

# Fitting a Line to Data

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Q Quick Review

When a scatter plot looks roughly linear, you can draw a **line of best fit** (a *trend line*) that passes as close as possible to all the points, with about half above and half below. A good fit follows the *direction* of the cloud and stays in the *middle* of it. Once you have two points on that line, find the **slope** with  $m = \frac{y_2 - y_1}{x_2 - x_1}$  — it tells you how fast  $y$  changes per unit of  $x$ . Then use  $y = mx + b$ , where  $b$  is the  **$y$ -intercept** (the value of  $y$  when  $x = 0$ ). The closer the points hug your line, the better the fit.

◇ **Example:** The points (0, 2), (2, 5), (4, 9), (6, 14) lie nearly on a line through (0, 2) and (6, 14). Find the equation of that line.

⇒ First find the slope using the two given points:  $m = \frac{14 - 2}{6 - 0} = \frac{12}{6} = 2$ . So  $y$  goes up about 2 for every step in  $x$ . Next, the  $y$ -intercept is the  $y$ -value when  $x = 0$ , and the point (0, 2) tells us that directly:  $b = 2$ . Putting it together, the line of best fit is  $y = 2x + 2$ . You can sanity-check it: at  $x = 4$  it predicts  $y = 10$ , which is close to the real value 9 — a nice fit!

**Answer:**  $y = 2x + 2$

## PRACTICE

Find the equation of the trend line through the two given points.

- |                                |       |                                |       |
|--------------------------------|-------|--------------------------------|-------|
| 1. through (0, 1) and (4, 9)   | _____ | 11. through (0, 4) and (8, 8)  | _____ |
| 2. through (0, 3) and (5, 13)  | _____ | 12. through (3, 5) and (3, 12) | _____ |
| 3. through (0, 0) and (3, 12)  | _____ | 13. through (2, 1) and (8, 4)  | _____ |
| 4. through (0, 5) and (10, 0)  | _____ | 14. through (0, -3) and (4, 5) | _____ |
| 5. through (0, 2) and (4, 2)   | _____ | 15. through (1, 6) and (3, 2)  | _____ |
| 6. through (1, 3) and (5, 11)  | _____ | 16. through (0, 1) and (6, 4)  | _____ |
| 7. through (2, 4) and (6, 16)  | _____ | 17. through (2, 7) and (5, 7)  | _____ |
| 8. through (0, 7) and (2, 3)   | _____ | 18. through (1, 2) and (4, 14) | _____ |
| 9. through (1, 1) and (4, 10)  | _____ | 19. through (0, 9) and (3, 0)  | _____ |
| 10. through (0, 10) and (5, 0) | _____ | 20. through (2, 5) and (7, 20) | _____ |

## ◆ Word Problems

21. A taxi's fare data fit a line through (0, 3) and (4, 11), where  $x$  is miles and  $y$  is dollars. Find the trend line and explain what the slope and intercept mean. \_\_\_\_\_
22. A candle burns so its height data fit a line through (0, 12) and (6, 0), where  $x$  is hours and  $y$  is height in cm. Find the trend line. \_\_\_\_\_
23. A gym's data on weeks of training and pull-ups completed fit a line through (2, 4) and (8, 16). Find the trend line. \_\_\_\_\_
24. A phone's battery percent over time fits a line through (0, 100) and (5, 60), where  $x$  is hours. Find the trend line and predict the battery at  $x = 10$  hours. \_\_\_\_\_



## Answer Keys

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| <ol style="list-style-type: none"> <li>1. <math>y = 2x + 1</math></li> <li>2. <math>y = 2x + 3</math></li> <li>3. <math>y = 4x</math></li> <li>4. <math>y = -\frac{1}{2}x + 5</math></li> <li>5. <math>y = 2</math></li> <li>6. <math>y = 2x + 1</math></li> <li>7. <math>y = 3x - 2</math></li> <li>8. <math>y = -2x + 7</math></li> <li>9. <math>y = 3x - 2</math></li> <li>10. <math>y = -2x + 10</math></li> <li>11. <math>y = \frac{1}{2}x + 4</math></li> <li>12. <math>x = 3</math></li> </ol> | <ol style="list-style-type: none"> <li>13. <math>y = \frac{1}{2}x</math></li> <li>14. <math>y = 2x - 3</math></li> <li>15. <math>y = -2x + 8</math></li> <li>16. <math>y = \frac{1}{2}x + 1</math></li> <li>17. <math>y = 7</math></li> <li>18. <math>y = 4x - 2</math></li> <li>19. <math>y = -3x + 9</math></li> <li>20. <math>y = 3x - 1</math></li> <li>21. <math>y = 2x + 3</math>; \$3 base fare, \$2 per mile</li> <li>22. <math>y = -2x + 12</math></li> <li>23. <math>y = 2x</math></li> <li>24. <math>y = -8x + 100</math>; 20% at 10 hours</li> </ol> |
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### Step-by-Step Explanations

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| <ol style="list-style-type: none"> <li>1. Slope = <math>\frac{9-1}{4-0} = 2</math>, and <math>(0, 1)</math> gives <math>b = 1</math>, so <math>y = 2x + 1</math>.</li> <li>2. Slope = <math>\frac{13-3}{5-0} = 2</math>; the point <math>(0, 3)</math> gives <math>b = 3</math>, so <math>y = 2x + 3</math>.</li> <li>3. Slope = <math>\frac{12-0}{3-0} = 4</math>, and <math>b = 0</math> from <math>(0, 0)</math>, so <math>y = 4x</math>.</li> <li>4. Slope = <math>\frac{0-5}{10-0} = -\frac{1}{2}</math>; <math>(0, 5)</math> gives <math>b = 5</math>, so <math>y = -\frac{1}{2}x + 5</math>.</li> <li>5. Slope = <math>\frac{2-2}{4-0} = 0</math>, so the line is flat: <math>y = 2</math>.</li> <li>6. Slope = <math>\frac{11-3}{5-1} = 2</math>. Use <math>y - 3 = 2(x - 1)</math>, which simplifies to <math>y = 2x + 1</math>.</li> <li>7. Slope = <math>\frac{16-4}{6-2} = 3</math>. Then <math>y - 4 = 3(x - 2)</math> gives <math>y = 3x - 2</math>.</li> <li>8. Slope = <math>\frac{3-7}{2-0} = -2</math>; <math>(0, 7)</math> gives <math>b = 7</math>, so <math>y = -2x + 7</math>.</li> <li>9. Slope = <math>\frac{10-1}{4-1} = 3</math>. Then <math>y - 1 = 3(x - 1)</math> gives <math>y = 3x - 2</math>.</li> <li>10. Slope = <math>\frac{0-10}{5-0} = -2</math>; <math>(0, 10)</math> gives <math>b = 10</math>, so <math>y = -2x + 10</math>.</li> <li>11. Slope = <math>\frac{8-4}{8-0} = \frac{1}{2}</math>; <math>(0, 4)</math> gives <math>b = 4</math>, so <math>y = \frac{1}{2}x + 4</math>.</li> <li>12. Both points have <math>x = 3</math> but different <math>y</math> — the line is vertical, so <math>x = 3</math> (it has no slope).</li> <li>13. Slope = <math>\frac{4-1}{8-2} = \frac{1}{2}</math>. Then <math>y - 1 = \frac{1}{2}(x - 2)</math> gives <math>y = \frac{1}{2}x</math>.</li> </ol> | <ol style="list-style-type: none"> <li>14. Slope = <math>\frac{5-(-3)}{4-0} = 2</math>; <math>(0, -3)</math> gives <math>b = -3</math>, so <math>y = 2x - 3</math>.</li> <li>15. Slope = <math>\frac{2-6}{3-1} = -2</math>. Then <math>y - 6 = -2(x - 1)</math> gives <math>y = -2x + 8</math>.</li> <li>16. Slope = <math>\frac{4-1}{6-0} = \frac{1}{2}</math>; <math>(0, 1)</math> gives <math>b = 1</math>, so <math>y = \frac{1}{2}x + 1</math>.</li> <li>17. The <math>y</math>-value stays 7 while <math>x</math> changes, so the slope is 0 and the line is <math>y = 7</math>.</li> <li>18. Slope = <math>\frac{14-2}{4-1} = 4</math>. Then <math>y - 2 = 4(x - 1)</math> gives <math>y = 4x - 2</math>.</li> <li>19. Slope = <math>\frac{0-9}{3-0} = -3</math>; <math>(0, 9)</math> gives <math>b = 9</math>, so <math>y = -3x + 9</math>.</li> <li>20. Slope = <math>\frac{20-5}{7-2} = 3</math>. Then <math>y - 5 = 3(x - 2)</math> gives <math>y = 3x - 1</math>.</li> <li>21. Slope = <math>\frac{11-3}{4-0} = 2</math> and <math>b = 3</math>, so <math>y = 2x + 3</math>. The intercept \$3 is the starting fare before driving, and the slope \$2 is the cost added per mile.</li> <li>22. Slope = <math>\frac{0-12}{6-0} = -2</math> (it loses 2 cm per hour) and <math>b = 12</math> (it started 12 cm tall), so <math>y = -2x + 12</math>.</li> <li>23. Slope = <math>\frac{16-4}{8-2} = 2</math>. Using <math>y - 4 = 2(x - 2)</math> gives <math>y = 2x</math>, so on average 2 more pull-ups per week of training.</li> <li>24. Slope = <math>\frac{60-100}{5-0} = -8</math> and <math>b = 100</math>, so <math>y = -8x + 100</math>. At <math>x = 10</math>: <math>y = -8(10) + 100 = 20</math>, so about 20% left.</li> </ol> |
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