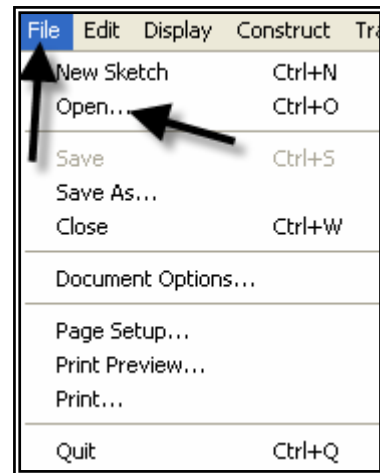
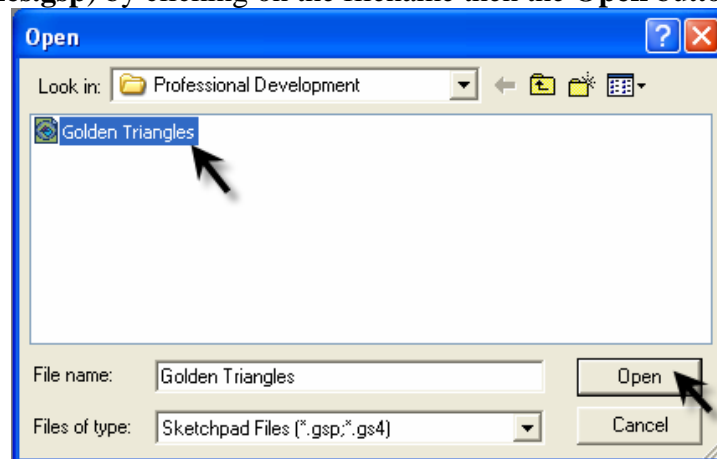


Opening a Sketch in Geometer's Sketchpad

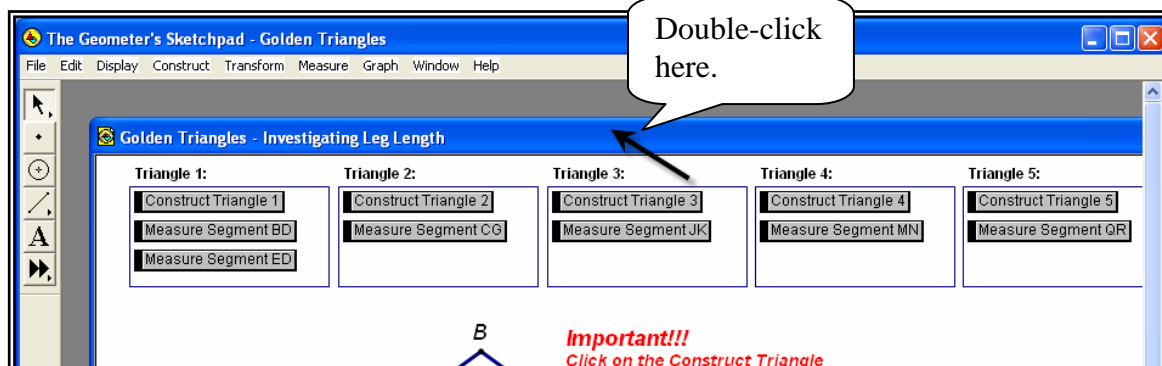
1. To *open* an existing sketch in Geometer's Sketchpad, select **Open** from the **File** menu.



2. A pop up window will appear. Follow the directions for your particular computer system to get to the file where the existing sketches are stored. Select the desired file (in this case, **Golden Triangles.gsp**) by clicking on the filename then the **Open** button.



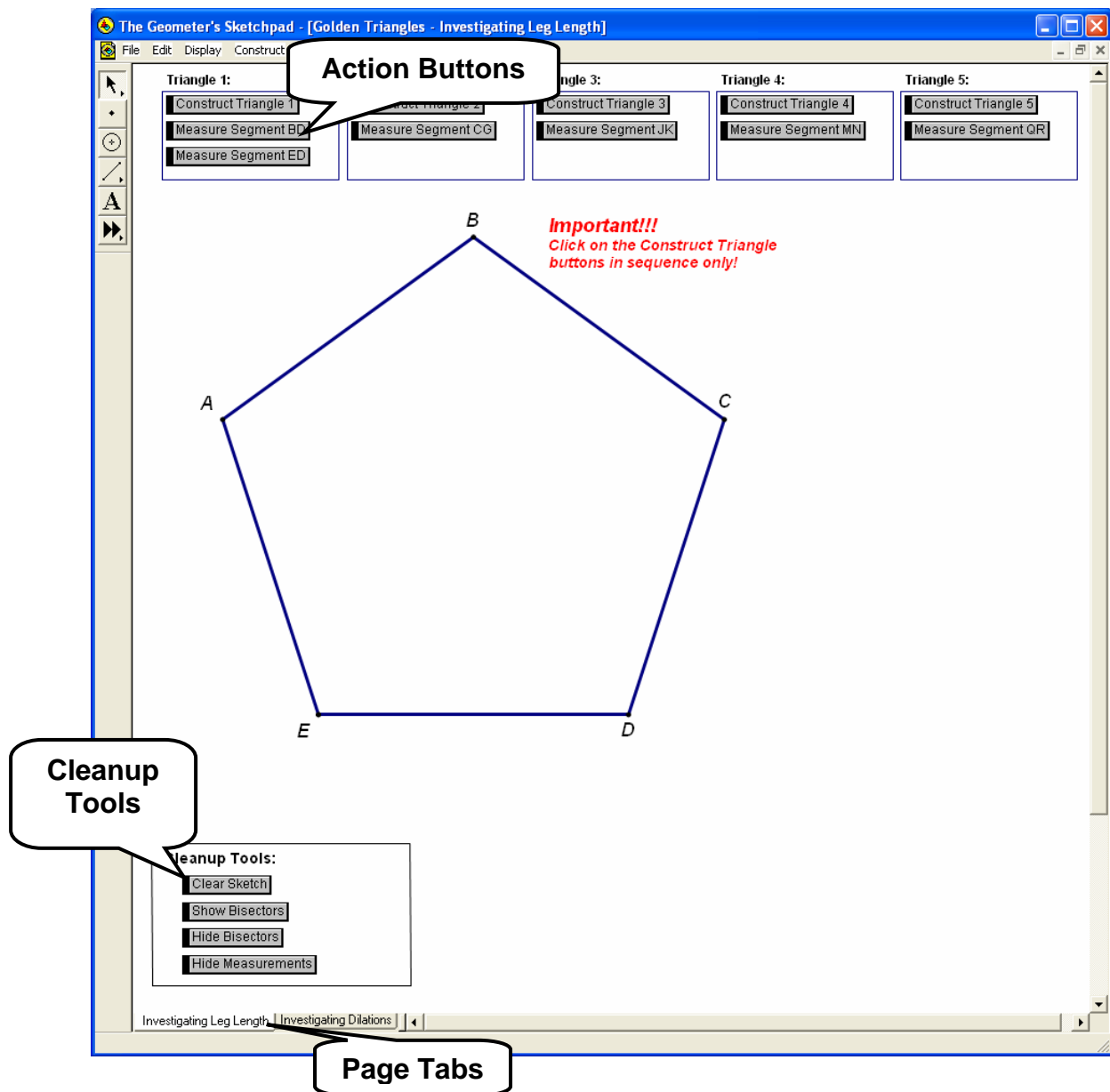
The sketch will open in its own window which you can manipulate like all other windows in Microsoft Windows. To maximize the window, you can double-click on the menu bar at the top of the window.



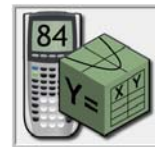
Working with the “Golden Triangles” sketch:

To work with the “Golden Triangles” sketch, you do not need to be familiar with how to use the Geometer’s Sketchpad software. Some features that you may need to know about are:

- ❑ **Action buttons** are buttons you can click on that cause a particular action to happen. In this sketch, buttons will either construct the next triangle in the sequence or measure a segment length.
- ❑ **Cleanup tools** are action buttons that cause certain parts of the sketch to disappear, thus “cleaning up” the sketch.
- ❑ **Page tabs** are divider tabs that separate different pages in the sketch. In this sketch, there are two pages: Investigating Leg Length and Investigating Dilations.



Part 1: Investigating Leg Length



Generating a Scatterplot of Leg Length vs. Triangle Number Using a Graphing Calculator

1. Press **[STAT]**. Then press **[ENTER]**.

```

3001) CALC TESTS
1: Edit...
2: SortA(
3: SortD(
4: ClrList
5: SetUpEditor
    
```

2. You will see a table containing lists. Your calculator may contain data in its lists from a previous investigation. If the lists do not contain previous data, you may skip to step 6.

L1	L2	L3	1
1	30	115	
2	12	-8	
4	15	-10	
5	19	12	
8	23	62	
-7	25	89	
8	30	-169	

L1 = {1, 2, 4, 5, 8, -...

3. To clear this previous data, press **[STAT]**.

```

3001) CALC TESTS
1: Edit...
2: SortA(
3: SortD(
4: ClrList
5: SetUpEditor
    
```

4. Highlight **ClrList**. Enter the lists that you wish to clear. Press **[ENTER]**.

```

ClrList L1, L2, L3
, L4
    
```

5. Press **[ENTER]** again.

```

ClrList L1, L2, L3
, L4
Done
    
```

6. Enter the data into the lists.
Be sure to press **[ENTER]** after each value.

L1	L2	L3	Z
1	12.33	-----	
2	7.62		
3	4.71		
4	2.91		
5	1.8		

L2(6) =

7. Press **[2nd]** **[STAT PLOT]**.

```

STAT PLOTS
1:Plot1...Off
  L1 L2
2:Plot2...Off
  L1 L3
3:Plot3...Off
  L1 L2
4↓PlotsOff
    
```

8. Use the arrows to select the necessary options.
For Plot 1, be sure that the Plot is On and a scatterplot is chosen (first Type). The independent variable (XList) is in L₁ and dependent variable (YList) is in L₂.

```

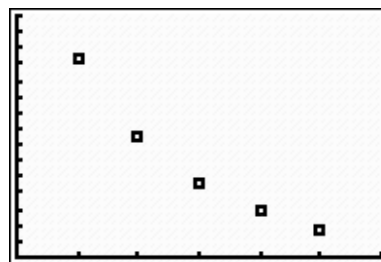
Plot1 Plot2 Plot3
On Off
Type: [Scatter] [Line] [Bar]
      [Normal] [Histogram]
Xlist: L1
Ylist: L2
Mark: [Square] + .
    
```

11. Choose an appropriate window by selecting **[WINDOW]** and specifying the appropriate domain and range.
Use the arrow keys to move up and down.

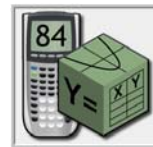
```

WINDOW
Xmin=0
Xmax=6
Xscl=1
Ymin=0
Ymax=15
Yscl=1
Xres=1█
    
```

12. To view the scatterplot, press **[GRAPH]**.



Part 1: Investigating Leg Length



Determining a Function Rule for Leg Length vs. Triangle Number Using a Graphing Calculator

Note: Directions follow for use of a TI-83, TI-83+, or TI-84.

Using Successive Quotients:

- In the List Editor (Press **STAT** then press **ENTER**), copy List 2 into List 3. To do so, use the arrow keys to move the cursor to the List 3 header, then press **2nd** **2**. Press **ENTER**.

L1	L2	L3	3
1	12.33	-----	
2	7.62		
3	4.71		
4	2.91		
5	1.8		
-----	-----		
L3 = L2			

- Delete the first element of List 3 by using the arrow keys to select it then press **DEL**.

L1	L2	L3	3
1	12.33	12.33	
2	7.62	7.62	
3	4.71	4.71	
4	2.91	2.91	
5	1.8	1.8	
-----	-----	-----	
L3(1)=12.33			

- Delete the last element of List 2 by using the arrow keys to select it then press **DEL**.

L1	L2	L3	3
1	12.33	7.62	
2	7.62	4.71	
3	4.71	2.91	
4	2.91	1.8	
5	1.8	-----	
-----	-----	-----	
L3(1)=7.62			

L1	L2	L3	2
1	12.33	7.62	
2	7.62	4.71	
3	4.71	2.91	
4	2.91	1.8	
5	1.8	-----	
-----	-----	-----	
L2(5) = 1.8			

L1	L2	L3	2
1	12.33	7.62	
2	7.62	4.71	
3	4.71	2.91	
4	2.91	1.8	
5	-----	-----	
-----	-----	-----	
L2(5) =			

- Use the arrow keys to select the List 4 header. We want List 4 to be the quotient of List 3 and List 2. Enter the formula $L_4 = L_3/L_2$ by pressing $\text{2nd}[3]$, [÷] , then $\text{2nd}[2]$. List 4 now contains the successive quotients of the leg lengths, or y-values.

L2	L3	L4	4
12.33	7.62	-----	
7.62	4.71		
4.71	2.91		
2.91	1.8		
-----	-----		
L4 = L3/L2			

L2	L3	L4	4
12.33	7.62	.618	
7.62	4.71	.61811	
4.71	2.91	.61783	
2.91	1.8	.61856	
-----	-----	-----	
L4(1) = .6180048661...			

- Return to the home screen by pressing $\text{2nd}[\text{MODE}]$ or $[\text{QUIT}]$. Calculate the mean value of the successive quotients (List 4) by using Math operations on the Lists. Retrieve the List menu by pressing $\text{2nd}[\text{STAT}]$ then choose the Math options using the arrow key ▶ twice. Use the down arrow key, ▼ , to select option 3: mean.

NAMES	OPS	Math
1:	min(
2:	max(
3:	mean(
4:	median(
5:	sum(
6:	Prod(
7:	stdDev(

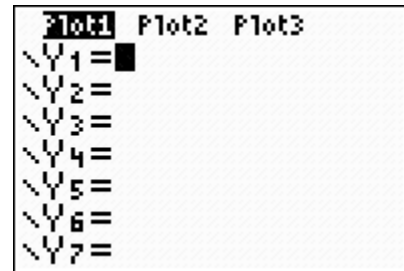
- Enter the list name for which you want to find the mean value, in this case List 4, by pressing $\text{2nd}[4]$. Press ENTER .

mean(L4)	
.6181265496	

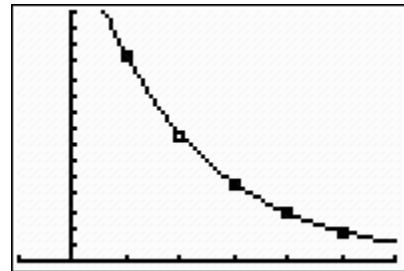
- Restore the deleted value from List 2. Return to the List Editor (Press STAT then press ENTER), and use the arrow keys to move to the bottom of List 2. Re-enter the value that you deleted.

L1	L2	L3	2
1	12.33	7.62	
2	7.62	4.71	
3	4.71	2.91	
4	2.91	1.8	
5	1.8	-----	
-----	-----		
L2(6) =			

8. Use the mean value to determine the values of a and b in the general form $y = a(b)^x$. Graph the function rule that you think might “fit” the data well. To do so, press $\boxed{Y=}$. Clear out any equations by pressing $\boxed{\text{CLEAR}}$.

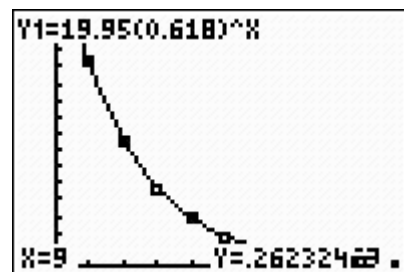
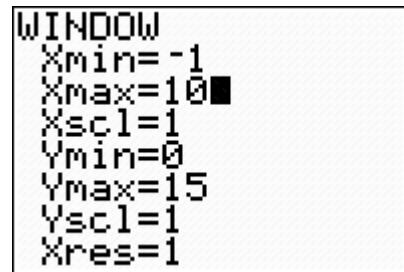


9. Enter the appropriate function rule into Y_1 . Press $\boxed{\text{ENTER}}$. Press $\boxed{\text{GRAPH}}$.



Using the Graph to Make Predictions

1. Press $\boxed{\text{WINDOW}}$ to enlarge the window. Adjust the settings to make the window large enough to predict with.
2. Press $\boxed{\text{GRAPH}}$ then $\boxed{\text{TRACE}}$. Press $\boxed{\blacktriangle}$ to select the function then trace to the prediction using the right and left arrow keys, $\boxed{\blacktriangleleft}$ $\boxed{\blacktriangleright}$.



Using the Table to Make Predictions

1. Press **2nd** **WINDOW**. Enter values for TblStart and ΔTbl , the value of the x increment.

```
TABLE SETUP
TblStart=0
ΔTbl=1
Indent:  Auto Ask
Depend:  Auto Ask
```

2. Press **2nd** **GRAPH**. Use the up and down arrow keys, **▲** and **▼**, to scroll to the desired value.

X	Y ₁	
6	1.1114	
7	.68685	
8	.42447	
9	.26232	
10	.16212	
11	.10019	
12	.06192	

X=9



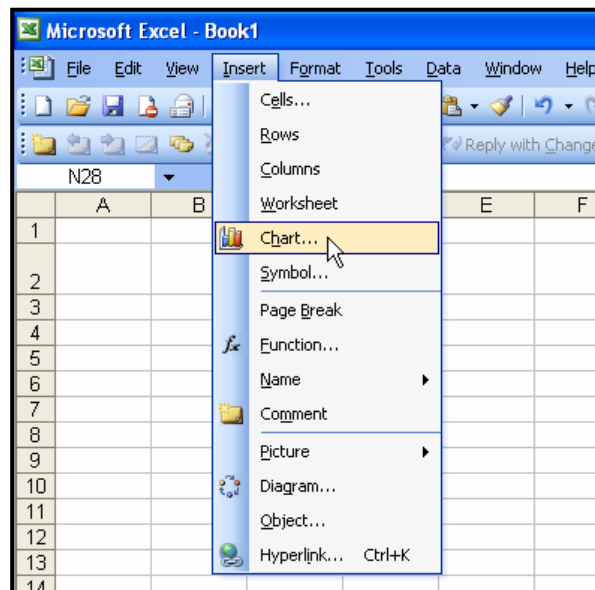
Part 1: Investigating Leg Length

Determining a Function Rule for Leg Length vs. Triangle Number Using a Microsoft Excel Spreadsheet

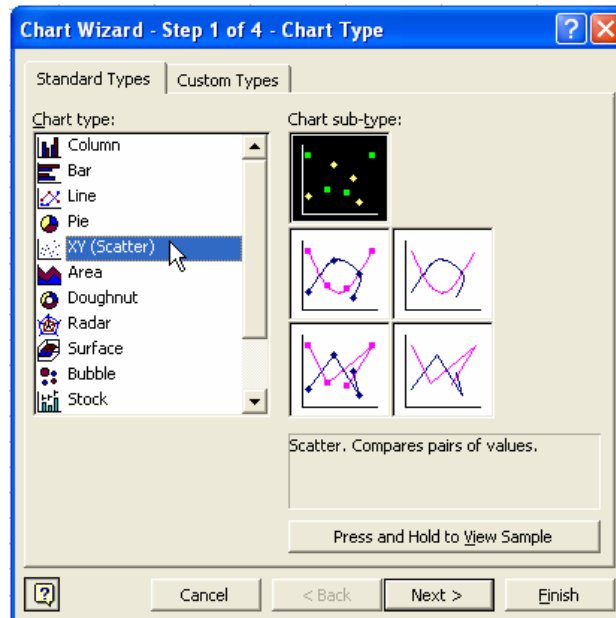
1. Enter your data into a blank Excel spreadsheet.

	A	B	C	D	E	F	G	H	I
1									
2			Triangle	Leg					
3			Number	Length					
4			1	12.33					
5			2	7.62					
6			3	4.71					
7			4	2.91					
8			5	1.8					
9									
10									

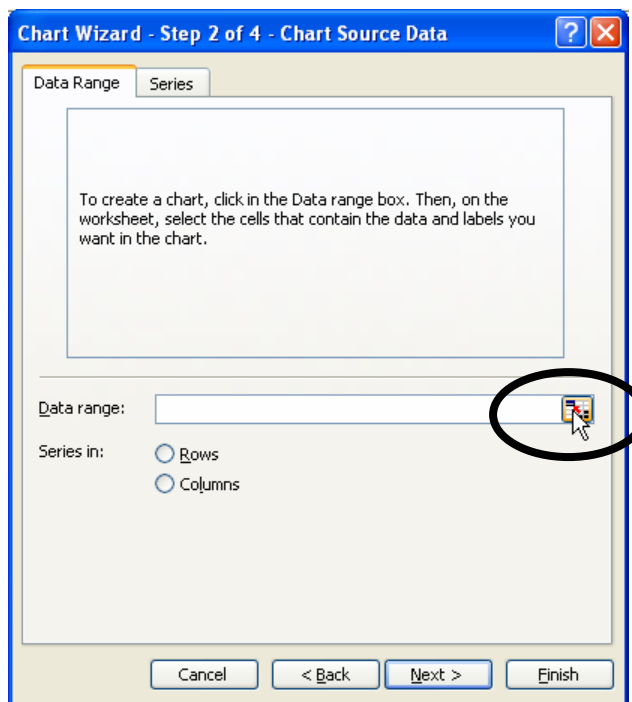
2. Choose **Chart** from the **Insert** menu.



3. Select **XY (Scatter)** from the **Chart Type** selection box then click **Next**.



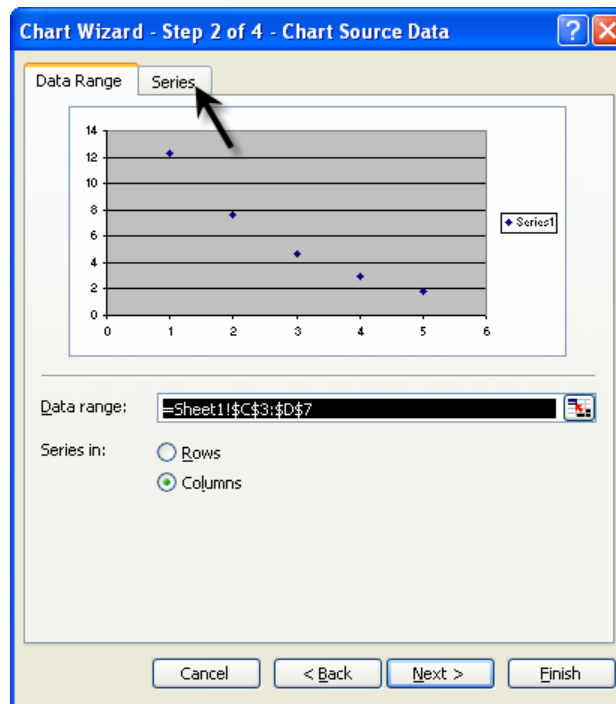
4. To select the Data Range, click the **Collapse Dialog** button next to the **Data Range** text box.



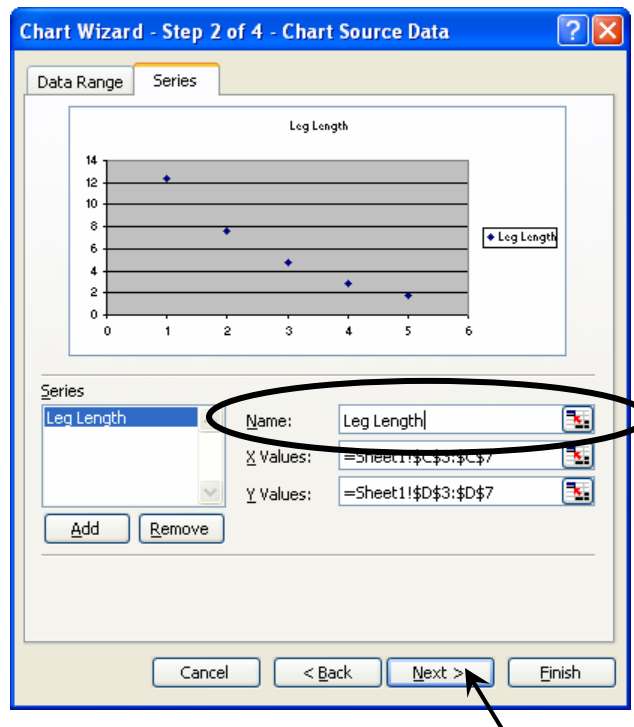
5. Select the cells containing your data then click the **Collapse Dialog** button next to the floating **Chart Source Data** box. You will return to the **Chart Wizard** dialog box.



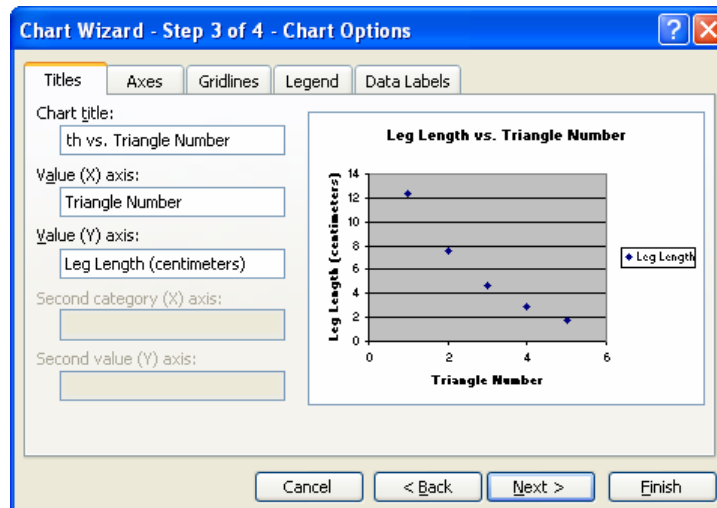
6. Click the **Series** tab in order to edit the source data features.

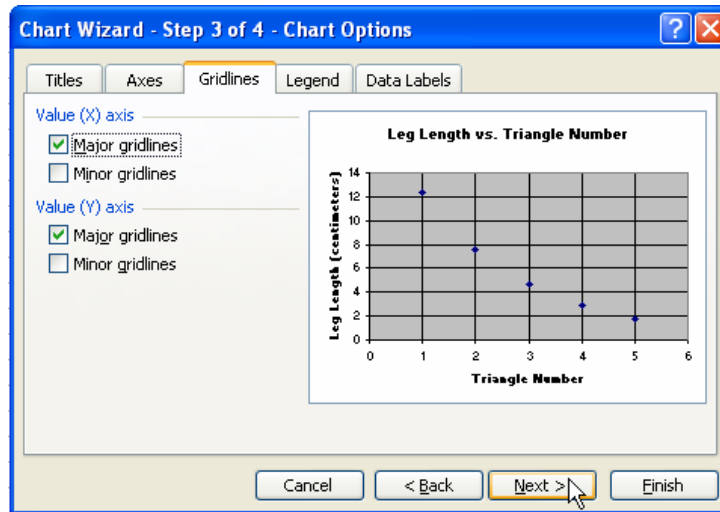


7. Give “Series 1” an appropriate name. Click inside the **Name** text box and type an appropriate name. In this example, we will use “Leg Length.” Click **Next**.

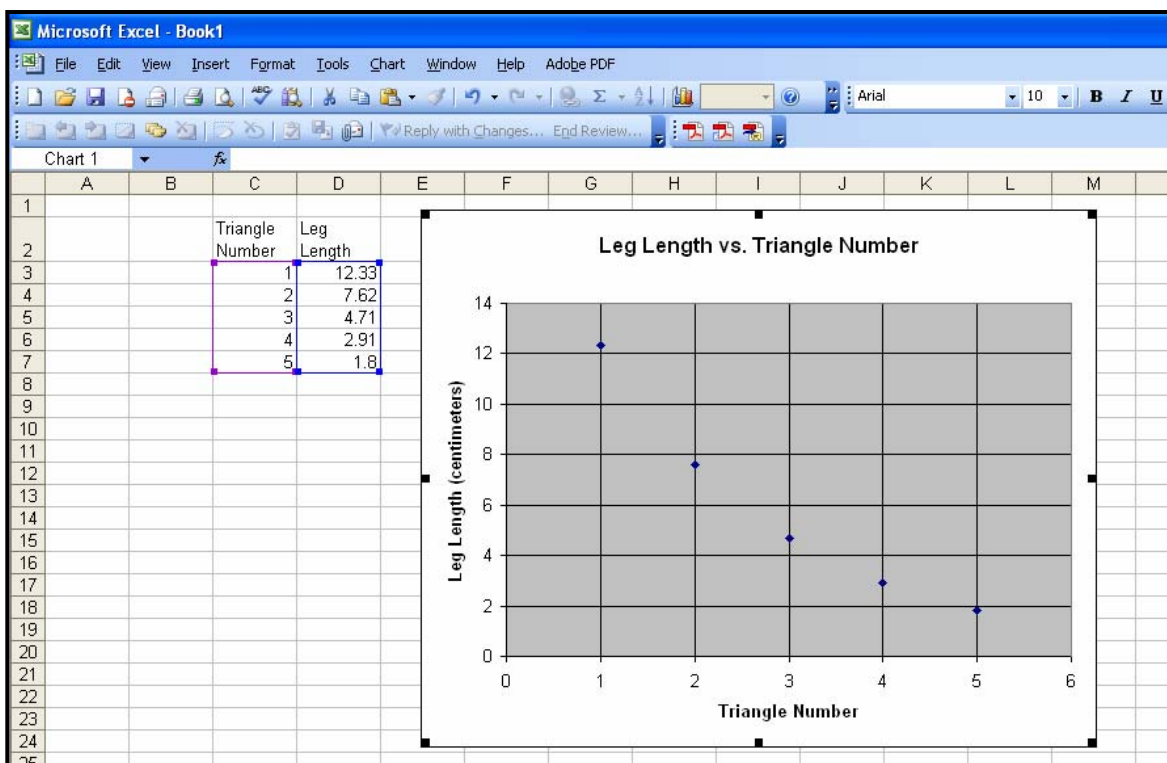
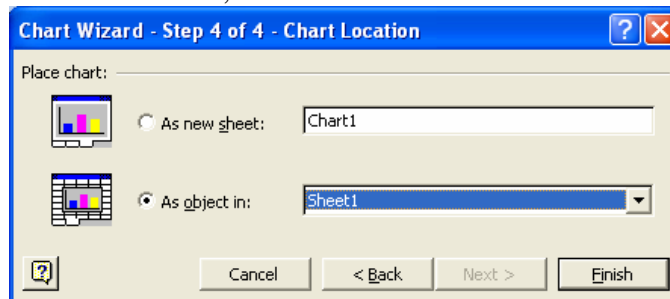


8. At this point you can customize the chart options, including the **Chart title**, **Value (x) axis**, and **Value (y) axis** labels. Enter the pertinent **Chart Options**, including appropriate labels for the x-axis and y-axis. You can also customize the axes, gridlines, legend, and data labels by clicking on the appropriate tab at the top of the dialog box. Click **Next** when you are ready to continue.





9. Select the location of the new chart, then click Finish.

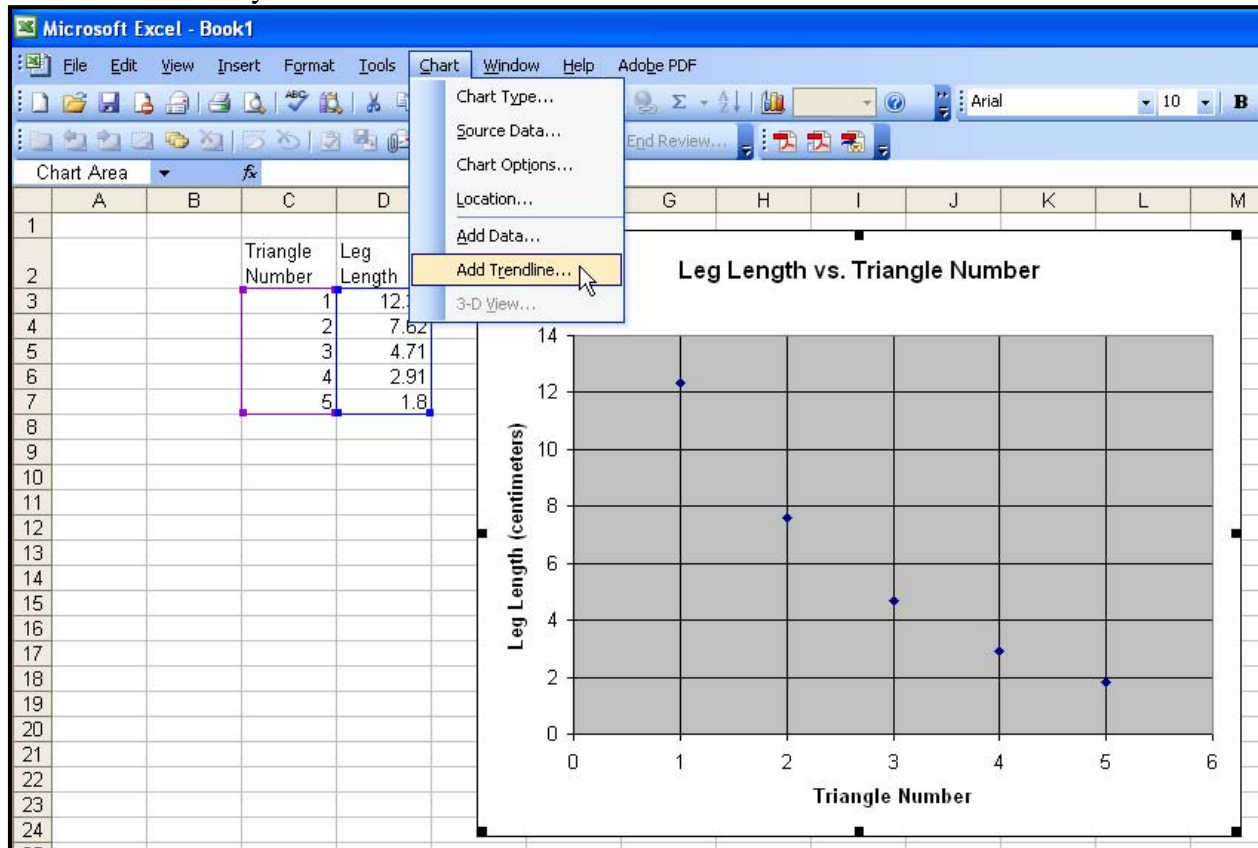


Part 1: Investigating Leg Length

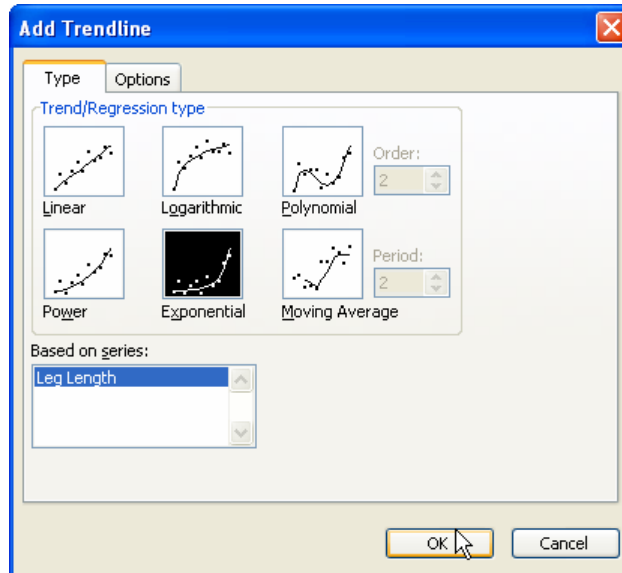


Determining a Function Rule for Leg Length vs. Triangle Number Using a Microsoft Excel Spreadsheet

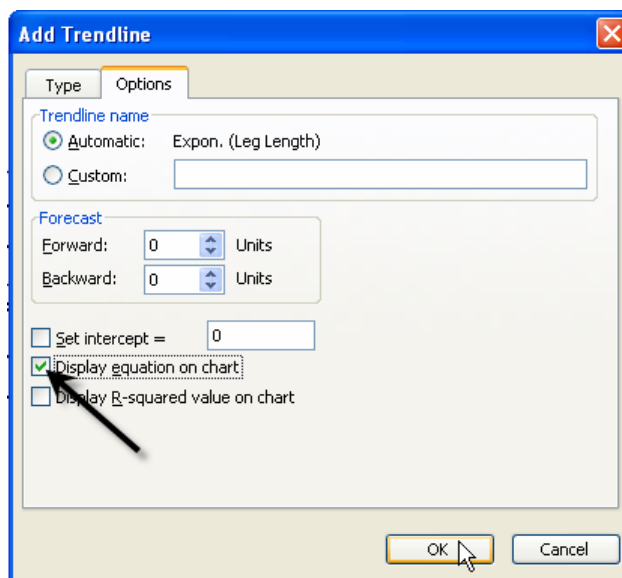
1. Click to select your chart. Choose **Add Trendline** from the **Chart** menu.



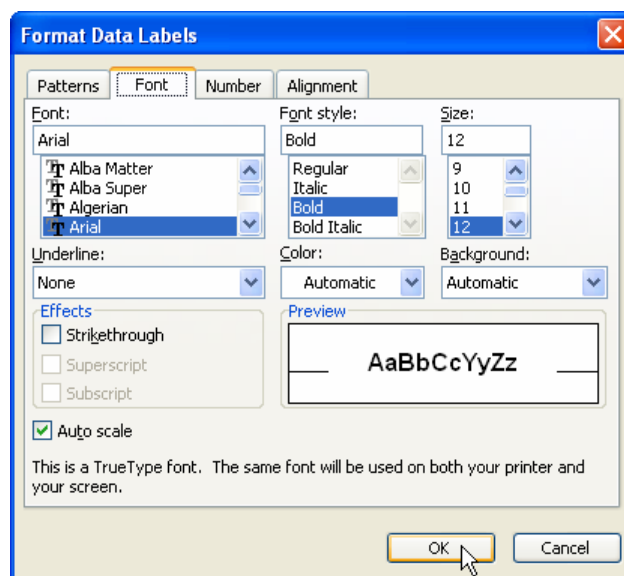
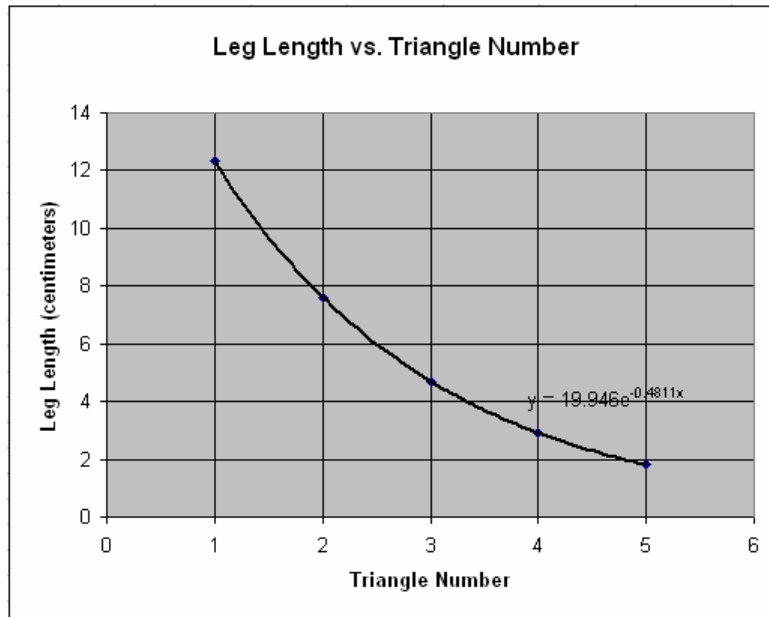
- The **Add Trendline** dialog box will appear. Click on the **parent function** for the trendline you wish to graph. If you select **Polynomial** or **Moving Average**, be sure to select the order or period, respectively.



- Click on the **Options** tab. Click on the **Display equation on chart** check box. Set any other features that you would like to customize related to your trend line. Click **OK**.

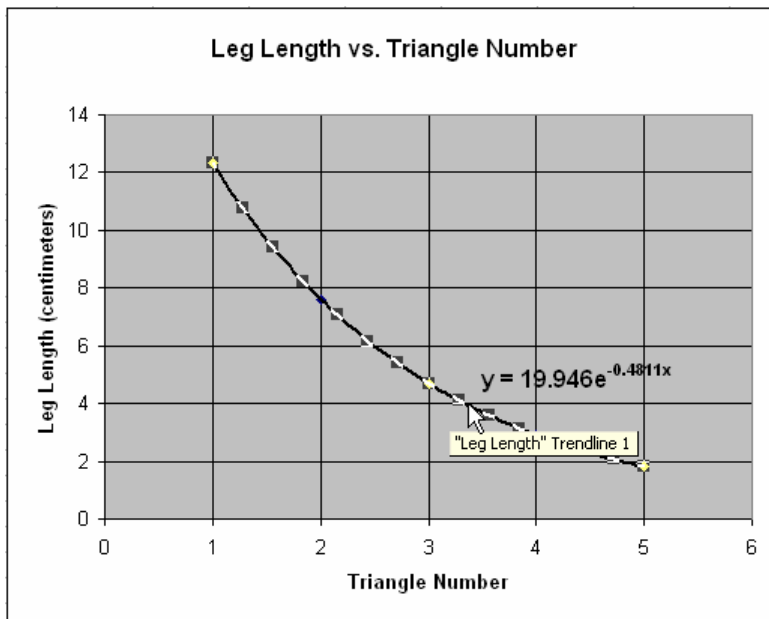


4. Customize the appearance of the equation by double-clicking on the equation. The **Format Data Labels** dialog box will appear. You can change the appearance of the equation, including font, number, and alignment. Click **OK** when you are finished.

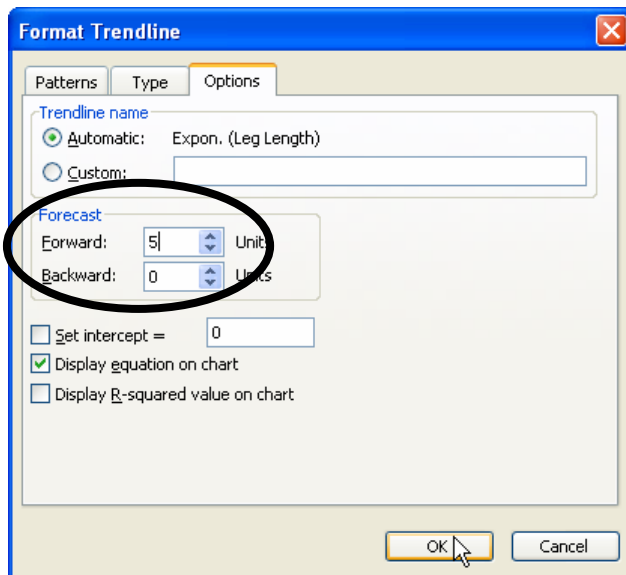


Using the Graph to Make Predictions

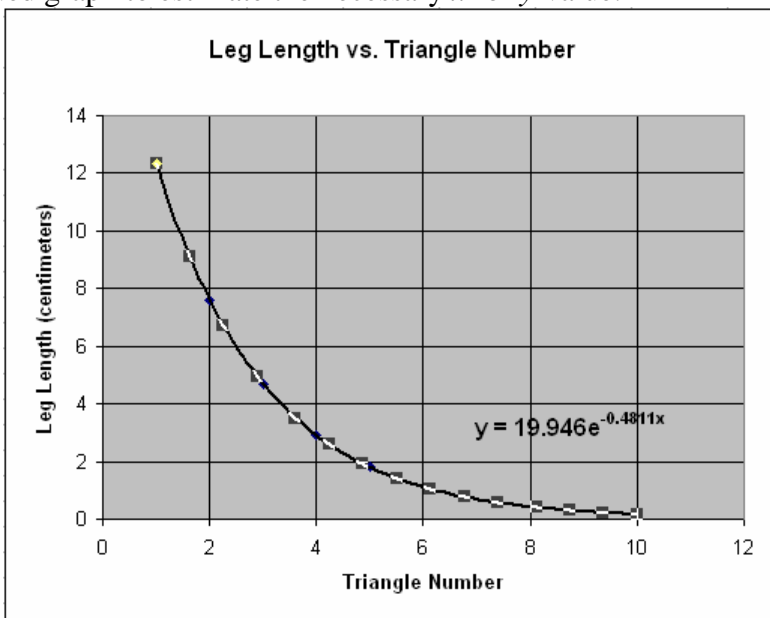
1. Double-click the trendline on your chart. The Format Trendline dialog box will appear.



2. Click the **Options** tab. In the **Forecast** text boxes, enter the number of units that you would like to extend the graph either **Forward** or **Backward** beyond your data set. Click **OK**.



3. Use the extended graph to estimate the necessary x - or y -value.



Part 2: Investigating Dilations



Generating a Scatterplot of Leg Length vs. Dilation Number Using a Graphing Calculator

1. Press **[STAT]**. Then press **[ENTER]**.

```

3001) CALC TESTS
1: Edit...
2: SortA(
3: SortD(
4: ClrList
5: SetUpEditor
  
```

2. You will see a table containing lists. Your calculator may contain data in its lists from a previous investigation. If the lists do not contain previous data, you may skip to step 6.

L1	L2	L3	1
1	30	115	
2	12	-8	
4	15	-10	
5	19	12	
8	23	62	
-7	25	89	
8	30	-169	

L1 = {1, 2, 4, 5, 8, -...

3. To clear this previous data, press **[STAT]**.

```

3001) CALC TESTS
1: Edit...
2: SortA(
3: SortD(
4: ClrList
5: SetUpEditor
  
```

4. Highlight **ClrList**. Enter the lists that you wish to clear. Press **[ENTER]**.

```

ClrList L1, L2, L3
, L4
  
```

5. Press **[ENTER]** again.

```

ClrList L1, L2, L3
, L4
Done
  
```

6. Enter the data into the lists.
Be sure to press **[ENTER]** after each value.

L1	L2	3
0	1.8	-----
1	2.91	
2	4.71	
3	7.62	
4	12.33	
-----	-----	

L3 = L2

7. Press **[2nd]** **[STAT PLOT]**.

```

STAT PLOTS
1:Plot1...Off
  L1 L2
2:Plot2...Off
  L1 L3
3:Plot3...Off
  L1 L2
4↓PlotsOff
    
```

8. Use the arrows to select the necessary options.
For Plot 1, be sure that the Plot is On and a scatterplot is chosen (first Type). The independent variable (XList) is in L₁ and dependent variable (YList) is in L₂.

```

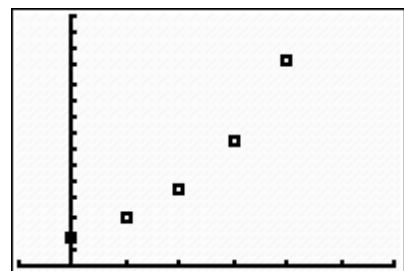
Plot2 Plot3
Off Off
Type: [ ] [ ] [ ]
      [ ] [ ] [ ]
Xlist:L1
Ylist:L2
Mark: [ ] + .
    
```

11. Choose an appropriate window by selecting **[WINDOW]** and specifying the appropriate domain and range.
Use the arrow keys to move up and down.

```

WINDOW
Xmin=-1
Xmax=6
Xscl=1
Ymin=0
Ymax=15
Yscl=1
Xres=1
    
```

12. To view the scatterplot, press **[GRAPH]**.



Part 2: Investigating Dilations



Determining a Function Rule for Leg Length vs. Dilation Number Using a Graphing Calculator

Note: Directions follow for use of a TI-83, TI-83+, or TI-84.

Using Successive Quotients:

- In the List Editor (Press **STAT** then press **ENTER**), copy List 2 into List 3. To do so, use the arrow keys to move the cursor to the List 3 header, then press **2nd** **2**. Press **ENTER**.

L1	L2	L3	3
0	1.8	1.8	
1	2.91	2.91	
2	4.71	4.71	
3	7.62	7.62	
4	12.33	12.33	
-----	-----	-----	
L3(1)=1.8			

- Delete the first element of List 3 by using the arrow keys to select it then press **DEL**.

L1	L2	L3	3
0	1.8	4.71	
1	2.91	4.71	
2	4.71	7.62	
3	7.62	12.33	
4	12.33	-----	
-----	-----	-----	
L3(1)=2.91			

- Delete the last element of List 2 by using the arrow keys to select it then press **DEL**.

L1	L2	L3	2
0	1.8	2.91	
1	2.91	4.71	
2	4.71	7.62	
3	7.62	12.33	
4	-----	-----	
-----	-----	-----	
L2(5) =			

- Use the arrow keys to select the List 4 header. We want List 4 to be the quotient of List 3 and List 2. Enter the formula $L_4 = L_3/L_2$ by pressing **2nd** **3**, **÷**, then **2nd** **2**. List 4 now contains the successive quotients of the leg lengths, or y-values.

L2	L3	L4	4
1.8	2.91	-----	
2.91	4.71	-----	
4.71	7.62	-----	
7.62	12.33	-----	
-----	-----	-----	
L4 = L3 / L2			

L2	L3	L4	4
1.8	2.91	1.6186	
2.91	4.71	1.6186	
4.71	7.62	1.6181	
7.62	12.33	1.6181	
-----	-----	-----	
L4(1)=1.616666666...			

5. Return to the home screen by pressing 2nd MODE or QUIT . Calculate the mean value of the successive quotients (List 4) by using Math operations on the Lists. Retrieve the List menu by pressing 2nd STAT , then choose the Math options using the arrow key \blacktriangleright twice. Use the down arrow key, \blacktriangledown , to select option 3: mean.

```
NAMES OPS  $\text{MATH}$ 
1:min(
2:max(
3:mean(
4:median(
5:sum(
6:prod(
7:stdDev(
```

6. Enter the list name of which you want to find the mean value, in this case List 4 by pressing 2nd 4 . Press ENTER .

```
mean(L4)
1.617792
```

7. Restore the deleted value from List 2. Return to the List Editor (Press STAT then press ENTER) and use the arrow keys to move to the bottom of List 2. Re-enter the value that you deleted.

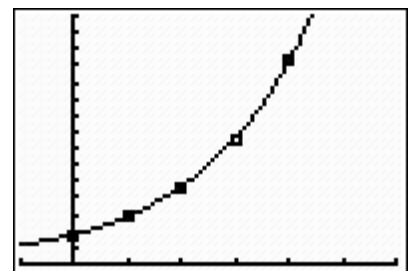
L1	L2	L3	Z
0	1.8	2.91	
1	2.91	4.71	
2	4.71	7.62	
3	7.62	12.33	
4	12.33	-----	
-----	-----	-----	

L2(6) =

8. Use the mean value to determine the values of a and b in the general form $y = a(b)^x$. Graph the function rule that you think might “fit” the data well. To do so, press Y= . Clear out any equations by pressing CLEAR .

```
 $\text{Y=}$  Plot2 Plot3
\Y1=
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

9. Enter the appropriate function rule into Y_1 . Press ENTER . Press GRAPH .



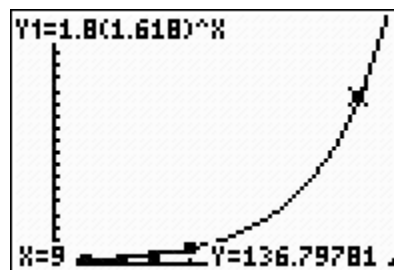
Using the Graph to Make Predictions

1. Press **WINDOW** to adjust the window. Adjust the settings to enlarge the window enough to make predictions.

```

WINDOW
Xmin=-1
Xmax=10
Xscl=1
Ymin=0
Ymax=200
Yscl=10
Xres=1
  
```

2. Press **GRAPH** then **TRACE**. Press **▲** to select the function then trace to the prediction using the right and left arrow keys, **▶▶**.



Using the Table to Make Predictions

1. Press **2nd** **WINDOW**. Enter values for TblStart and ΔTbl , the value of the x increment.

```

TABLE SETUP
TblStart=0
ΔTbl=1
Indent: Auto Ask
Depend: Auto Ask
  
```

2. Press **2nd** **GRAPH**. Use the up and down arrow keys, **▲** and **▼**, to scroll to the desired value.

X	Y1
6	32.296
7	52.254
8	84.547
9	136.8
10	221.34
11	358.13
12	579.45

X=11



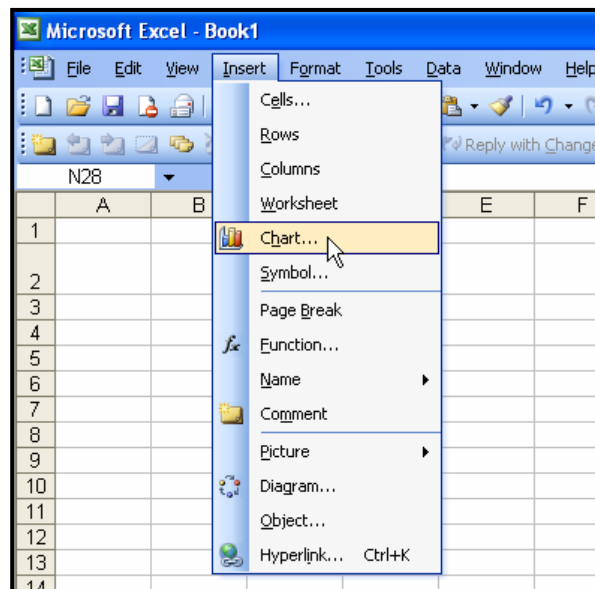
Part 2: Investigating Dilations

Determining a Function Rule for Leg Length vs. Triangle Number Using a Microsoft Excel Spreadsheet

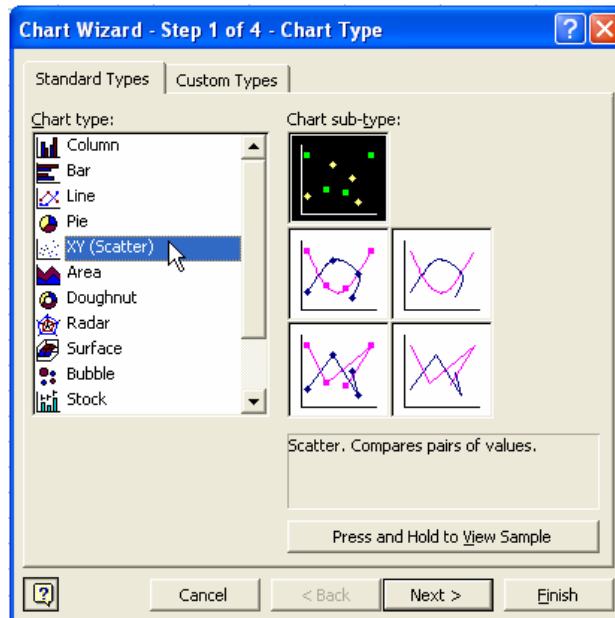
1. Enter your data into a blank Excel spreadsheet.

	A	B	C	D	E	F	G	H	I
1									
2			Dilation Number	Leg Length					
3			0	1.8					
4			1	2.91					
5			2	4.71					
6			3	7.62					
7			4	12.33					
8									

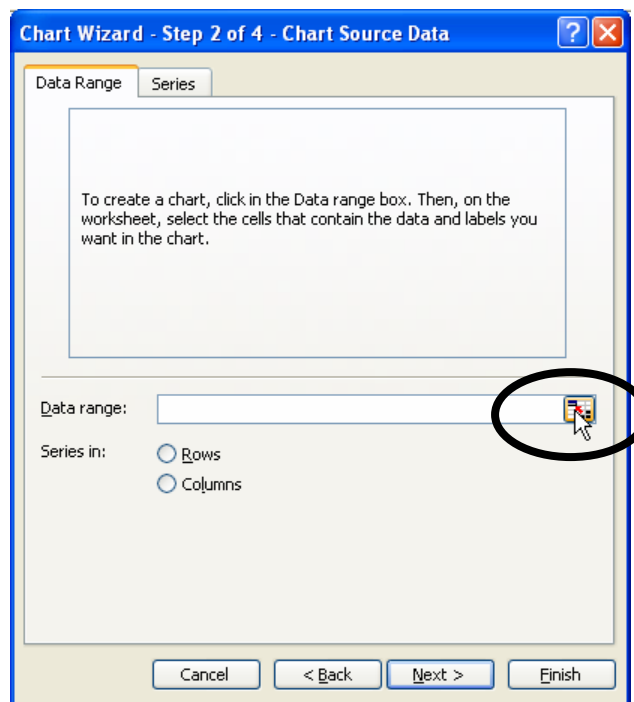
2. Choose **Chart** from the **Insert** menu.



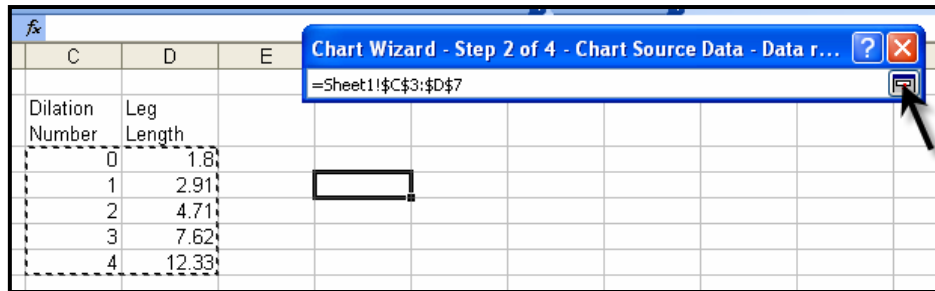
3. Select **XY (Scatter)** from the **Chart Type** selection box then click **Next**.



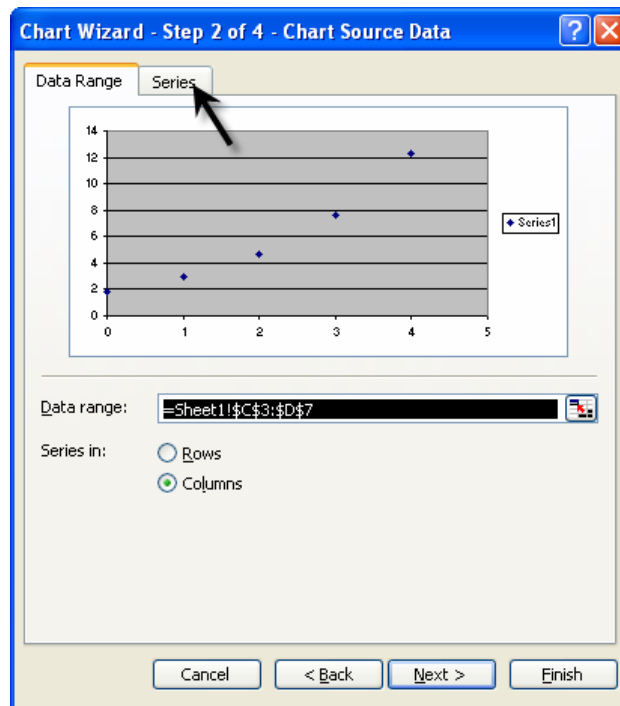
4. To select the Data Range, click the **Collapse Dialog** button next to the **Data Range** text box.



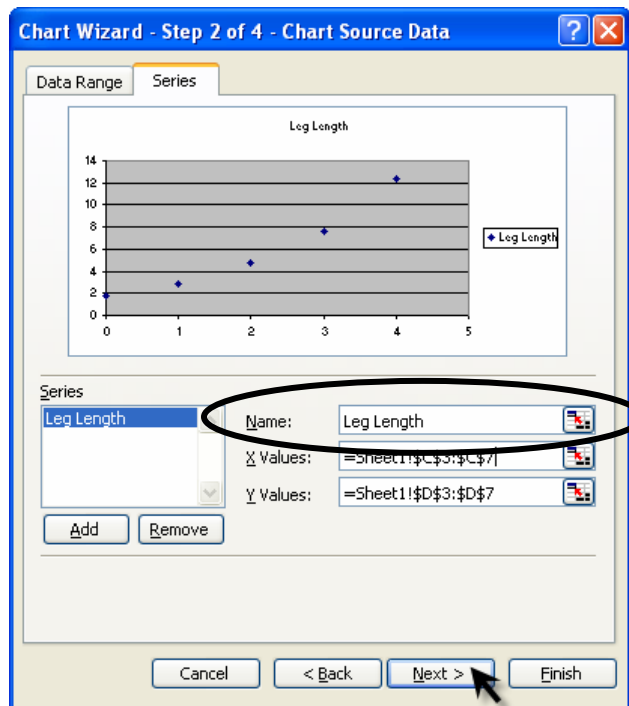
5. Select the cells containing your data then click the **Collapse Dialog** button next to the floating **Chart Source Data** box. You will return to the **Chart Wizard** dialog box.



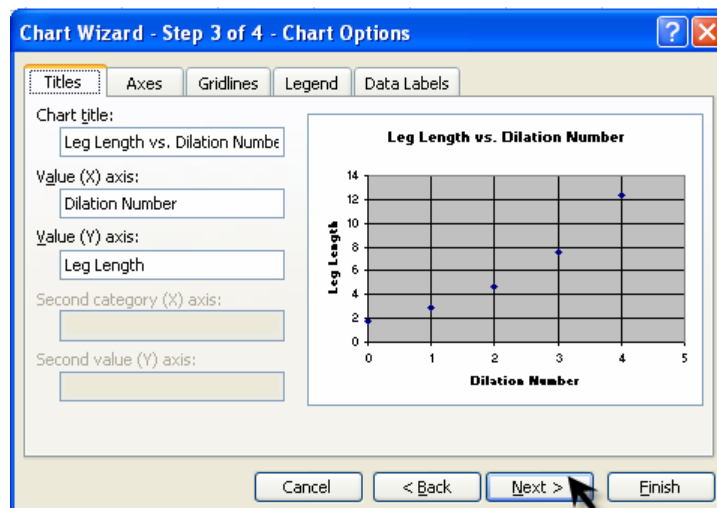
6. Click the **Series** tab to edit the source data features.



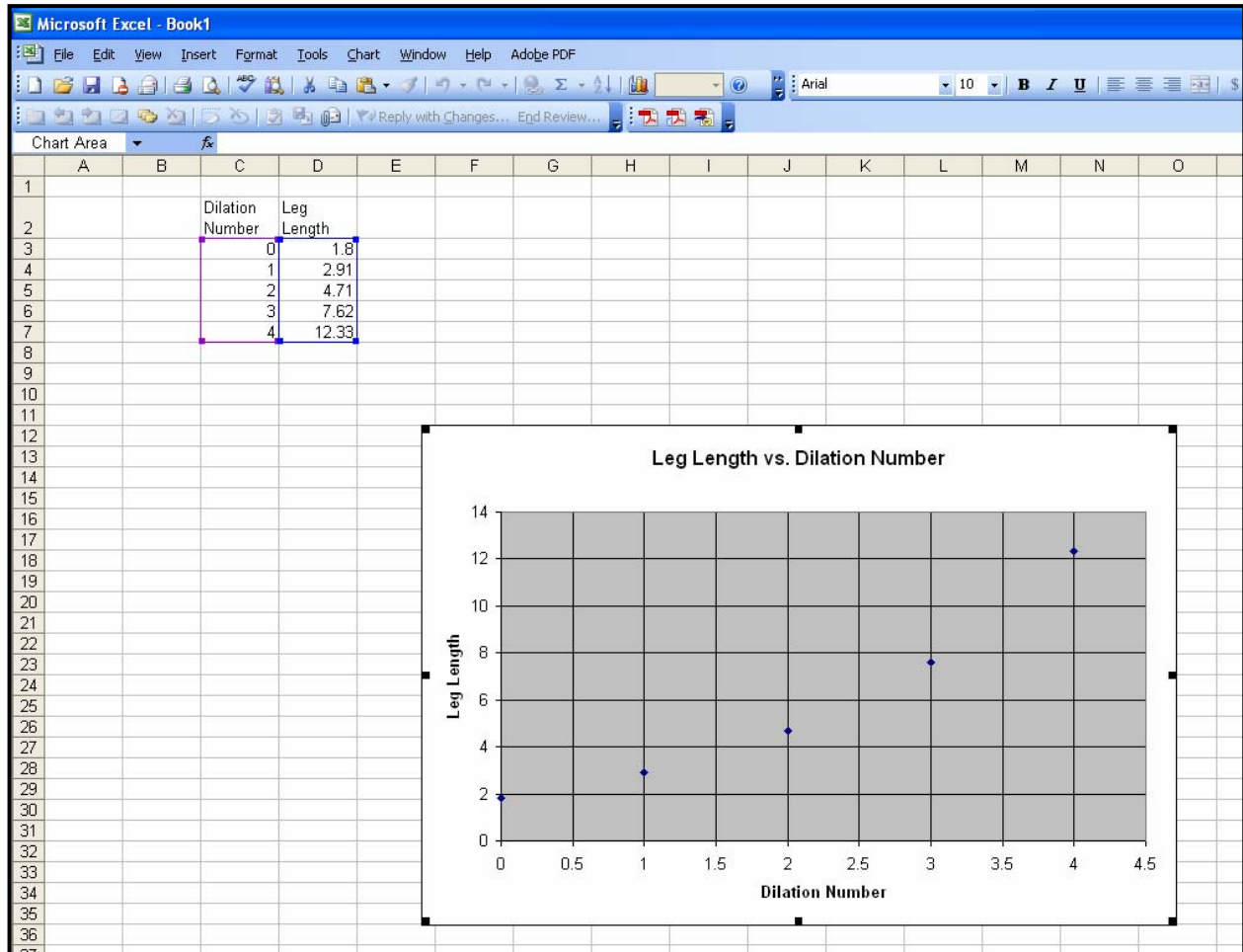
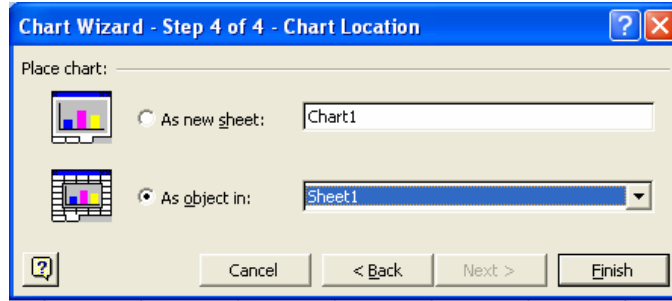
7. Give “Series 1” an appropriate name. Click inside the **Name** text box and type an appropriate name. In this example, we will use “Leg Length.” Click **Next**.



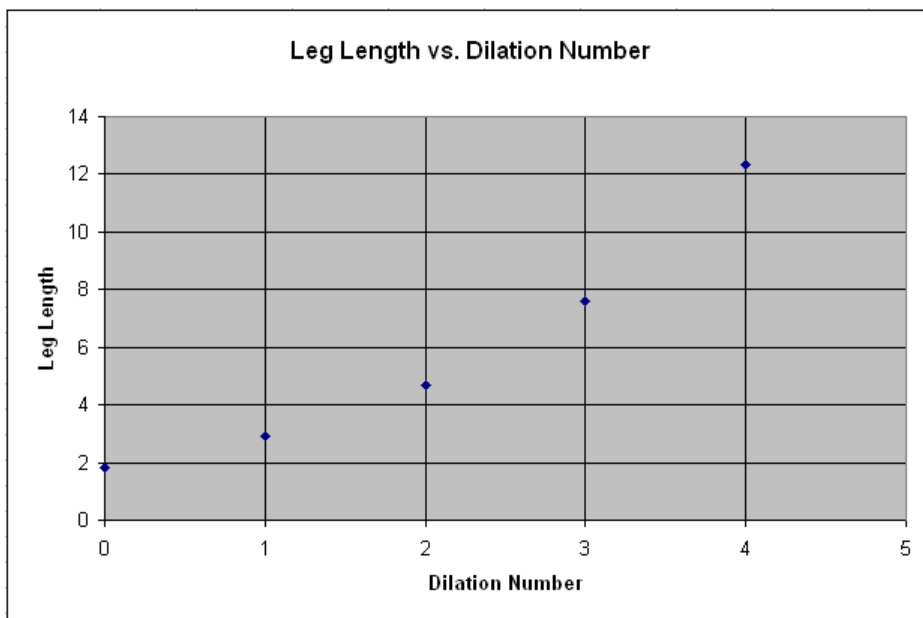
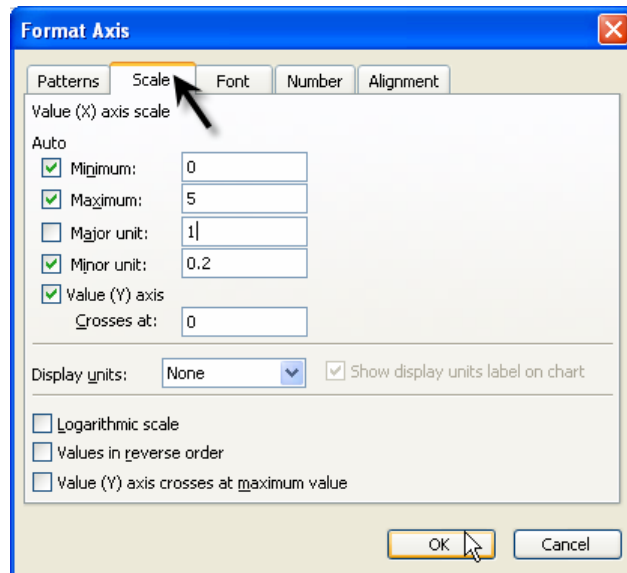
8. At this point you can customize the chart options, including the **Chart title**, **Value (x) axis**, and **Value (y) axis** labels. Enter the pertinent **Chart Options**, including appropriate labels for the x-axis and y-axis. You can also customize the axes, gridlines, legend, and data labels by clicking on the appropriate tab at the top of the dialog box. Click **Next** when you are ready to continue.



9. Select the location of the new chart, then click Finish.



10. You can customize the features of your chart by double-clicking the part that you wish to change. For example, to change the scale of the x -axis, double-click the x -axis. The **Format Axis** dialog box will appear. Click on the **Scale** tab, then change the major unit. Click **OK**.

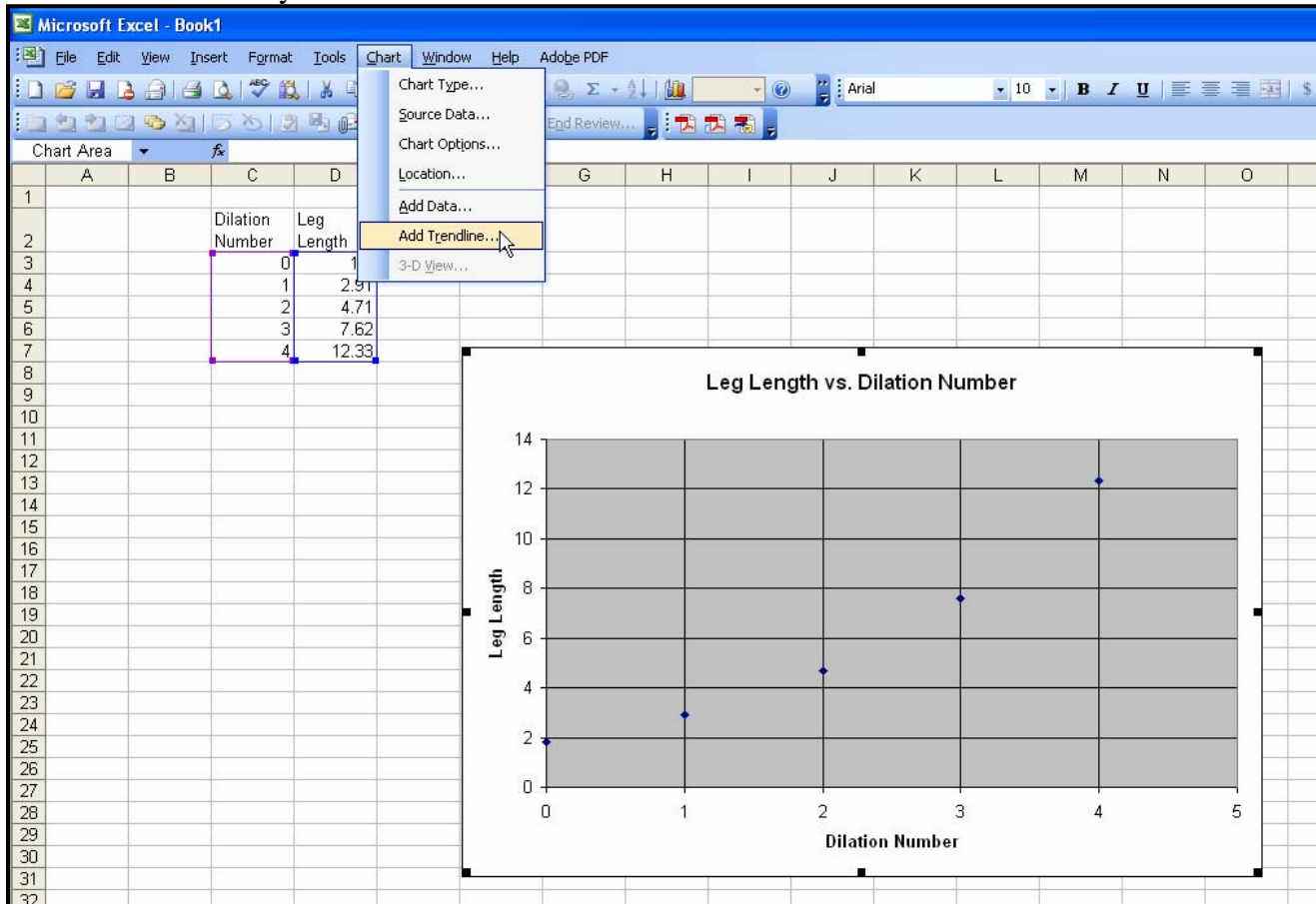


Part 2: Investigating Dilations

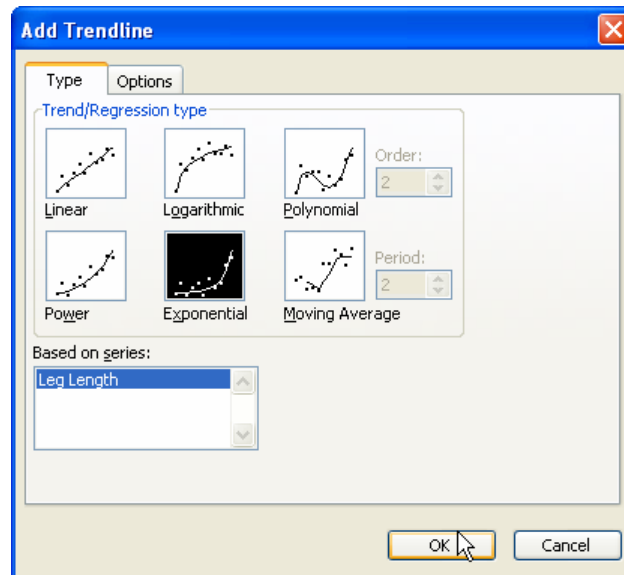


Determining a Function Rule for Leg Length vs. Triangle Number Using a Microsoft Excel Spreadsheet

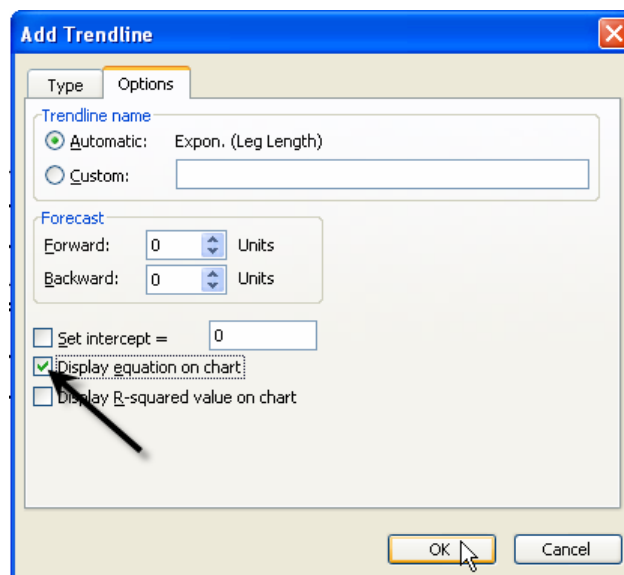
5. Click to select your chart. Choose **Add Trendline** from the **Chart** menu.



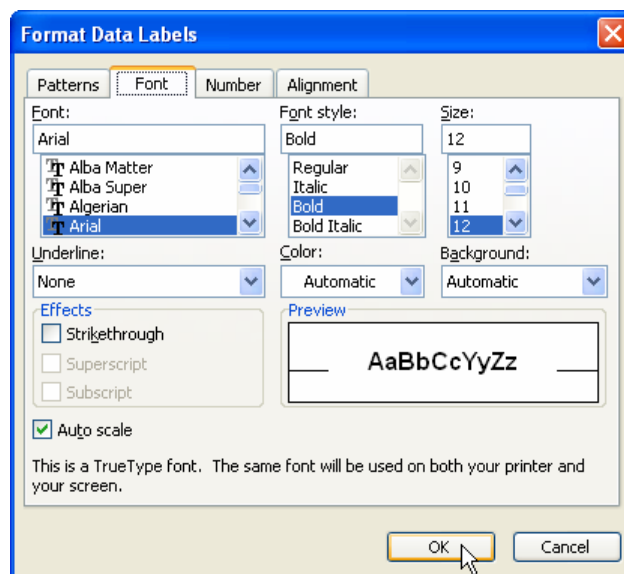
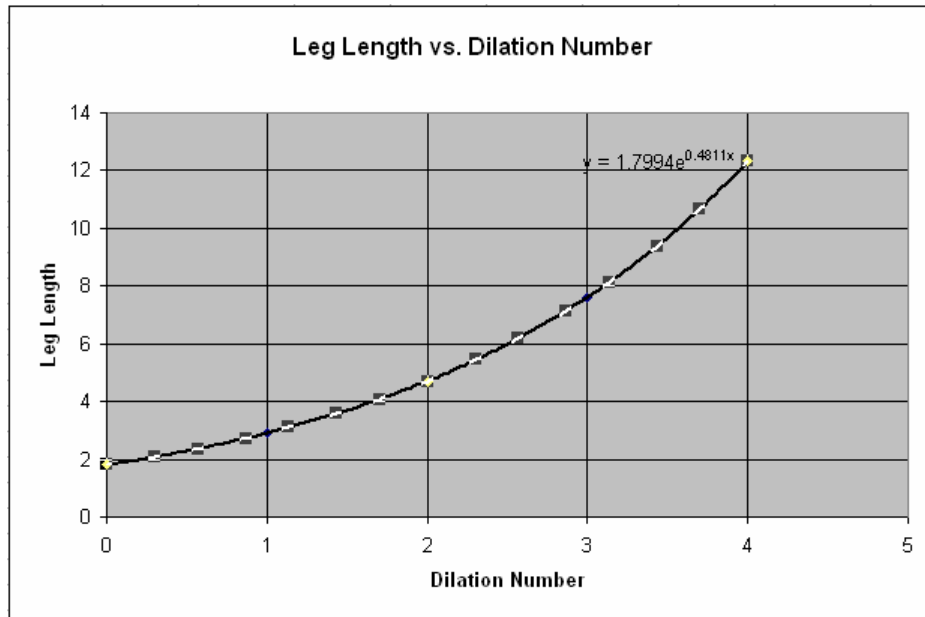
6. The **Add Trendline** dialog box will appear. Click on the **parent function** for the trendline you wish to graph. If you select **Polynomial** or **Moving Average**, be sure to select the order or period, respectively.



7. Click on the **Options** tab. Click on the **Display equation on chart** check box. Set any other features that you would like to customize related to your trend line. Click **OK**.

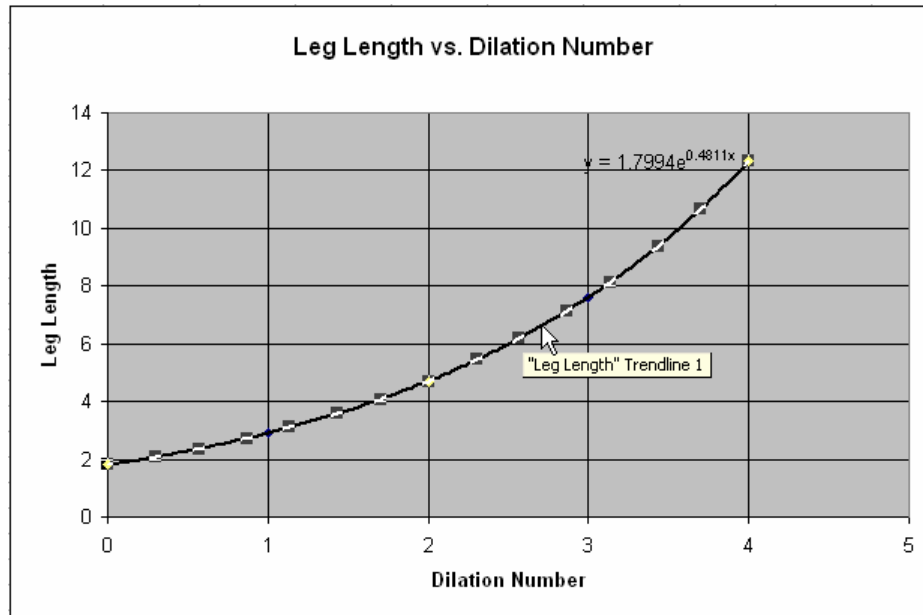


8. Customize the appearance of the equation by double-clicking on the equation. The **Format Data Labels** dialog box will appear. You can change the appearance of the equation, including font, number, and alignment. Click **OK** when you are finished.

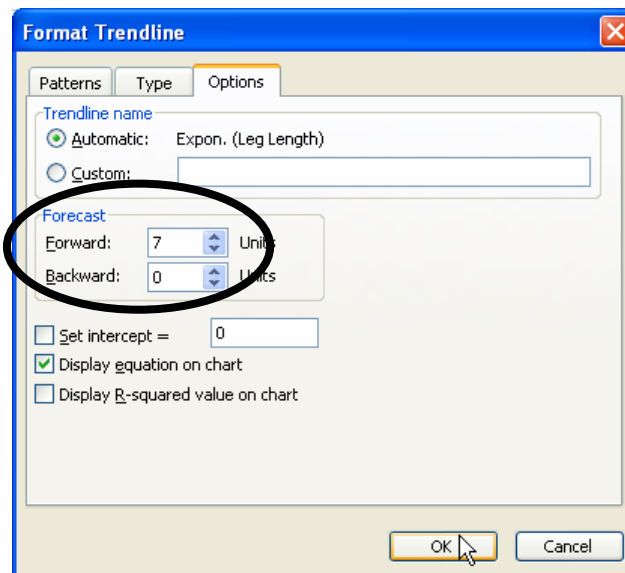


Using the Graph to Make Predictions

4. Double-click the trendline on your chart. The Format Trendline dialog box will appear.



5. Click the **Options** tab. In the **Forecast** text boxes, enter the number of units that you would like to extend the graph either **Forward** or **Backward** beyond your data set. Click **OK**.



6. Use the extended graph to estimate the necessary x - or y -value.

