

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.

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|--------------------------------|-------|--------------------------------|-------|
| 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

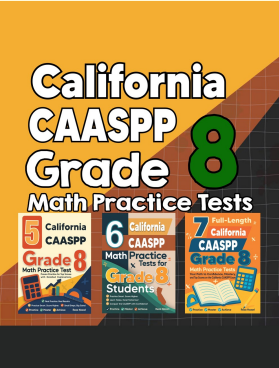
- | | |
|---|--|
| <ol style="list-style-type: none"> 1. $y = 2x + 1$ 2. $y = 2x + 3$ 3. $y = 4x$ 4. $y = -\frac{1}{2}x + 5$ 5. $y = 2$ 6. $y = 2x + 1$ 7. $y = 3x - 2$ 8. $y = -2x + 7$ 9. $y = 3x - 2$ 10. $y = -2x + 10$ 11. $y = \frac{1}{2}x + 4$ 12. $x = 3$ | <ol style="list-style-type: none"> 13. $y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

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