Quadratic Relations

Calculating Second Differences

Equations that represent a Quadratic Function.

- There are three forms to the equation of a quadratic function.
  - Standard Form $y = ax^2 + bx + c$
  - Factored Form $y = a(x - s)(x - t)$
  - Vertex Form $y = a(x - h)^2 + k$

Variations of these Quadratic Equations.

- $y = x^2$
- $y = x^2 + k$
- $y = ax^2$
- $y = ax^2 + k$
- $y = a(x - h)^2 + k$
- $y = ax^2 + bx + c$
- $y = ax(x - s) + t$
- $y = (x - s)(x - t)$

Linear and Quadratic Relations

- We will compare the graphs, tables of values and equations of each relation.

Linear and Quadratic Relations

- A relation is linear:
  - The graph is a line.
  - The first differences are the same. This number is the slope of the line.
  - The equation has a degree of 1.
- A relation is quadratic:
  - The graph is a parabola.
  - The second differences are equal. The sign of this number tells you the direction of the parabola.
  - The equation has a degree of 2.
- If neither the first of second difference are equal then the relation is not linear or quadratic.

Calculating Second Differences

- First differences are differences found from the y-values in the tables with evenly spaced x-values. First differences are calculated by subtracted consecutive y-values. Second differences are calculated by subtracting consecutive first differences, and so on.

- Example:

  $y = 4x^2 + 3x - 1$

x	y	1st Difference	2nd Difference
-3			
-2			
-1			
0			
1			
2			
3			

Example #1

1.) Determine if the following relations are linear or quadratic or neither.

The first differences are not equal, the second differences are not the equal, therefore this relation is not linear or quadratic.

x	y	first	second
-3	-27		
-2	-8		
-1	-1		
0	0		
1	1		12
2	8		
3	27		

Example #2

x	y
-3	8
0	2
-4	10
-1	4
-2	6
1	0

- The x values must be in order, lowest to highest by ones.
- Rewrite the x values in order with the corresponding y values.

Example #2 (continued)

x	y	First	second
-4	10		
-3	8		
-2	6		
-1	4		
0	2		
1	0		

- The first differences are the same therefore the relation is linear, and we do not need to calculate the second differences.

Example #3

x	y	First	second
-3	32		
-2	18		
-1	8		
0	2		
1	0		
2	2		
3	8		

- The first differences are not the same, and the second differences are equal, therefore this relation is quadratic.

Example #4

- Complete the table of values and determine if this relation represents a linear or quadratic function.
- $y = 2x^2 - x + 6$
- The x-values are consistently increasing by one, the first differences are not the same, there this relation is not linear, the second difference are equal, therefore this relation represents a quadratic function.

x	y	1st	2nd
-3			
-2			
-1			
0			
1			
2			
3			

Homework

- Worksheet ☺