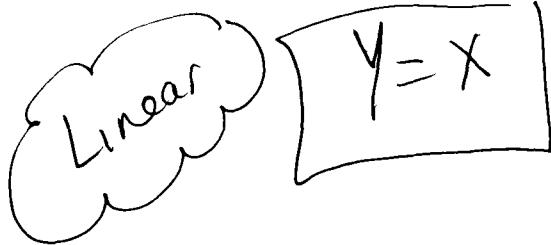


# FINITE DIFFERENCES

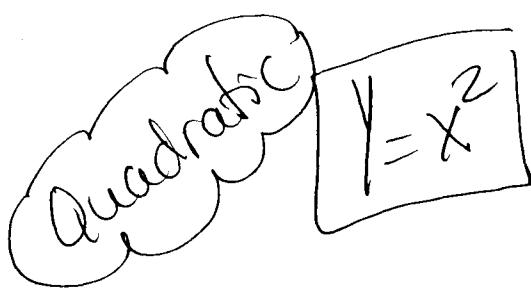
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## Numerical Properties of Polynomial Functions

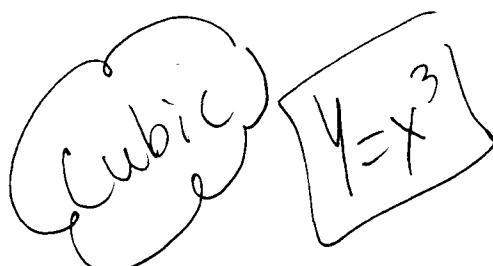
- Consider the function  $y = x$ 
  - What type of function is it?
  - Complete the table of values.
  - Calculate the first differences.
  - In this case, the first differences were positive. How would the graph differ if the first differences were negative?



- Consider the function  $y = x^2$ 
  - What type of function is it?
  - Complete the table of values.
  - Calculate the first and second differences.



- Consider the function  $y = x^3$ 
  - What type of function is it?
  - Complete the table of values.
  - Calculate the first, second, and third differences.



x	y	First Differences	
		First	Second
-3	-3	► +1	
-2	-2	► +1	
-1	-1	► +1	
0	0	► +1	
1	1	► +1	
2	2	► +1	
3	3	► +1	

x	y	Differences		
		First	$\Delta y$	Second
-3	9	► -5		
-2	4	► -3	► +2	
-1	1	► -1	► +2	
0	0	► +1	► +2	
1	1	► +3	► +2	
2	4	► +5	► +2	
3	9			

x	y	Differences			
		First	$\Delta y$	Second	$\Delta y$
-3	-27	► +19			
-2	-8	► +7	► -12		
-1	-1	► +1	► -6	► +6	
0	0	► +1	► 0	► +6	
1	1	► +7	► 6	► +6	
2	8	► +19	► 12	► +6	
3	27				

First Difference is constant  
∴ it is linear

2nd difference is constant  
∴ it is a quadratic

3rd difference is constant  
∴ it is a cubic

4. Consider the function  $y = x^4$
- What type of function is it?
  - Complete the table of values.
  - Calculate the first, second, and third differences.

*Quartic*  
 $y = x^4$

x	y	Differences			
		First $\Delta y$	Second $\Delta^2 y$	Third $\Delta^3 y$	Fourth $\Delta^4 y$
-3	81	► -65			
-2	16	► -15	► 50	► -36	
-1	1	► -1	► 14	► -12	► 24
0	0	► 1	► 2	► 12	► 24
1	1	► 15	► 14	► 36	► 24
2	16	► 65			
3	81				

*4th difference  
is constant  
∴ it is  
a quartic*

*Summary*

$$Y = X$$

linear

$$\Delta y = 1$$

$$Y = X^2$$

quadratic

$$\Delta^2 y = 2$$

$$Y = X^3$$

cubic

$$\Delta^3 y = 6$$

$$Y = X^4$$

quartic

$$\Delta^4 y = 24$$