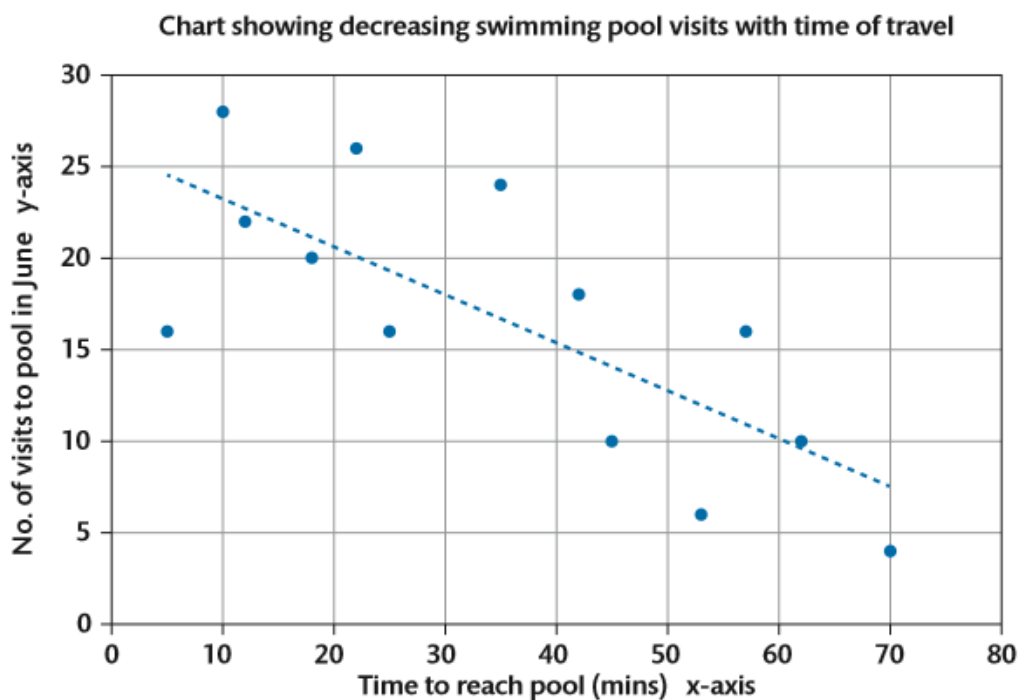


**Figure 10.17** Using a scatter plot to see a possible relationship between two ratio variables

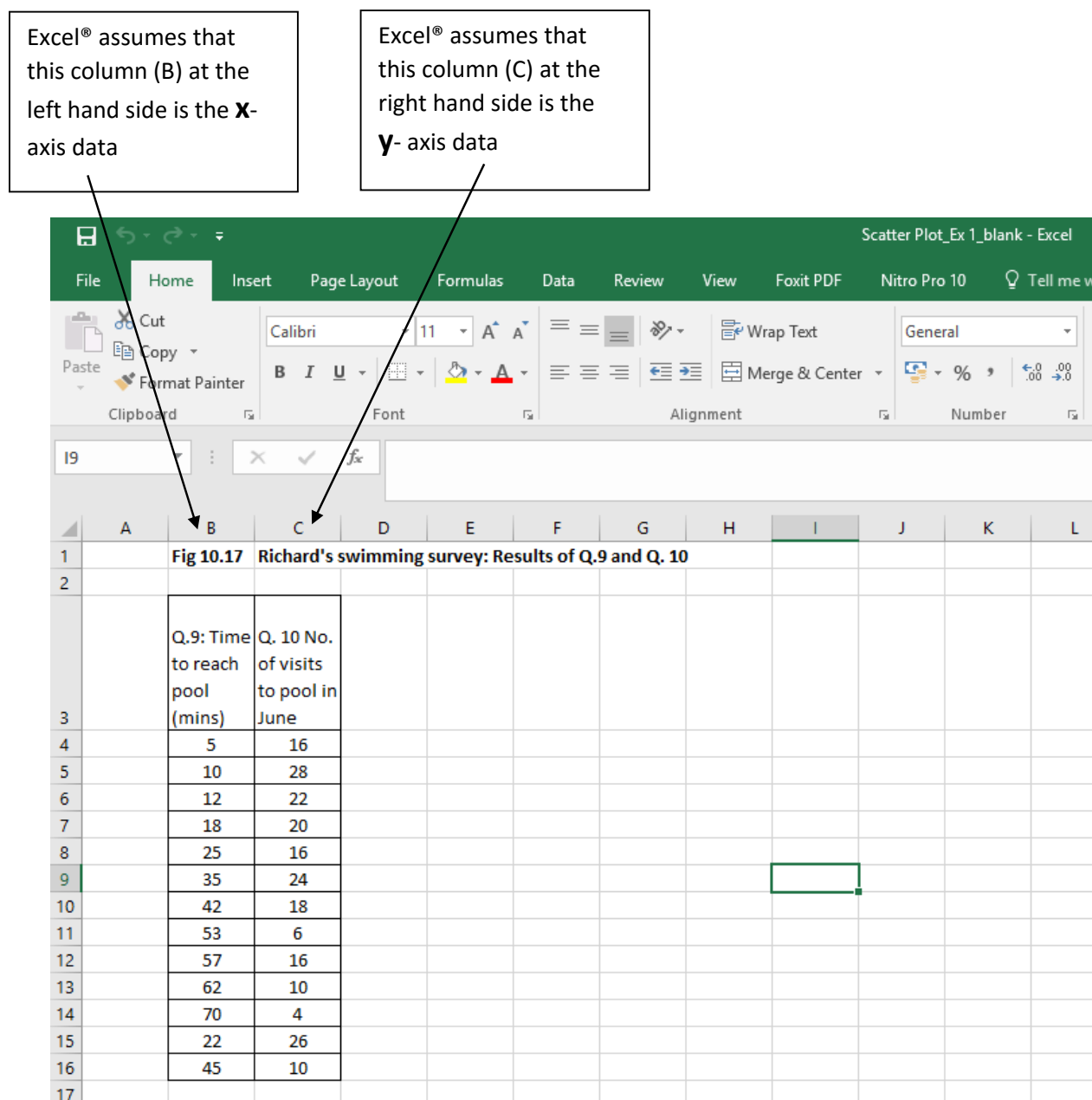
In this tutorial we will use Excel® to construct this chart. Additional tips on constructing scatterplots for other charts will be given.

### 1. Entering the data in Excel®

The first thing to do is to open Excel® and to enter the data (type in). As we are considering continuous data these will be numbers. The screen shot below shows the data for Question 9 (Time to reach pool, measured in minutes) and Question 10 (Number of visits made to the swimming pool in June). There are 13 respondents in the survey.

If you are following this tutorial on your own computer please open the accompanying file

Scatter Plot\_ex1\_blank.xls which you will find on the Online Resource Centre.



## 2. Quick and Easy way to construct the Scatter Plot for this example

Excel® can construct charts in a variety of ways. The quickest way to construct the chart for the above data is shown below.

### Important Note – Limitations of this approach

However, you need to be aware of what Excel® is assuming: namely that the left hand column represents the X- axis data and the right hand column represents the Y-axis data. We are fortunate because the spreadsheet happens to have the data already typed into this format.

We are also fortunate to have questions 9 and 10 adjacent to one another in the spreadsheet. If they were not – for instance, if the relevant questions had been 8 and 10, say, we would have had to have copied and pasted the relevant columns to another position on the spreadsheet so that they were

adjacent and in the correct x-axis and y-axis positions. (However, we will look at another way – see section 3 which follows - to construct scatter plots from our spreadsheet data to handle this sort of problem, which does not involve copying and pasting).

You are in  
the 'Home'  
tab

Scatter Plot\_Ex 1\_blank - Excel

File Home Insert Page Layout Formulas Data Review View Foxit PDF Nitro Pro 10 Tell me w

Cut Copy Paste Format Painter Clipboard

Calibri 11 A A

B I U

Font

Alignment

General

Number

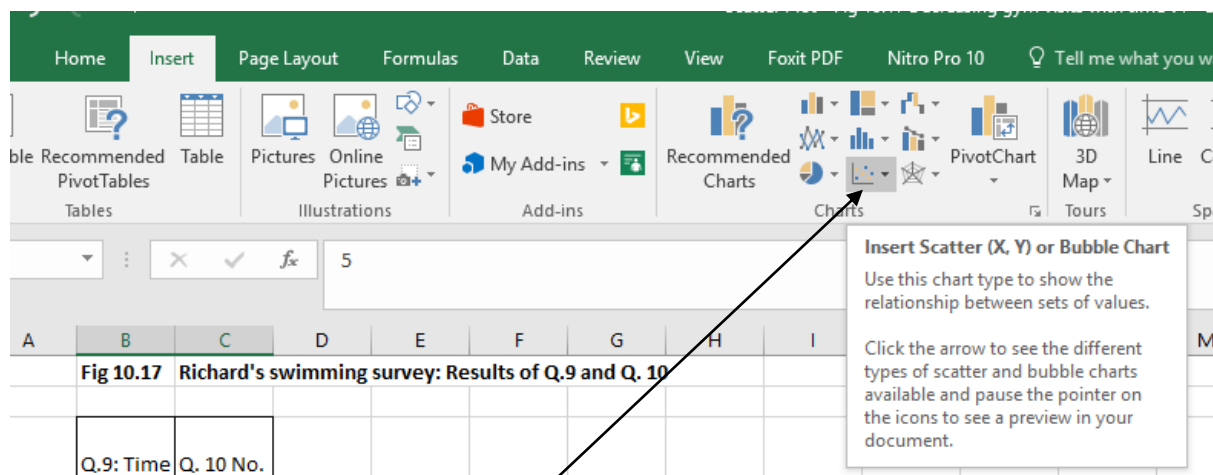
19

Fig 10.17 Richard's swimming survey: Results of Q.9 and Q. 10

|    | A | B                                                             | C                                       | D                                            | E | F | G | H | I | J | K | L |
|----|---|---------------------------------------------------------------|-----------------------------------------|----------------------------------------------|---|---|---|---|---|---|---|---|
| 1  |   | Fig 10.17 Richard's swimming survey: Results of Q.9 and Q. 10 |                                         |                                              |   |   |   |   |   |   |   |   |
| 2  |   |                                                               |                                         |                                              |   |   |   |   |   |   |   |   |
| 3  |   |                                                               | Q.9: Time<br>to reach<br>pool<br>(mins) | Q. 10 No.<br>of visits<br>to pool in<br>June |   |   |   |   |   |   |   |   |
| 4  |   |                                                               | 5                                       | 16                                           |   |   |   |   |   |   |   |   |
| 5  |   |                                                               | 10                                      | 28                                           |   |   |   |   |   |   |   |   |
| 6  |   |                                                               | 12                                      | 22                                           |   |   |   |   |   |   |   |   |
| 7  |   |                                                               | 18                                      | 20                                           |   |   |   |   |   |   |   |   |
| 8  |   |                                                               | 25                                      | 16                                           |   |   |   |   |   |   |   |   |
| 9  |   |                                                               | 35                                      | 24                                           |   |   |   |   |   |   |   |   |
| 10 |   |                                                               | 42                                      | 18                                           |   |   |   |   |   |   |   |   |
| 11 |   |                                                               | 53                                      | 6                                            |   |   |   |   |   |   |   |   |
| 12 |   |                                                               | 57                                      | 16                                           |   |   |   |   |   |   |   |   |
| 13 |   |                                                               | 62                                      | 10                                           |   |   |   |   |   |   |   |   |
| 14 |   |                                                               | 70                                      | 4                                            |   |   |   |   |   |   |   |   |
| 15 |   |                                                               | 22                                      | 26                                           |   |   |   |   |   |   |   |   |
| 16 |   |                                                               | 45                                      | 10                                           |   |   |   |   |   |   |   |   |
| 17 |   |                                                               |                                         |                                              |   |   |   |   |   |   |   |   |

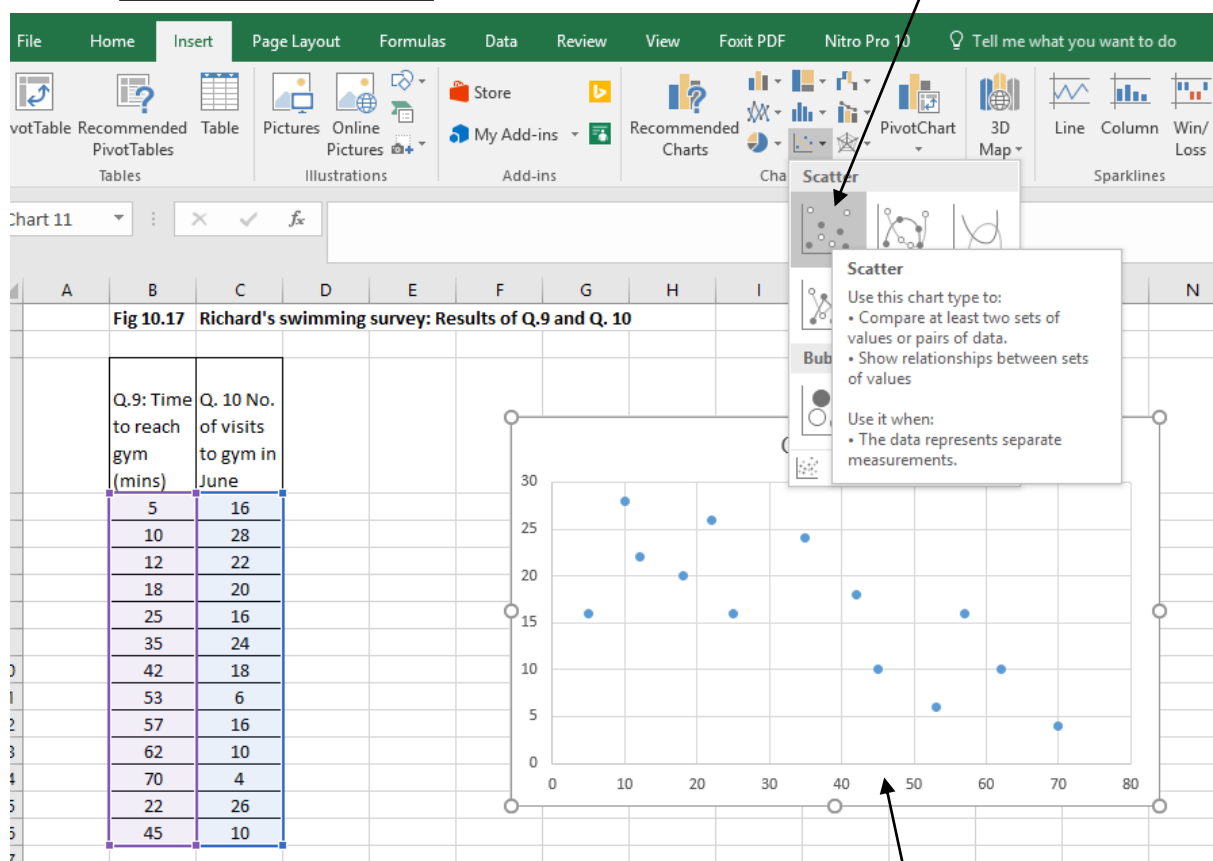
2. Left  
click on  
'insert'

1. Select  
data – e.g.  
left click  
and drag  
cursor  
over **all**  
data (not  
headings),  
then  
release



3. Left click on the scatter charts symbol

4. Left click on this type of scatter chart

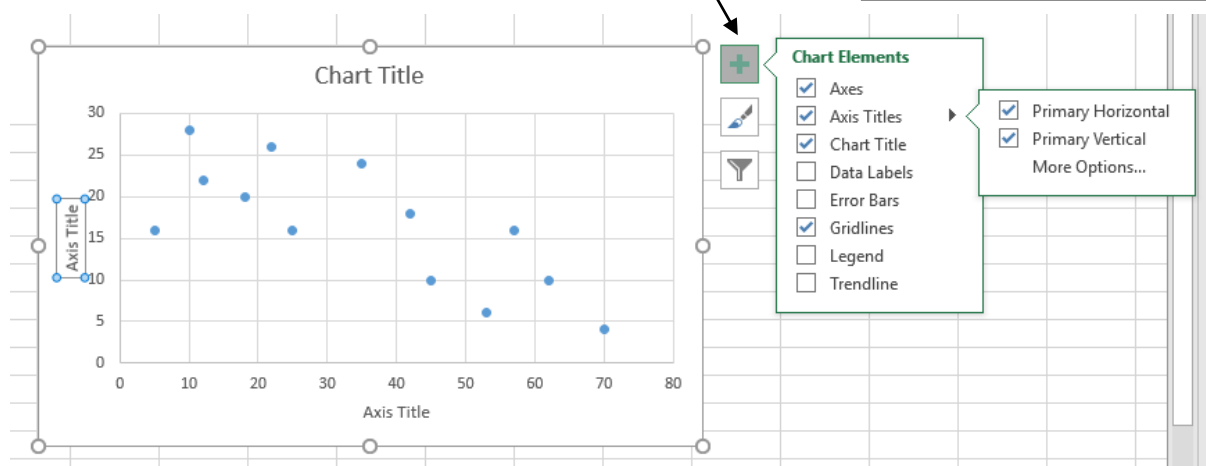


Look at the chart data points. They do seem to be following a pattern.

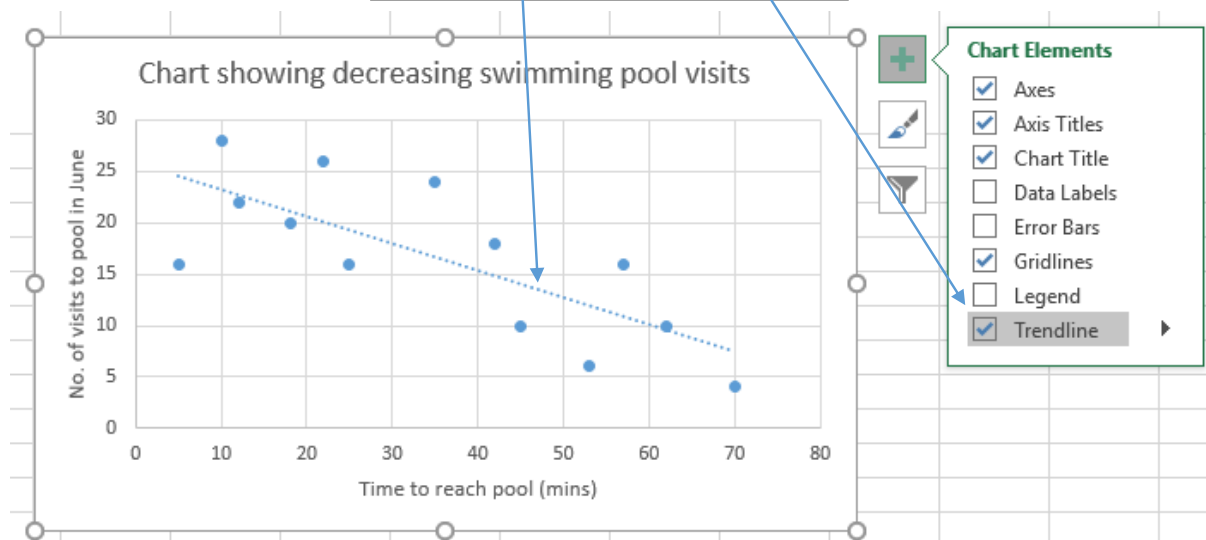
5. This chart appears

6. Left click on 'Chart Elements' , click on 'Axis Titles' and 'Chart Title' – then move your cursor to these boxes in your chart and type in your chosen titles

Note: In earlier Excel® versions click on 'Layout' at top of screen



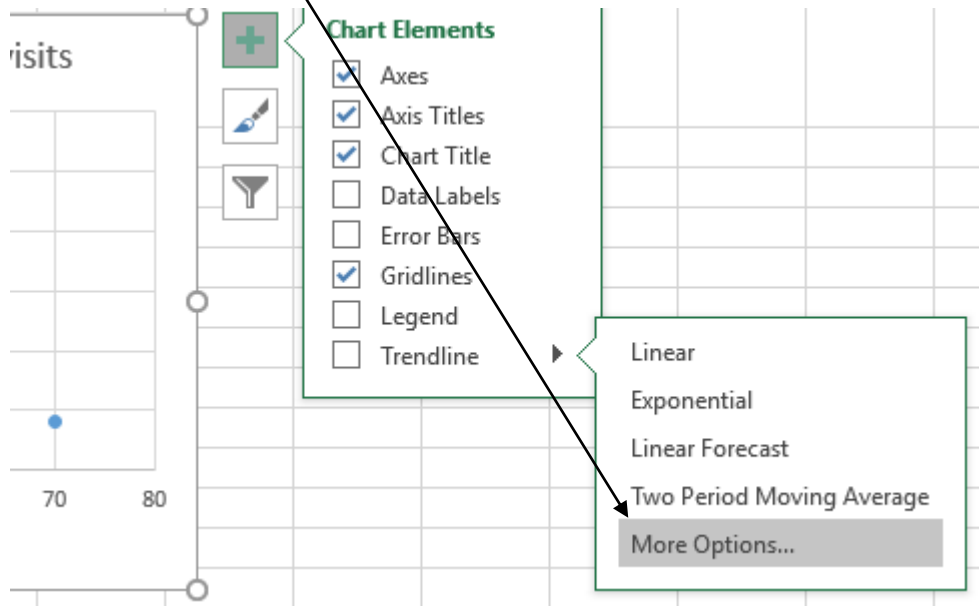
Add a trendline by clicking here



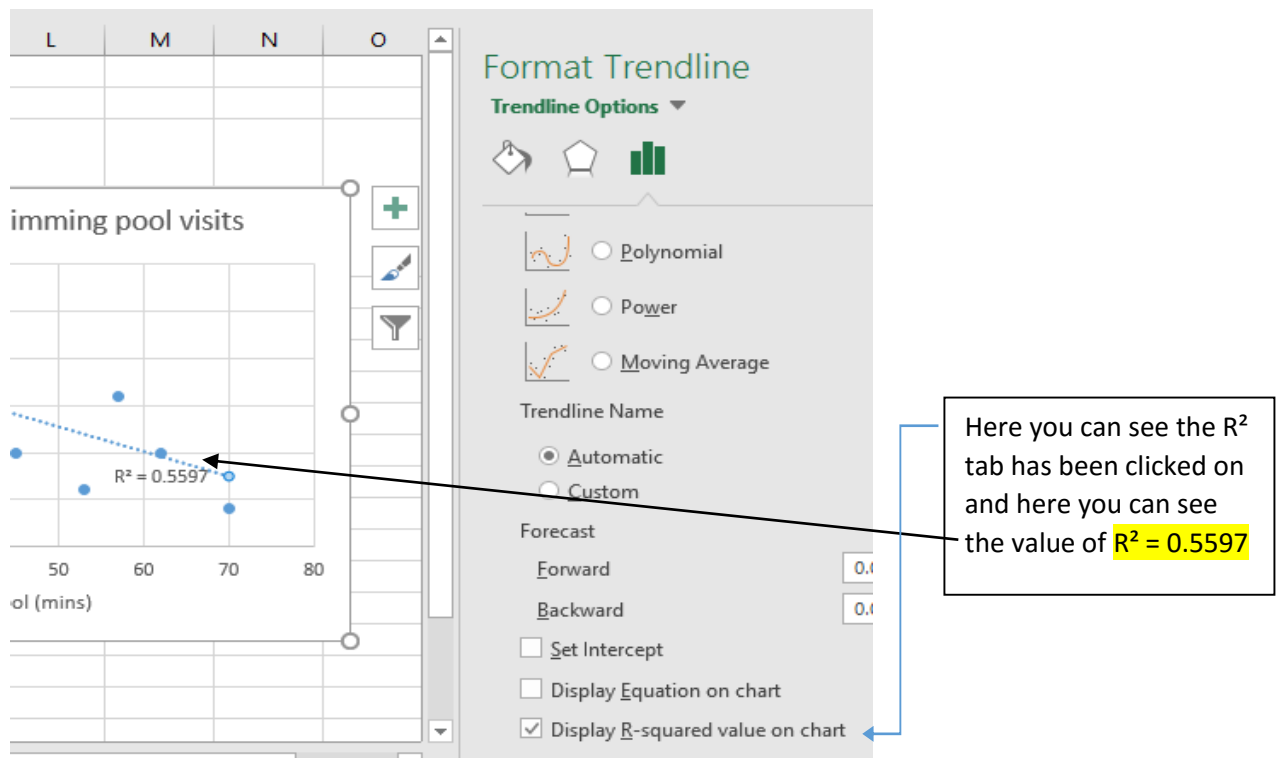
Your chart is now complete ...unless, that is, you want to add the equation of the trend line or see what the correlation is in terms of  $R^2$  (we will do this now and explain what this term means).

## R<sup>2</sup>

Excel® can calculate a term called R<sup>2</sup> (pronounce as ‘R-squared’) – you can find this under the Trendline ‘More options’ tab.



R<sup>2</sup> can take values from 0 to 1. The closer to 1 that the value is, the better the correlation between the two variables in the chart. An R<sup>2</sup> value of 1 (very unlikely!) indicates total correlation, whereas an R<sup>2</sup> value of zero indicates no correlation at all.



### 3. Interpreting $R^2$

OK – so you can say from this result that there appears to be a reasonably strong correlation between the 2 variables in the chart, as  $R^2 = 0.5597$  (rounding to 2 decimal places we might say 0.56). You can say this when you are describing your findings. However, what you can also say is that **56% of the variation in your y-axis variable – ie The number of visits to the pool in June, is explained by the variation in the X-axis variable – ie Time taken to reach the pool.** (note that 56% is simply the  $R^2$  value x 100%). This sounds much more impressive in your discussion!

### Relationship between $R^2$ and $r$ (Pearson correlation coefficient)

A widely used term (not shown in the above Excel® menu) to indicate the level of correlation is Pearson's correlation coefficient – usually denoted by  **$r$** . This can take values from -1 to +1. A –value indicates a downward slope from left to right in your chart (a negative correlation) whereas a + value indicates an upward slope from left to right in your chart (A positive correlation). Values closer to either extreme of -1 or +1 show greater correlation with a value of 0 showing no correlation.

Luckily you have the  $R^2$  value for this example– so you can calculate the  $r$  value by getting the square root of 0.5597 = (square roots are always + or -) +/- 0.748 (you can get this in Excel® from the Formula tab under math and trig which gives the option **SQRT – or simply use a calculator**). This is a reasonably strong correlation.

Now look at your chart. You can see that it indicates that, as the time taken to reach the pool increases, then the number of pool visits per month decreases. (Does this make sense? – yes! It is quite likely that if your journey to the pool is a lengthy, that you would make less visits than if it was right on your doorstep). This is a negative correlation. Our Pearson's  $r$  value is therefore – 0.748. You can quote this in your findings.

### 4. Constructing Scatter Plots from non-adjacent column data in your Excel® spreadsheet

How do you construct your scatter plot if your data is not conveniently arranged in adjacent columns in your spreadsheet (as previously shown, with the left hand column representing the x-axis and the right-hand column representing the y-axis)?

For this example consider how we would do this if Richard had constructed his questionnaire with a different sequence of questions – the results of which are shown below:

If you are following this tutorial on your own computer please open the accompanying file [Scatter Plot\\_ex2\\_blank.xls](#) which you will find the Online Resource Centre.

|    | A                                                                                       | B                 | C                                | D                     | E               | F                              | G                                                     | H                                    | I                                                 | J                             |
|----|-----------------------------------------------------------------------------------------|-------------------|----------------------------------|-----------------------|-----------------|--------------------------------|-------------------------------------------------------|--------------------------------------|---------------------------------------------------|-------------------------------|
| 1  | <b>Alternative version of Richard's swimming survey - columns in different sequence</b> |                   |                                  |                       |                 |                                |                                                       |                                      |                                                   |                               |
| 2  |                                                                                         |                   |                                  |                       |                 |                                |                                                       |                                      |                                                   |                               |
| 3  |                                                                                         | <b>Respondent</b> | <b>Q.1.<br/>Swimmer<br/>type</b> | <b>Q2.<br/>Gender</b> | <b>Q.3. Age</b> | <b>Q.4<br/>Degree<br/>type</b> | <b>Q. 5 No.<br/>of visits<br/>to pool in<br/>June</b> | <b>Q.6<br/>Mode of<br/>transport</b> | <b>Q.7: Time<br/>to reach<br/>pool<br/>(mins)</b> | <b>Q.8. Solo<br/>or group</b> |
| 4  |                                                                                         | 1                 | 7                                | 1                     | 23              | 3                              | 16                                                    | 2                                    | 5                                                 | 1                             |
| 5  |                                                                                         | 2                 | 3                                | 2                     | 19              | 1                              | 28                                                    | 1                                    | 10                                                | 2                             |
| 6  |                                                                                         | 3                 | 5                                | 2                     | 56              | 1                              | 22                                                    | 1                                    | 12                                                | 2                             |
| 7  |                                                                                         | 4                 | 2                                | 2                     | 18              | 1                              | 20                                                    | 1                                    | 18                                                | 1                             |
| 8  |                                                                                         | 5                 | 2                                | 1                     | 25              | 3                              | 16                                                    | 2                                    | 25                                                | 2                             |
| 9  |                                                                                         | 6                 | 6                                | 1                     | 27              | 2                              | 24                                                    | 1                                    | 35                                                | 2                             |
| 10 |                                                                                         | 7                 | 4                                | 2                     | 35              | 6                              | 18                                                    | 1                                    | 42                                                | 1                             |
| 11 |                                                                                         | 8                 | 4                                | 2                     | 45              | 4                              | 6                                                     | 1                                    | 53                                                | 3                             |
| 12 |                                                                                         | 9                 | 3                                | 1                     | 39              | 5                              | 16                                                    | 2                                    | 57                                                | 1                             |
| 13 |                                                                                         | 10                | 5                                | 1                     | 25              | 2                              | 10                                                    | 1                                    | 62                                                | 1                             |
| 14 |                                                                                         | 11                | 5                                | 2                     | 23              | 1                              | 4                                                     | 1                                    | 70                                                | 2                             |
| 15 |                                                                                         | 12                | 2                                | 2                     | 20              | 2                              | 26                                                    | 3                                    | 22                                                | 1                             |
| 16 |                                                                                         | 13                | 3                                | 1                     | 23              | 1                              | 10                                                    | 1                                    | 45                                                | 2                             |

Let's say we want to want to plot Q.5. (on y-axis) against Q.7. (on X-axis) to consider any correlation.

(You will note that the data in Q.5 and Q7 is the same as we previously used in Fig 10.17 example Q.10 and Q.9 respectively.)

**Step 1:**  
Left click on insert

**Step 2:** Left click on Scatter graph symbol and this type of chart

**3.** This box appears

**Scatter**

Use this chart type to:

- Compare at least two sets of values or pairs of data.
- Show relationships between sets of values

Use it when:

- The data represents separate measurements.

More Scatter Charts...

| Respondent | Q.1. Swimmer type | Q.2. Gender | Q.3. Age | Q.4. Degree type | Q.5 No. of times per week | Q.6. Distance in km | Q.7. Distance in miles | Q.8. Distance in miles | Q.9. Distance in miles |
|------------|-------------------|-------------|----------|------------------|---------------------------|---------------------|------------------------|------------------------|------------------------|
| 1          | 7                 | 1           | 23       | 3                |                           |                     |                        |                        |                        |
| 2          | 3                 | 2           | 19       | 1                |                           |                     |                        |                        |                        |
| 3          | 5                 | 2           | 56       | 1                |                           |                     |                        |                        |                        |
| 4          | 2                 | 2           | 18       | 1                |                           |                     |                        |                        |                        |
| 5          | 2                 | 1           | 25       | 3                |                           |                     |                        |                        |                        |
| 6          | 6                 | 1           | 27       | 2                |                           |                     |                        |                        |                        |
| 7          | 4                 | 2           | 35       | 6                |                           |                     |                        |                        |                        |
| 8          | 4                 | 2           | 45       | 4                |                           |                     |                        |                        |                        |
| 9          | 3                 | 1           | 39       | 5                |                           |                     |                        |                        |                        |
| 10         | 5                 | 1           | 25       | 2                |                           |                     |                        |                        |                        |
| 11         | 5                 | 2           | 23       | 1                |                           |                     |                        |                        |                        |
| 12         | 2                 | 2           | 20       | 2                |                           |                     |                        |                        |                        |
| 13         | 3                 | 1           | 23       | 1                | 10                        | 1                   | 45                     | 2                      |                        |

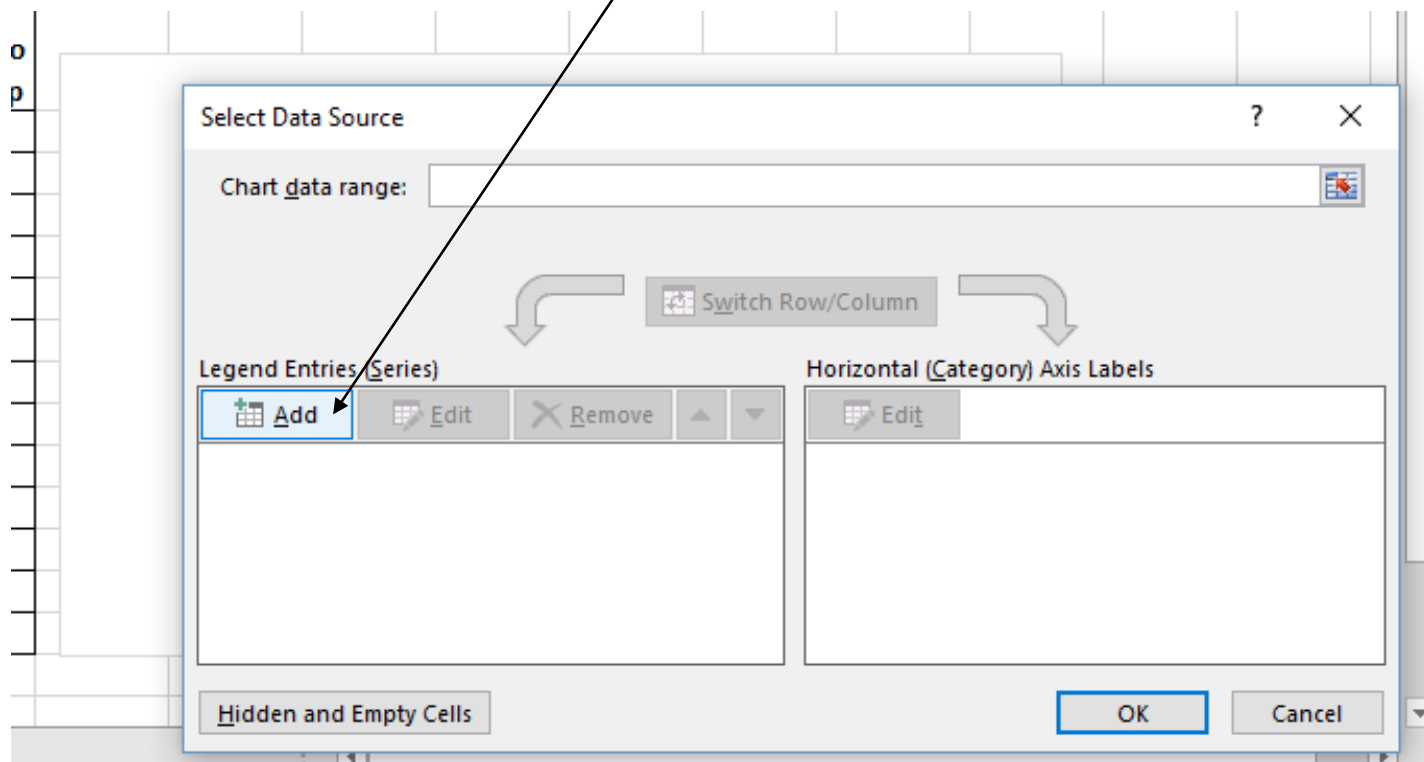
**Step 4.** Move the box here by left clicking and dragging (to give access to Q.5 and Q.7 data)

**Step 5.** Left Click on 'select data'

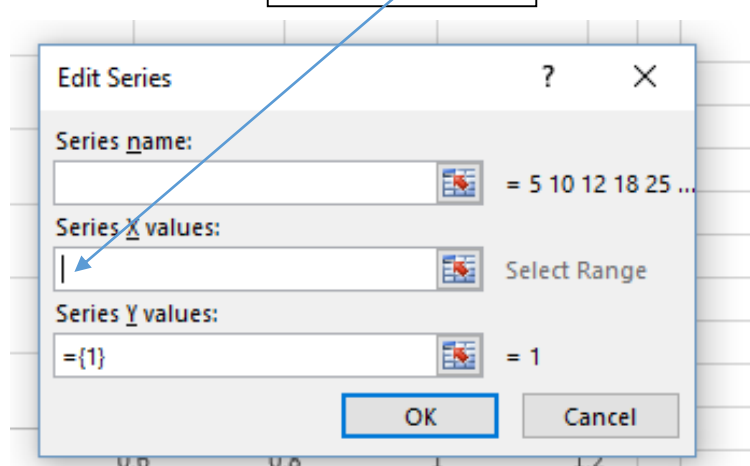
Chart 1

|    | A                                                                                | B          | C                 | D           | E        | F                | G                                  | H                     | I                              | J                  | K | L | M | N | O | P | Q | R |  |
|----|----------------------------------------------------------------------------------|------------|-------------------|-------------|----------|------------------|------------------------------------|-----------------------|--------------------------------|--------------------|---|---|---|---|---|---|---|---|--|
| 1  | Alternative version of Richard's swimming survey - columns in different sequence |            |                   |             |          |                  |                                    |                       |                                |                    |   |   |   |   |   |   |   |   |  |
| 2  |                                                                                  |            |                   |             |          |                  |                                    |                       |                                |                    |   |   |   |   |   |   |   |   |  |
| 3  |                                                                                  | Respondent | Q.1. Swimmer type | Q.2. Gender | Q.3. Age | Q.4. Degree type | Q. 5 No. of visits to pool in June | Q.6 Mode of transport | Q.7: Time to reach pool (mins) | Q.8. Solo or group |   |   |   |   |   |   |   |   |  |
| 4  |                                                                                  | 1          | 7                 | 1           | 23       | 3                | 16                                 | 2                     | 5                              | 1                  |   |   |   |   |   |   |   |   |  |
| 5  |                                                                                  | 2          | 3                 | 2           | 19       | 1                | 28                                 | 1                     | 10                             | 2                  |   |   |   |   |   |   |   |   |  |
| 6  |                                                                                  | 3          | 5                 | 2           | 56       | 1                | 22                                 | 1                     | 12                             | 2                  |   |   |   |   |   |   |   |   |  |
| 7  |                                                                                  | 4          | 2                 | 2           | 18       | 1                | 20                                 | 1                     | 18                             | 1                  |   |   |   |   |   |   |   |   |  |
| 8  |                                                                                  | 5          | 2                 | 1           | 25       | 3                | 16                                 | 2                     | 25                             | 2                  |   |   |   |   |   |   |   |   |  |
| 9  |                                                                                  | 6          | 6                 | 1           | 27       | 2                | 24                                 | 1                     | 35                             | 2                  |   |   |   |   |   |   |   |   |  |
| 10 |                                                                                  | 7          | 4                 | 2           | 35       | 6                | 18                                 | 1                     | 42                             | 1                  |   |   |   |   |   |   |   |   |  |
| 11 |                                                                                  | 8          | 4                 | 2           | 45       | 4                | 6                                  | 1                     | 53                             | 3                  |   |   |   |   |   |   |   |   |  |
| 12 |                                                                                  | 9          | 3                 | 1           | 39       | 5                | 16                                 | 2                     | 57                             | 1                  |   |   |   |   |   |   |   |   |  |
| 13 |                                                                                  | 10         | 5                 | 1           | 25       | 2                | 10                                 | 1                     | 62                             | 1                  |   |   |   |   |   |   |   |   |  |
| 14 |                                                                                  | 11         | 5                 | 2           | 23       | 1                | 4                                  | 1                     | 70                             | 2                  |   |   |   |   |   |   |   |   |  |
| 15 |                                                                                  | 12         | 2                 | 2           | 20       | 2                | 26                                 | 3                     | 22                             | 1                  |   |   |   |   |   |   |   |   |  |
| 16 |                                                                                  | 13         | 3                 | 1           | 23       | 1                | 10                                 | 1                     | 45                             | 2                  |   |   |   |   |   |   |   |   |  |
| 17 |                                                                                  |            |                   |             |          |                  |                                    |                       |                                |                    |   |   |   |   |   |   |   |   |  |

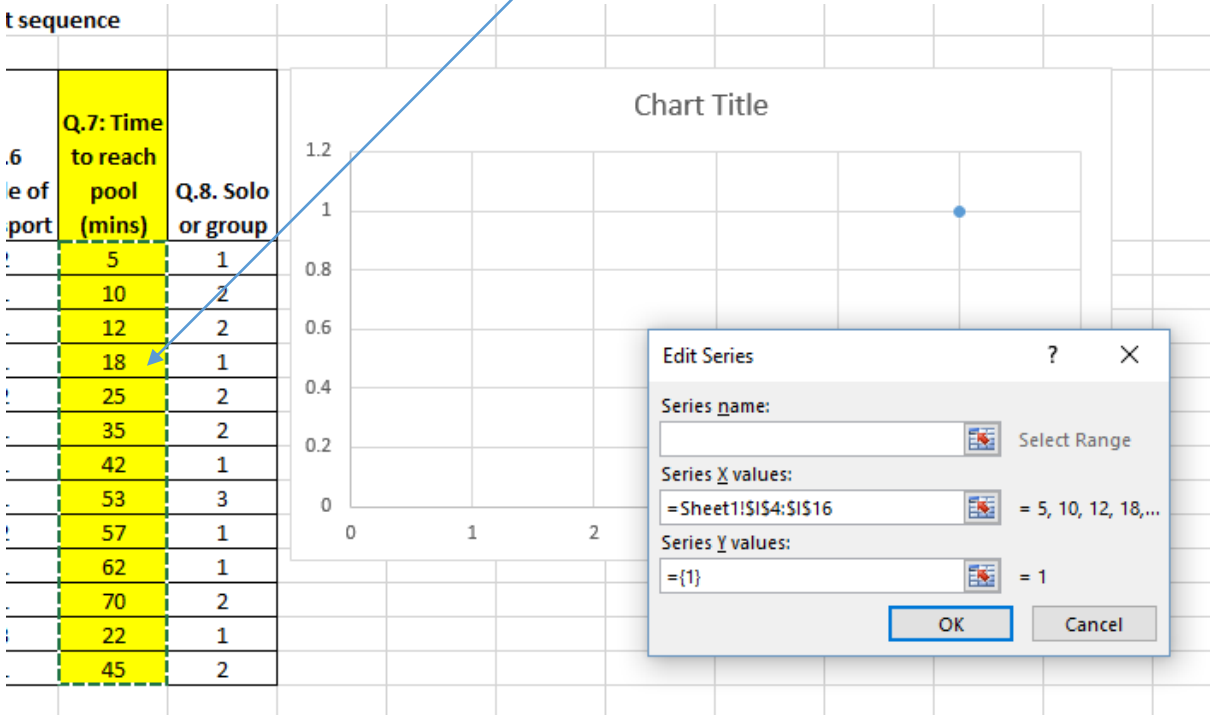
**Step 6.** This menu appears – Left Click on 'Add' for full control in choosing data from your spreadsheet



**Step 7.** Move your cursor to this point



**Step 8.** Select the series X values (Q.7 data) using your cursor



**Step 9.** Next, delete =(1) and position. Your cursor will be here

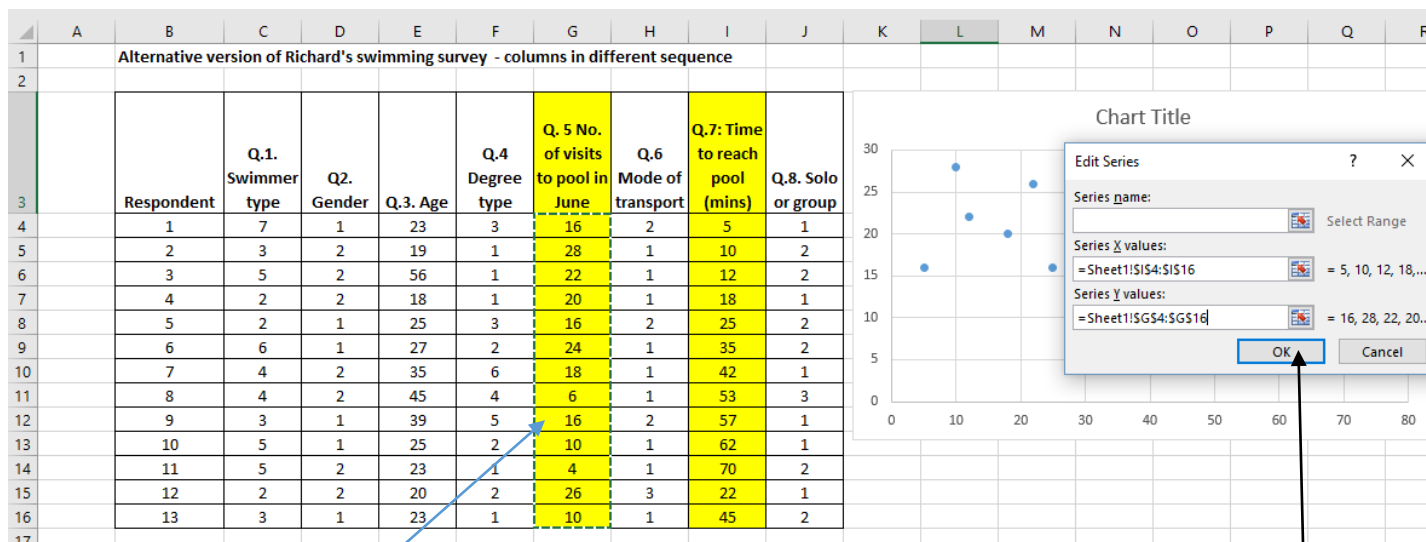
Edit Series

Series name:  = 5 10 12 18 25 ...

Series X values:  = Sheet1!\$I\$4:\$I\$16 = 5, 10, 12, 18, ...

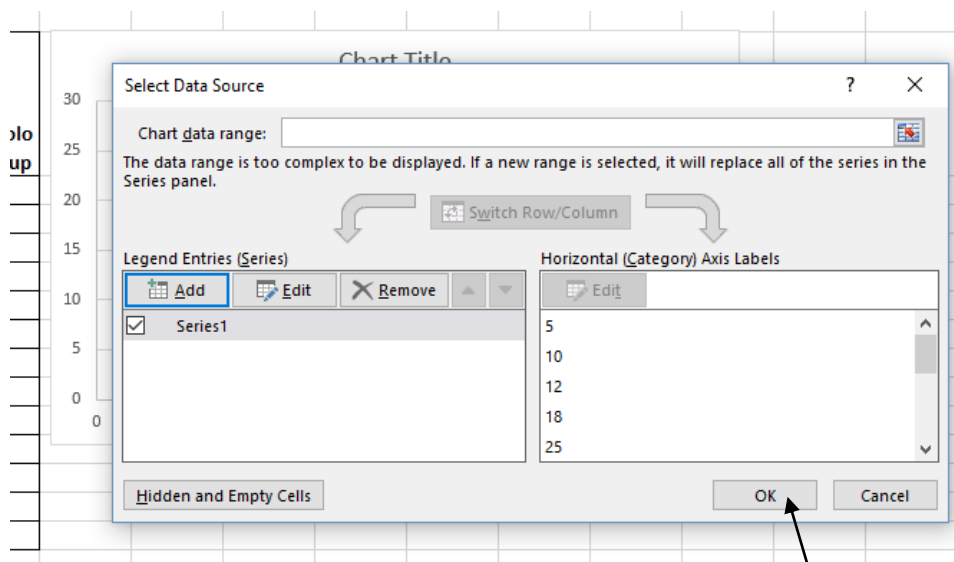
Series Y values:  = 1

OK Cancel



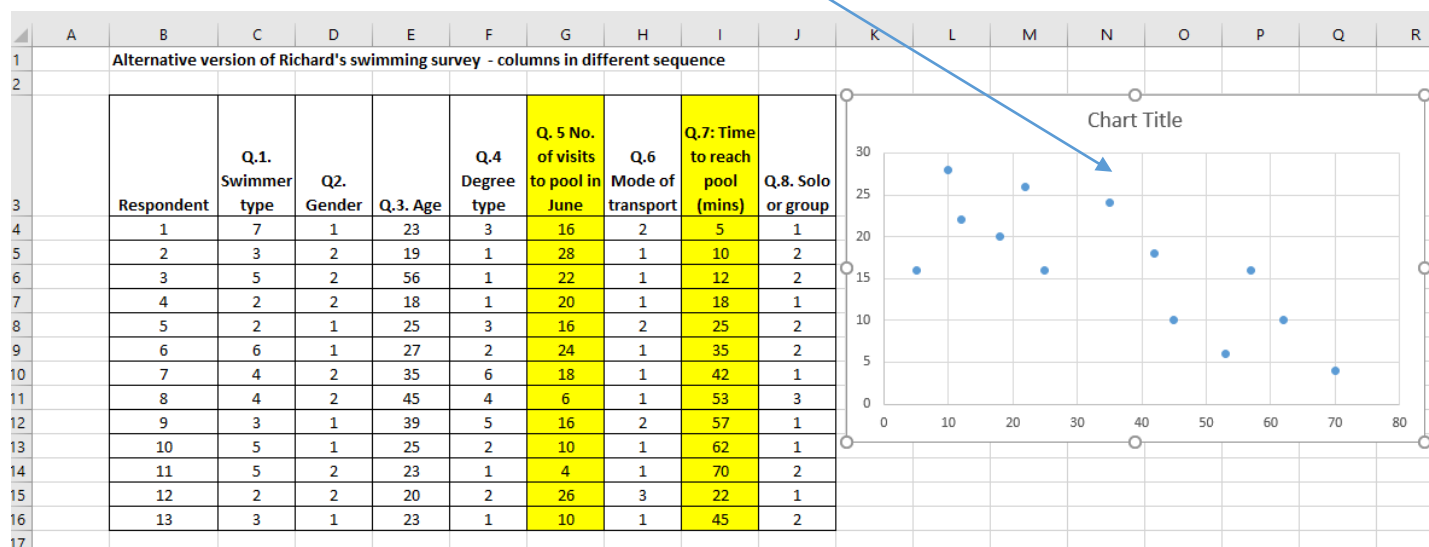
**Step 10.** Select the series Y values (Q.5 data) using your cursor

**Step 11.** You will see your Series X and Series Y values have been entered. Now press 'OK'

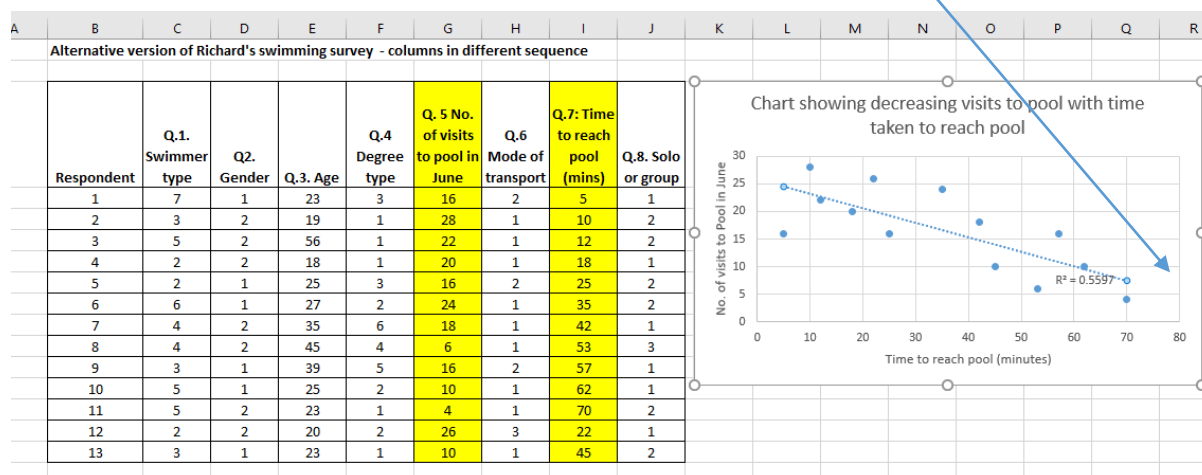


**Step 12.** The box appears like this. Press 'OK'

**Step 13.** The chart now appears like this



**Steps 14 +.** You can now edit the chart (as shown earlier in this tutorial – Section 2. Quick and Easy way...) to create a chart like this



End of this tutorial

Used with permission from Microsoft (Microsoft.com).