Fitting a Line to Data

Name: _____	Date: _____	Score: _____ / 24

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 $m = \dfrac{y_2 - y_1}{x_2 - x_1}$ — 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: $m = \dfrac{14 - 2}{6 - 0} = \dfrac{12}{6} = 2$. 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 $(4, 9)$ _____

2. through $(0, 3)$ and $(5, 13)$ _____

3. through $(0, 0)$ and $(3, 12)$ _____

4. through $(0, 5)$ and $(10, 0)$ _____

5. through $(0, 2)$ and $(4, 2)$ _____

6. through $(1, 3)$ and $(5, 11)$ _____

7. through $(2, 4)$ and $(6, 16)$ _____

8. through $(0, 7)$ and $(2, 3)$ _____

9. through $(1, 1)$ and $(4, 10)$ _____

10. through $(0, 10)$ and $(5, 0)$ _____

11. through $(0, 4)$ and $(8, 8)$ _____

12. through $(3, 5)$ and $(3, 12)$ _____

13. through $(2, 1)$ and $(8, 4)$ _____

14. through $(0, -3)$ and $(4, 5)$ _____

15. through $(1, 6)$ and $(3, 2)$ _____

16. through $(0, 1)$ and $(6, 4)$ _____

17. through $(2, 7)$ and $(5, 7)$ _____

18. through $(1, 2)$ and $(4, 14)$ _____

19. through $(0, 9)$ and $(3, 0)$ _____

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

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. $x = 3$
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

Step-by-Step Explanations

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 $y = \frac{1}{2}x$.
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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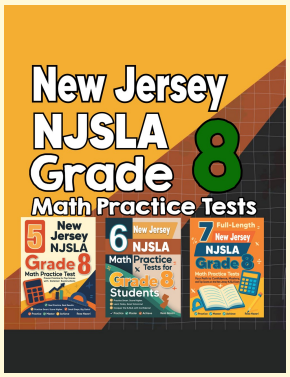

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