

Using First Differences to Determine Types of Functions. April 17th

$$y = 2x - 3 \text{ (Linear Function)}$$

x	y	Δy	Change in "y" First Difference
-3	-9		
-2	-7	+2	
-1	-5	+2	
0	-3	+2	
1	-1	+2	
2	1	+2	
3	3		↑

\therefore the first difference is constant \therefore the function is linear.

$$y = (x-3)^2 + 1 \text{ (Quadratic Function)}$$

x	y	Δy	$\Delta^2 y$
-3	37	>-11	
-2	26	>-9	{+2}
-1	17	>-7	{+2}
0	10	>-5	{+2}
1	5	>-3	{+2}
2	2	>-1	{+2}
3	1		

\therefore the second difference is constant \therefore function is a quadratic.

$$y = 2^x \text{ (Exponential)}$$

x	y	Δy
-3	$\frac{1}{8}$	
-2	$\frac{1}{4}$	$\nearrow +\frac{1}{8} \times 2$
-1	$\frac{1}{2}$	$\nearrow +\frac{1}{4} \times 2$
0	1	$\nearrow +\frac{1}{2} \times 2$
1	2	$\nearrow +1 \times 2$
2	4	$\nearrow +2 \times 2$
3	8	$\nearrow +4 \times 2$

Common Ratio for the 1st differences
 then the function is exponential.

$$y = 2^{x-1} + 2$$

x	y	Δy
-3	$\frac{33}{16}$	
-2	$\frac{17}{8}$	$\nearrow +\frac{1}{16} \times 2$
-1	$\frac{9}{4}$	$\nearrow +\frac{1}{8} \times 2$
0	$\frac{5}{2}$	$\nearrow +\frac{1}{4} \times 2$
1	3	$\nearrow +\frac{1}{2} \times 2$
2	4	$\nearrow +1 \times 2$
3	6	$\nearrow +2 \times 2$

$$y = 3x$$

x	y	Δy
-2	1/9	+2/9
-1	1/3	+2/3
0	1	+2
1	3	+6
2	9	

Ex 1 Common ratio of 3, y-int of 5, and horizo-

ntal asymptote $y = -2$.

$$y = a(b)^x + q$$

↑ ↑
stretch common
ratio

horizontal Asymptote.

$$y = a(3)^x - 2 \quad \therefore y = 7(3)^x - 2$$

$$5 = a(3)^0 - 2$$

$$5 = a - 2$$

$$5 + 2 = a$$

$$7 = a$$

Ex 2) Passing through $(-2, -3), (-1, -1), (0, 0)$. Horizontal Asymptote of $y = 1$

General $y = a(b)^x + q$ Find common ratio

$$\begin{array}{l} y = a(b)^x + q \\ y = a(b)^x + 1 \\ y = a(\frac{1}{2})^x + 1 \\ 0 = a(\frac{1}{2})^0 + 1 \\ 0 = a + 1 \\ -1 = a \end{array}$$
$$\begin{array}{c|c|c} x & y & \Delta y \\ \hline -2 & -3 & \\ -1 & -1 & +2 \\ 0 & 0 & +1 \end{array} \times \frac{1}{2}$$
$$\therefore y = -(\frac{1}{2})^x + 1$$