

**Linear vs. Quadratic
& Writing Equations from Tables**

Determining if a function is linear or quadratic from a table:

If the first differences are the same, then it is linear. If the second differences are the same, then it's quadratic.

Linear	Quadratic																								
<p>Determine if the function is linear or quadratic.</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>x</td><td>y</td></tr> <tr><td>1</td><td>7</td></tr> <tr><td>2</td><td>4</td></tr> <tr><td>3</td><td>1</td></tr> <tr><td>4</td><td>-2</td></tr> <tr><td>5</td><td>-5</td></tr> </table> <p>1st Fill in the blanks: $\begin{array}{r} -3 \\ -3 \\ -3 \\ -3 \end{array}$</p> <p>The function is linear because it has a 1st difference that is constant.</p>	x	y	1	7	2	4	3	1	4	-2	5	-5	<p>Determine if the function is linear or quadratic.</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>x</td><td>y</td></tr> <tr><td>1</td><td>9</td></tr> <tr><td>2</td><td>3</td></tr> <tr><td>3</td><td>1</td></tr> <tr><td>4</td><td>3</td></tr> <tr><td>5</td><td>9</td></tr> </table> <p>1st 2nd Fill in the blanks: $\begin{array}{r} -6 \\ -2 \\ +2 \\ +6 \end{array}$ $\begin{array}{r} +4 \\ +4 \\ +4 \end{array}$</p> <p>The function is quadratic because it has a 2nd difference that is constant.</p>	x	y	1	9	2	3	3	1	4	3	5	9
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Determine if the function is Linear or Quadratic. Use the word bank to fill in the blanks.

The function is _____ because it has a _____ that is _____.

Possible responses are:	Linear or Quadratic	1 st difference or 2 nd difference	constant
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<p>EXAMPLE</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>x</td><td>y</td></tr> <tr><td>1</td><td>-15</td></tr> <tr><td>2</td><td>-8</td></tr> <tr><td>3</td><td>-1</td></tr> <tr><td>4</td><td>6</td></tr> <tr><td>5</td><td>13</td></tr> </table> <p>1st 2nd <i>1st diff. is +7</i> <i>..because</i> $-15+7=-8$ $-8+7=-1$ $-1+7=6$ $6+7=13$</p> <p>The function is linear because it has a 1st difference that is constant.</p>	x	y	1	-15	2	-8	3	-1	4	6	5	13	<p>EXAMPLE</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>x</td><td>y</td></tr> <tr><td>1</td><td>2</td></tr> <tr><td>2</td><td>16</td></tr> <tr><td>3</td><td>24</td></tr> <tr><td>4</td><td>26</td></tr> <tr><td>5</td><td>22</td></tr> </table> <p>1st 2nd $+14$ -6 $+8$ -6 $+2$ -6 -4 -6</p> <p>The function is quadratic because it has a 2nd difference that is constant.</p>	x	y	1	2	2	16	3	24	4	26	5	22	<p>1.</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td>x</td><td>y</td></tr> <tr><td>1</td><td>10</td></tr> <tr><td>2</td><td>3</td></tr> <tr><td>3</td><td>4</td></tr> <tr><td>4</td><td>13</td></tr> <tr><td>5</td><td>30</td></tr> </table> <p>The function is _____ because it has a _____ that is _____.</p>	x	y	1	10	2	3	3	4	4	13	5	30
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Writing the Equation from a Table

A linear equation uses the formula $f(x) = mx + b$, so you need to find m & b .

A quadratic equation uses the formula $f(x) = ax^2 + bx + c$, so you need to find $a, b, & c$.

Steps for writing the Linear equation...	Linear Example																																				
<p>Step 1: Find the 1st differences.</p>	<table border="1"> <tr><td>x</td><td>y</td><td></td></tr> <tr><td>1</td><td>7</td><td></td></tr> <tr><td>2</td><td>4</td><td></td></tr> <tr><td>3</td><td>1</td><td></td></tr> <tr><td>4</td><td>-2</td><td></td></tr> <tr><td>5</td><td>-5</td><td></td></tr> </table> <p style="text-align: center;">↑ That gives us this ↓</p> <table border="1"> <tr><td>x</td><td>y</td><td>1st</td></tr> <tr><td>1</td><td>7</td><td>-3</td></tr> <tr><td>2</td><td>4</td><td>-3</td></tr> <tr><td>3</td><td>1</td><td>-3</td></tr> <tr><td>4</td><td>-2</td><td>-3</td></tr> <tr><td>5</td><td>-5</td><td>-3</td></tr> </table>	x	y		1	7		2	4		3	1		4	-2		5	-5		x	y	1 st	1	7	-3	2	4	-3	3	1	-3	4	-2	-3	5	-5	-3
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<p>Step 2: Find the leading coefficient (the first number in the equation), m.</p> <p>Here's how When it's <u>linear</u>, $f(x) = mx + b$, the leading coefficient is: $m = \frac{1st\ difference}{1}$</p>	<p>When it's linear, use: $f(x) = mx + b$</p> $m = \frac{first\ difference}{1}$ $m = \frac{-3}{1}$ $m = -3$ <p>My equation so far: $f(x) = mx + b$ $f(x) = -3x + b$</p>																																				
<p>Step 3: Find the constant (the last number in the equation-the one that doesn't have an x), b.</p> <p>Here's how The constant (b) is where x is 0.</p> <p>So, use the differences to find what y would be if x were 0.</p>	<p>$b = y$ when $x = 0$ (use the 1st difference to get 0)</p> <p><i>I know that the y-value at $x = 0$ is b, and that it will go down 3 units to become 7 (the y-value at $x = 1$). So...</i></p> <table border="1"> <tr><td>x</td><td>y</td><td>1st</td></tr> <tr><td>0</td><td>b</td><td></td></tr> <tr><td>1</td><td>7</td><td>-3</td></tr> </table> $b - 3 = 7$ $b = 10$ <p>My equation so far: $f(x) = -3x + b$ $f(x) = -3x + 10$</p> <p>I'm done! The equation of this line is: $f(x) = -3x + 10$.</p>	x	y	1 st	0	b		1	7	-3																											
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<p>Step 3: Find the constant (the last number in the equation-the one that doesn't have an <i>x</i>), <i>c</i>.</p> <p>Here's how The constant (<i>b</i>) is where <i>x</i> is 0.</p> <p>First, use the second differences to figure out what the first difference is</p>	<p style="text-align: center;">$c = y$ when $x = 0$ (Start by using the 2nd difference to find the 1st)</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">0</td><td style="border: 1px solid black; padding: 2px;">c</td><td style="border: 1px solid black; padding: 2px;">1st</td><td style="border: 1px solid black; padding: 2px;">2nd</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">1</td><td style="border: 1px solid black; padding: 2px;">9</td><td style="border: 1px solid black; padding: 2px;">?</td><td style="border: 1px solid black; padding: 2px;">+4</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">2</td><td style="border: 1px solid black; padding: 2px;">3</td><td style="border: 1px solid black; padding: 2px;">-6</td><td style="border: 1px solid black; padding: 2px;">+4</td> </tr> </table> <p style="text-align: center; margin-top: 5px;"><i>So, focusing on the 1st difference that I need...</i></p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">?</td><td style="border: 1px solid black; padding: 2px;">+4</td><td style="padding: 2px;">$1^{st} + 4 = -6$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">-6</td><td style="border: 1px solid black; padding: 2px;">+4</td><td style="padding: 2px;">$1^{st} = -10$</td> </tr> </table>	0	c	1 st	2 nd	1	9	?	+4	2	3	-6	+4	?	+4	$1^{st} + 4 = -6$	-6	+4	$1^{st} = -10$	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>7</td></tr> <tr><td>2</td><td>11</td></tr> <tr><td>3</td><td>17</td></tr> <tr><td>4</td><td>25</td></tr> <tr><td>5</td><td>35</td></tr> </table>	x	y	1	7	2	11	3	17	4	25	5	35	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>13</td></tr> <tr><td>3</td><td>19</td></tr> <tr><td>4</td><td>21</td></tr> <tr><td>5</td><td>19</td></tr> </table>	x	y	1	3	2	13	3	19	4	21	5	19																														
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<p>Now, use the 1st differences to find what <i>y</i> would be if <i>x</i> were 0.</p>	<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">0</td><td style="border: 1px solid black; padding: 2px;">c</td><td style="border: 1px solid black; padding: 2px;">1st</td><td style="padding: 2px;">$c - 10 = 9$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">1</td><td style="border: 1px solid black; padding: 2px;">9</td><td style="border: 1px solid black; padding: 2px;">-10</td><td style="padding: 2px;">$c = 19$</td> </tr> </table> <p style="text-align: center; margin-top: 5px;">My equation so far: $f(x) = 2x^2 + bx + c$ $f(x) = 2x^2 + bx + 19$</p>	0	c	1 st	$c - 10 = 9$	1	9	-10	$c = 19$	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>7</td></tr> <tr><td>2</td><td>11</td></tr> <tr><td>3</td><td>17</td></tr> <tr><td>4</td><td>25</td></tr> <tr><td>5</td><td>35</td></tr> </table>	x	y	1	7	2	11	3	17	4	25	5	35	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>13</td></tr> <tr><td>3</td><td>19</td></tr> <tr><td>4</td><td>21</td></tr> <tr><td>5</td><td>19</td></tr> </table>	x	y	1	3	2	13	3	19	4	21	5	19																																								
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<p>Finally, use the point (1, 9) to solve for <i>b</i>. (Plug them in)</p>	<p>(1, 9) → $f(x) = 2x^2 + bx + 19$ $9 = 2(1)^2 + b(1) + 19$ $9 = 2 + 1b + 19$ $9 = b + 21$ $-12 = b$</p> <p>So, my equation is: $f(x) = 2x^2 - 12x + 19$</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>7</td></tr> <tr><td>2</td><td>11</td></tr> <tr><td>3</td><td>17</td></tr> <tr><td>4</td><td>25</td></tr> <tr><td>5</td><td>35</td></tr> </table>	x	y	1	7	2	11	3	17	4	25	5	35	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th>x</th><th>y</th></tr> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>13</td></tr> <tr><td>3</td><td>19</td></tr> <tr><td>4</td><td>21</td></tr> <tr><td>5</td><td>19</td></tr> </table>	x	y	1	3	2	13	3	19	4	21	5	19																																																
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When you're done solving the problems on this handout, make sure you check your answers against the **correct answers below**.

1. The function is quadratic because it has a 2nd difference that is constant .	2. The function is linear because it has a 1st difference that is constant .
3. The function is linear because it has a 1st difference that is constant .	4. The function is quadratic because it has a 2nd difference that is constant .
5. The function is linear because it has a 1st difference that is constant .	6. The function is quadratic because it has a 2nd difference that is constant .
7. The function is quadratic because it has a 2nd difference that is constant .	8. $f(x) = 3x - 4$
9. $f(x) = -6x + 21$	10. $f(x) = 2x - 20$
11. $f(x) = 5x - 8$	12. $f(x) = -7x + 31$
13. $f(x) = 11x - 28$	14. $f(x) = 4x^2 - 19x + 25$
15. $f(x) = -x^2 + 8x - 15$	16. $f(x) = -3x^2 + 21x - 19$
17. $f(x) = -5x^2 + 24x - 33$	18. $f(x) = x^2 + x + 5$
19. $f(x) = -2x^2 + 16x - 11$	