Fitting a Line to Data

Apply the skill to decisions and designs

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

A data-based line is an estimate, even when its equation is calculated exactly from selected anchors. Use the input units when interpreting its slope and the output units when interpreting residuals. Substitution predicts an outcome; solving backward estimates an input. A useful fit follows the center of the data rather than chasing a single unusual point.

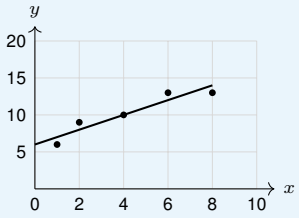
Worked example

Example for form 3: recover the selected line. Use the fitted line through $(0, 6)$ and $(8, 14)$.

1. The selected line has slope $m = (14 - 6)/(8 - 0) = 8/8 = 1$ and intercept $b = 6$.

2. Its equation is $\widehat{y} = 1x + 6$. The scattered observations need not lie exactly on this fitted line.

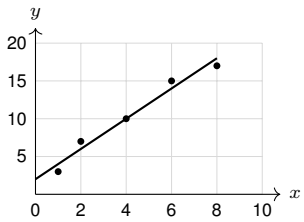
Answer: $\widehat{y} = 1x + 6$



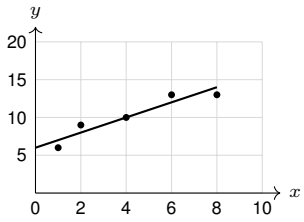
Practice Problems

Show your thinking.

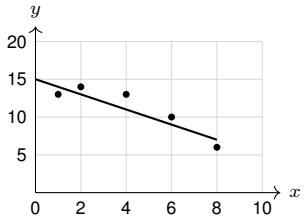
1. A practice study uses x hours and y skill points. Build the selected prediction rule. Use the fitted line through $(0, 2)$ and $(8, 18)$.



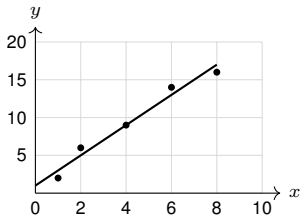
2. A plant study uses x weeks and y cm. Estimate its week-5 height. Predict the output at $x = 5$. Use the fitted line through $(0, 6)$ and $(8, 14)$.



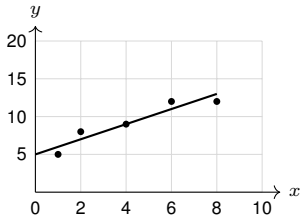
3. A bike study uses x years and y hundreds of dollars. Find the resale-value residual. At $x = 4$, an observed output is 13. Find observed minus predicted. Use the fitted line through $(0, 15)$ and $(8, 7)$.



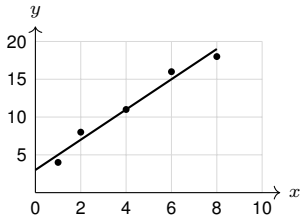
4. A water study uses x liters and y growth units. Choose the lower-error design. Compare line A, $\widehat{y} = 2x + 1$, with line B, $\widehat{y} = 2x + 4$, using total absolute vertical error. Use the fitted line through $(0, 1)$ and $(8, 17)$.



5. A coach uses x training sessions and y performance units. Estimate the sessions for the target. At what input does the model predict 12? Use the fitted line through $(0, 5)$ and $(8, 13)$.



6. A designer proposes a sensor calibration. Repair its starting output. A learner proposes $\widehat{y} = 2x + 6$. Correct the rule. Use the fitted line through $(0, 3)$ and $(8, 19)$.



Answer Key

1. $\widehat{y} = 2x + 2$
2. $\widehat{y}(5) = 11$
3. Residual 2.
4. Line A; total errors 4 versus 15.
5. $x = 7$
6. $\widehat{y} = 2x + 3$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The selected line has slope $m = (18 - 2)/(8 - 0) = 16/8 = 2$ and intercept $b = 2$.

2. Its equation is $\widehat{y} = 2x + 2$. The scattered observations need not lie exactly on this fitted line.

Problem 2

1. The selected line has slope $m = (14 - 6)/(8 - 0) = 8/8 = 1$ and intercept $b = 6$.

2. Substitute the requested input: $\widehat{y}(5) = 1(5) + 6 = 11$. This is a model estimate, not a guaranteed observation.

Problem 3

1. The selected line has slope $m = (7 - 15)/(8 - 0) = -8/8 = -1$ and intercept $b = 15$.

2. The prediction is $-1(4) + 15 = 11$. Subtract predicted from observed: $13 - (11) = 2$. The observation lies above the line.

Problem 4

1. For line A, absolute errors at inputs $1, 2, 4, 6, 8$ are $1, 1, 0, 1, 1$, totaling 4.

2. For line B they are $4, 2, 3, 2, 4$, totaling 15. Since $4 < 15$, line A fits better by this stated criterion.

Problem 5

1. The selected line has slope $m = (13 - 5)/(8 - 0) = 8/8 = 1$ and intercept $b = 5$.

2. Solve $12 = 1x + 5$: $7 = 1x$, so $x = 7/1 = 7$. Substituting gives the required predicted output 12.

Problem 6

1. At the anchor input $x = 0$, the claimed rule gives 6 instead of the required 3. The intercept is wrong by 3.

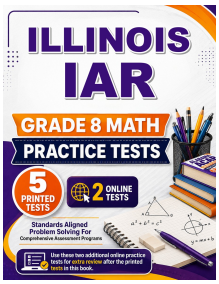
2. The selected line has slope $m = (19 - 3)/(8 - 0) = 16/8 = 2$ and intercept $b = 3$. Therefore use $\widehat{y} = 2x + 3$; at $x = 8$ it gives 19, matching the other anchor.

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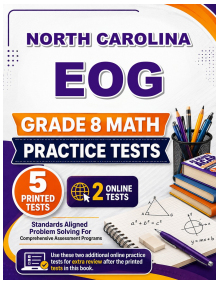
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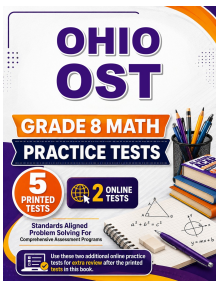
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