

TEACHER AND STUDENT RESOURCE

Fit and check bivariate models



NC Math 1 • NC.M1.S-ID.6

Statistics and Probability

Seven instructional sections • 30 multiple-choice tasks • 30 open or performance tasks. Includes exact alignment, teaching models, technology directions where needed, reusable organizers, student workspaces, worked keys and evidence records.

Free sample | Contents

NC.M1.S-ID.6 | NC Math 1 mathematics

This sample contains 26 complete selected pages from the 199-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-18, 47-50, 107-108, 137, 139

Representative activities

M01: sample PDF page(s) 18; original page(s) 17

M02: sample PDF page(s) 19; original page(s) 18

O01: sample PDF page(s) 20-21; original page(s) 47-48

O02: sample PDF page(s) 22-23; original page(s) 49-50

Selected teacher prompts and keys: original page(s) 107-108, 137, 139

Using this sample

Read the preparation and access guidance before using a selected activity.
Keep teacher keys and private preparation pages separate from student copies.
Use the original resource contents to see the scope of the complete packet.

Complete paid download

The complete resource includes the full PDF task bank and teaching materials.

ALIGNMENT

Standard and learning targets

Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

- a. Fit a least squares regression line to linear data using technology. Use the fitted function to solve problems.
- b. Assess the fit of a linear function by analyzing residuals.
- c. Fit a function to exponential data using technology. Use the fitted function to solve problems.

T1 • Represent paired quantitative data and describe direction and form.

T2 • Fit a least-squares line with technology and use predictions.

T3 • Compute and analyze residuals to assess linear fit.

T4 • Fit exponential data with technology and solve contextual problems.

Current NC Math 1 standards apply during 2026–27 and 2027–28. Newly adopted standards begin in 2028–29. Course content is not assigned to a fixed high-school grade.

NAVIGATION

Plan several learning sessions

Warm-up: M01–M04 and O01–O04

I Do: M05–M08 and O05–O08

We Do: M09–M13 and O09–O13

Collaborative practice: M14–M18 and O14–O18

Independent practice: M19–M23 and O19–O23

Small-group reteach: M24–M27 and O24–O27

Exit ticket: M28–M30 and O28–O30

T1: O01, O02, O03, O04, O05, O06, O07, O08, O09, O10, O11, O12, O13, O14, O15, O16, O17, O18, O19, O20, O21, O22, O23, O24, O25, O26, O27, O28, O29, O30

T2: M01, M02, M07, M08, M13, M14, M19, M20, M25, M26, O01, O02, O04, O05, O07, O08, O10, O11, O13, O14, O16, O17, O19, O20, O22, O23, O25, O26, O28, O29

T3: M03, M04, M09, M10, M15, M16, M21, M22, M27, M28, O01, O02, O04, O05, O07, O08, O10, O11, O13, O14, O16, O17, O19, O20, O22, O23, O25, O26, O28, O29

T4: M05, M06, M11, M12, M17, M18, M23, M24, M29, M30, O03, O06, O09, O12, O15, O18, O21, O24, O27, O30

PLANNING

Materials, access and evidence

Materials

Student pages, pencil, straightedge and graph paper. For standards .6 and .8, actual school-approved regression/graphing technology is required, not optional. Teacher keys are revealed after learners produce evidence.

Prerequisites

Read ordered pairs, distinguish explanatory and response variables, interpret units, evaluate formulas, and use a coordinate plane. For .6/.8 also understand mean, signed differences and squared deviations; teach natural-log entry as a tool operation for the exponential method.

Pacing

Use two to four selected items per meeting, with more time for technology and study-design tasks. Session 1: interpret representations and model the process. Session 2: construct and analyze jointly. Session 3: collaborate and independently transfer. Session 4: targeted reteaching and exit evidence. The 60-item bank is reusable across multiple sessions.

Access

Read directions, enlarge graphs, allow dictation or alternate input devices, and provide neutral technology navigation support. Keep the data and mathematical demand unchanged. Record answer-supplying cues separately from access support.

Precision

Data are exactly the displayed fictional values. Keep full precision in regression coefficients and intermediate calculations. Final numerical results use 3 decimals unless stated otherwise, with halfway cases rounded away from zero. For open responses, accept values within 0.002 of full-precision calculations. For MC, select the correctly rounded option exactly. Do not use rounded coefficients to judge more precise predictions.

Evidence

Preserve the first independent response. A copied graph or supplied r is not evidence that a learner operated technology. Collect the saved output, screenshot, printout or faithful sketch plus commands/settings and a brief observed demonstration.

LEARNER TOOL DIRECTIONS

Run, record, and check

Use an available, school-approved spreadsheet such as LibreOffice Calc or Google Sheets. The teacher must approve the tool; this packet cannot certify school approval. No new account, installation or personal data is needed for these fictional tables. A calculator with equivalent regression and scatter-plot functions is also acceptable if commands and settings are documented. These instructions were checked against function documentation, not run inside the learner's application.

For every six-pair dataset: put x in A2:A7 and y in B2:B7, one pair per row. Keep row pairing intact. In H2 enter `=SLOPE(B2:B7,A2:A7)`; in H3 enter `=INTERCEPT(B2:B7,A2:A7)`; in H4 enter `=CORREL(A2:A7,B2:B7)`. Some locales use semicolons instead of commas. Keep full precision; display 6 or more decimals in coefficient cells.

In C2 enter `=$H$2*A2+$H$3` and fill down through C7 for predicted y. In D2 enter `=B2-C2` and fill down for residuals. Create an XY scatter chart using A2:A7 as x and B2:B7 as y. Create a second XY scatter chart using A2:A7 as x and D2:D7 as y; include zero on the vertical scale. Use points, not a category line chart. Label axes, units and residual zero. Save or faithfully sketch the actual outputs and record the app, formulas, ranges and settings.

For exponential log-linear fitting only: all y must be positive. Put `=LN(B2)` in E2, fill through E7. H5: `=SLOPE(E2:E7,A2:A7)`; H6: `=INTERCEPT(E2:E7,A2:A7)`. H7: `=EXP(H6)`, the coefficient A. H8: `=EXP(H5)`, the multiplier B. In F2 use `=$H$7*($H$8^A2)`, fill down; original-y residual in G2 is `=B2-F2`. Plot x against G. This minimizes squared log residuals, not squared original-y errors. Other exponential fit methods can differ: report the method and do not silently compare incompatible outputs.

TEACHER MODEL

From data to a defensible claim

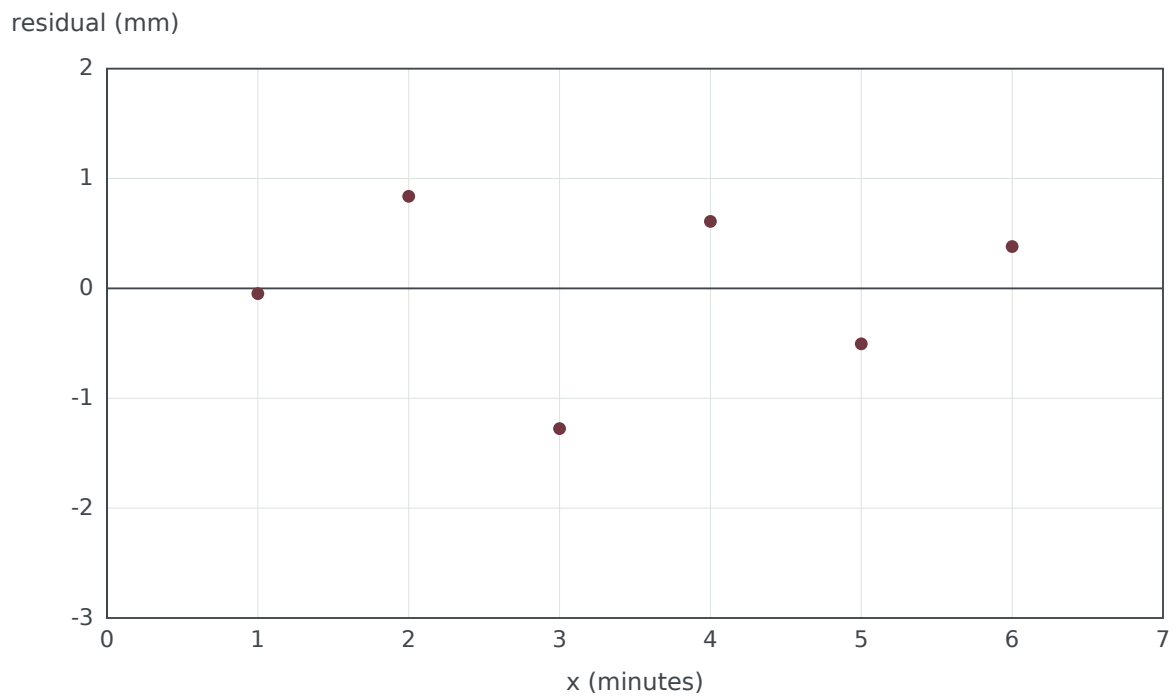
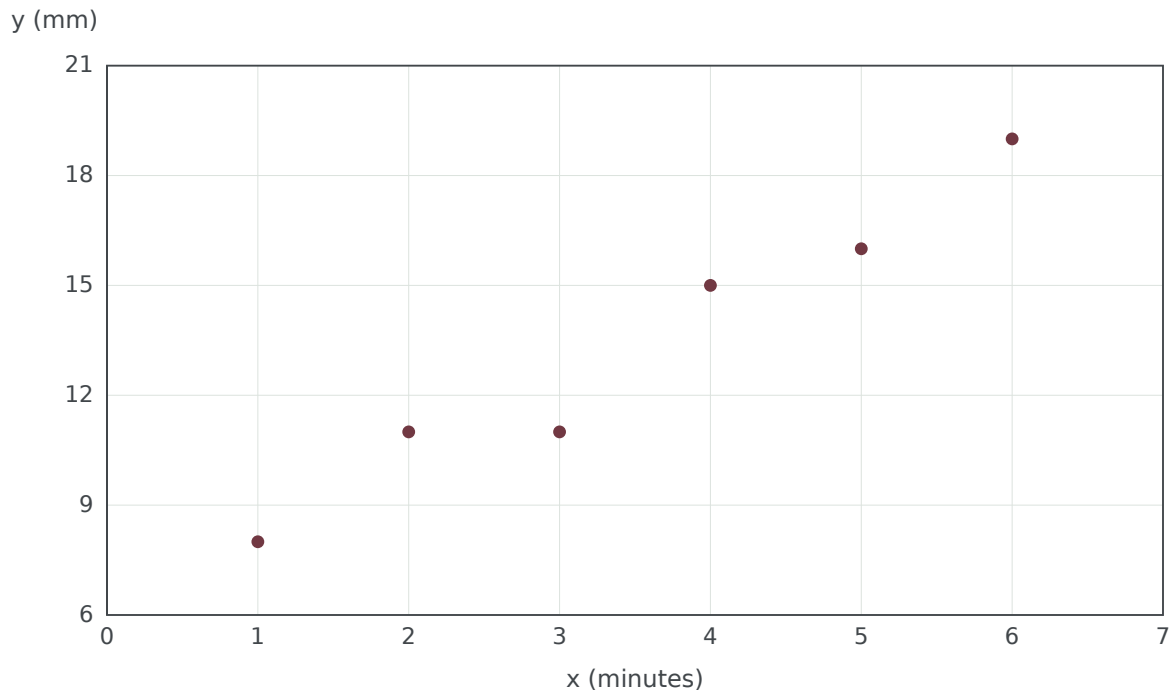
Fictional time x (minutes): 1, 2, 3, 4, 5, 6; travel y (mm): 8, 11, 11, 15, 16, 19. Ask: “What pattern do you predict before fitting? What would a residual tell us?”

$\bar{x} = 3.5$, $\bar{y} = 13.333$; $S_{xx} = 17.5$, $S_{xy} = 37$, $S_{yy} = 81.333$. Slope = $S_{xy}/S_{xx} = 2.114$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 5.933$. $\hat{y} = 2.114x + 5.933$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.981$. Residuals $y - \hat{y}$, in x order: -0.048, 0.838, -1.276, 0.61, -0.505, 0.381. $SSE = 3.105 \text{ mm}^2$. Use full precision internally.

Think aloud: “The residual at $x=3$ is observed 11 minus the model prediction, not the reverse. I inspect the scatter, r and residuals together. A good fit describes these data; it does not establish a causal law.” Require learners to distinguish residual units (mm) from unitless r .

TEACHER MODEL GRAPHS

Scatter and residual evidence



TEACHER EXPONENTIAL MODEL

Declare the fitting method

Fictional $x = 1, 2, 3, 4, 5, 6$ minutes and $y = 6, 9, 13.5, 20.25, 30.375, 45.5625$ mm. Enter $\ln(y)$ in a third column. Regress $\ln(y)$ on x : slope $\ln(1.5) \approx 0.405465$ and intercept $\ln(4) \approx 1.386294$. Exponentiate: $A=4$ and $B=1.5$, so $\hat{y}=4 \cdot (1.5)^x$. At $x=3.5$, $\hat{y} \approx 16.534$ mm. Every original- y residual here is zero because these invented values exactly follow that model. The multiplier 1.5 represents 50% growth per minute.

Say: “Our regression minimizes squared differences on the log scale. It is not a claim that a nonlinear least-squares fit in y uses the same objective.” Check positivity before taking logs. In later noisy datasets, use the declared method and examine residuals in original units. A perfect invented example does not show that all real processes grow exponentially forever.

REUSABLE ORGANIZER

Build an evidence chain

Variables, units, domain or study design

Representation / calculations / proposed causal diagram

Evidence supporting and challenging the claim

Conclusion, uncertainty and next evidence needed

WARM-UP

Teaching script and response plan

Core task O01. Optional bank: M01–M04; O01–O04. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

Collect a first response. Ask learners to name the two variables and identify what the evidence can establish before calculating or debating the claim.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

$\bar{x} = 3.5$, $\bar{y} = 39.3$; $S_{xx} = 17.5$, $S_{xy} = 68$, $S_{yy} = 268.6$. Slope = $S_{xy}/S_{xx} = 3.886$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 25.7$. $\hat{y} = 3.886x + 25.7$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.992$. Residuals $y - \hat{y}$, in x order: 0.214, -1.371, 1.043, 0.957, -0.629, -0.214. $SSE = 4.371 \text{ mm}^2$. Use full precision internally. At $x = 1.53$, $\hat{y} = 31.645 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

I DO

Teaching script and response plan

Core task O05. Optional bank: M05–M08; O05–O08. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

Model the core task aloud using the exact data. Predict the form first, show each operation or causal arrow, and explain why the conclusion follows. Do not let learners copy a completed graph as independent evidence.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

$\bar{x} = 3.5$, $\bar{y} = 20.117$; $S_{xx} = 17.5$, $S_{xy} = 18.25$, $S_{yy} = 26.308$. Slope = $S_{xy}/S_{xx} = 1.043$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 16.467$. $\hat{y} = 1.043x + 16.467$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.851$. Residuals $y - \hat{y}$, in x order: 0.19, 1.348, -0.995, -1.338, -0.681, 1.476. $SSE = 7.276 \text{ mm}^2$. Use full precision internally. At $x = 2.05$, $\hat{y} = 18.605 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

WE DO

Teaching script and response plan

Core task O09. Optional bank: M09–M13; O09–O13. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit exponential data with technology and solve contextual problems.

Ask learners to propose one step at a time. Have a second learner verify units, data pairing and the meaning of a sign or arrow. Invite a competing interpretation and test it against the prompt.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

Regress $\ln(y)$ on x : intercept 3.200719, slope 0.22113. $A = 24.550183$, $B = 1.247486$; $\hat{y} = 24.55 \cdot (1.247)^x$. At 2.85 minutes, prediction = 46.106 mm. The multiplier 1.247 corresponds to about 24.749% growth per minute. The scatter rises with increasing increments. Original- y residuals: -0.186, -0.226, 0.579, 0.714, -0.441, -0.557. Residual size relative to y is small for this dataset; the exponential is a reasonable descriptive fit over 1–6 minutes, not a guarantee. This method minimizes squared differences in $\ln(y)$; it is different from nonlinear least squares on y . Inspect the actual technology output and record settings.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

COLLABORATIVE PRACTICE

Teaching script and response plan

Core task O14. Optional bank: M14–M18; O14–O18. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

Use reader, representer, checker and explainer roles. Each learner records an initial claim before the group compares evidence. Require each learner to produce a personal conclusion.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

$\bar{x} = 3.5$, $\bar{y} = 26.95$; $S_{xx} = 17.5$, $S_{xy} = 45.25$, $S_{yy} = 121.775$. Slope = $S_{xy}/S_{xx} = 2.586$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 17.9$. $\hat{y} = 2.586x + 17.9$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.98$. Residuals $y - \hat{y}$, in x order: -0.786, -0.171, 1.943, -0.443, -0.329, -0.214. $SSE = 4.771 \text{ mm}^2$. Use full precision internally. At $x = 3.22$, $\hat{y} = 26.226 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

INDEPENDENT PRACTICE

Teaching script and response plan

Core task O19. Optional bank: M19–M23; O19–O23. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

Provide the complete task and neutral access supports. Preserve unaided work, technology records and explanations before discussion. Ask only neutral clarification questions.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

$\bar{x} = 3.5$, $\bar{y} = 22.7$; $S_{xx} = 17.5$, $S_{xy} = 53.5$, $S_{yy} = 166.7$. Slope = $S_{xy}/S_{xx} = 3.057$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 12$. $\hat{y} = 3.057x + 12$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.991$. Residuals $y - \hat{y}$, in x order: 0.143, -0.214, 0.929, -1.429, 0.214, 0.357. $SSE = 3.143 \text{ mm}^2$. Use full precision internally. At $x = 3.87$, $\hat{y} = 23.831 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

SMALL-GROUP RETEACH

Teaching script and response plan

Core task O24. Optional bank: M24–M27; O24–O27. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit exponential data with technology and solve contextual problems.

Use prior evidence to identify the missing connection. Model one contrast, such as observed minus predicted versus its reverse, or association versus random assignment. Then check transfer on a fresh task.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

Regress $\ln(y)$ on x : intercept 2.9436, slope 0.21562. $A = 18.984062$, $B = 1.24063$; $\hat{y} = 18.984 \cdot (1.241)^x$. At 3.85 minutes, prediction = 43.542 mm. The multiplier 1.241 corresponds to about 24.063% growth per minute. The scatter rises with increasing increments. Original- y residuals: 0.148, -0.18, -0.461, 0.486, 0.574, -0.572. Residual size relative to y is small for this dataset; the exponential is a reasonable descriptive fit over 1–6 minutes, not a guarantee. This method minimizes squared differences in $\ln(y)$; it is different from nonlinear least squares on y . Inspect the actual technology output and record settings.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

EXIT TICKET

Teaching script and response plan

Core task O28. Optional bank: M28–M30; O28–O30. Select a few tasks; allow additional sessions for construction and technology.

Learning target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

Collect a concise claim with mathematical or design evidence. Do not show a completed answer until responses are preserved; use the evidence to plan the next meeting.

Ask: “Where are the points relative to zero? Does r describe straight-line strength or every possible relationship? What method produced the coefficients?”

Exact core-task teacher solution

$\bar{x} = 3.5$, $\bar{y} = 32.583$; $S_{xx} = 17.5$, $S_{xy} = -64.75$, $S_{yy} = 243.708$. Slope = $S_{xy}/S_{xx} = -3.7$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 45.533$. $\hat{y} = -3.7x + 45.533$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = -0.991$. Residuals $y - \hat{y}$, in x order: -1.333, 0.867, 0.567, 0.767, -0.033, -0.833. $SSE = 4.133 \text{ mm}^2$. Use full precision internally. At $x = 5.04$, $\hat{y} = 26.885 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Evidence response: distinguish a wrong calculation from an unsupported interpretation. Revisit the relevant representation, then choose a fresh item from the bank. Suggested discussion: 10–20 minutes; adjust to evidence and access, never a fluency cutoff.

WARM-UP

M01 • Select and justify

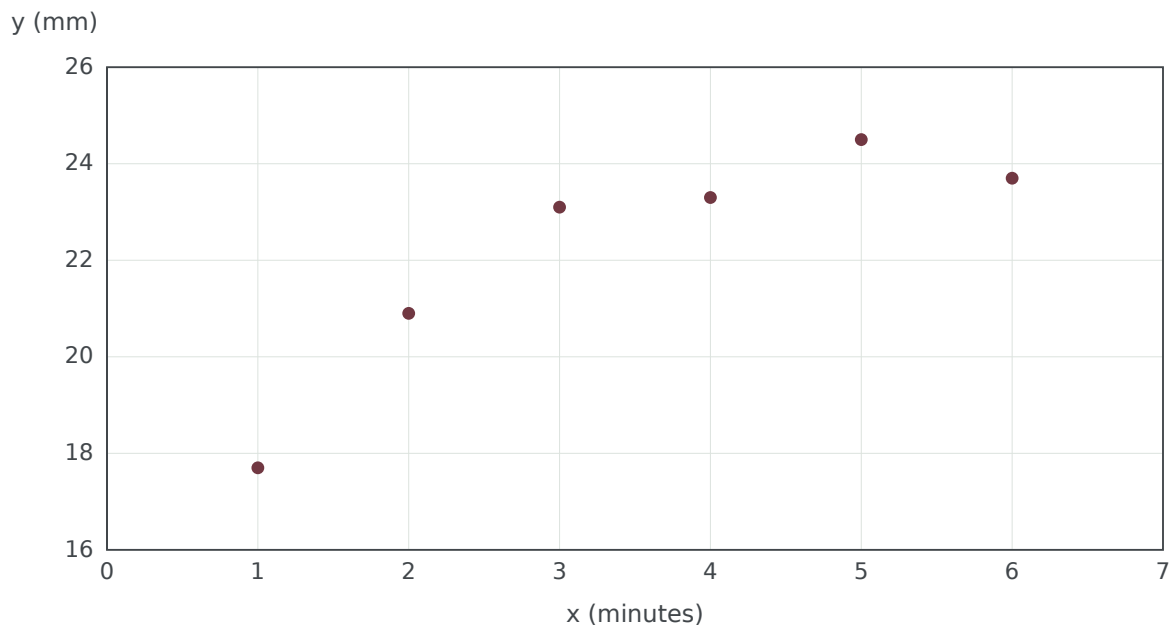
Target: Fit a least-squares line with technology and use predictions.

Fictional test rig: time x (minutes), travel y (mm).

x : 1, 2, 3, 4, 5, 6

y : 17.7, 20.9, 23.1, 23.3, 24.5, 23.7

Use technology to find the least-squares slope. Round to 3 decimals.



- A. 1.171
- B. -1.171
- C. 0.195
- D. 18.1

Reasoning / evidence

WARM-UP

M02 • Select and justify

Target: Fit a least-squares line with technology and use predictions.

Fictional test rig: time x (minutes), travel y (mm).

x : 1, 2, 3, 4, 5, 6

y : 26.2, 30.4, 33.6, 34.3, 38, 41.7

Fit a least-squares line using technology. What is predicted y at $x = 3.5$? Round to 3 decimals.

- A. 33.6
- B. 26.819
- C. 34.033
- D. 23.933

Reasoning / evidence

WARM-UP

001 • Construct and explain

Target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

All data are fictional test-rig measurements: x minutes; y mm.

x: 1, 2, 3, 4, 5, 6

y: 29.8, 32.1, 38.4, 42.2, 44.5, 48.8

Use school-approved technology to construct a scatter plot and fit a least-squares line. Record slope, intercept, commands/settings, and the fitted equation. Predict y at $x = 1.53$. Calculate all residuals, construct a residual plot, and assess linear fit using both graphs. Describe direction and form with units; explain what least squares minimizes.

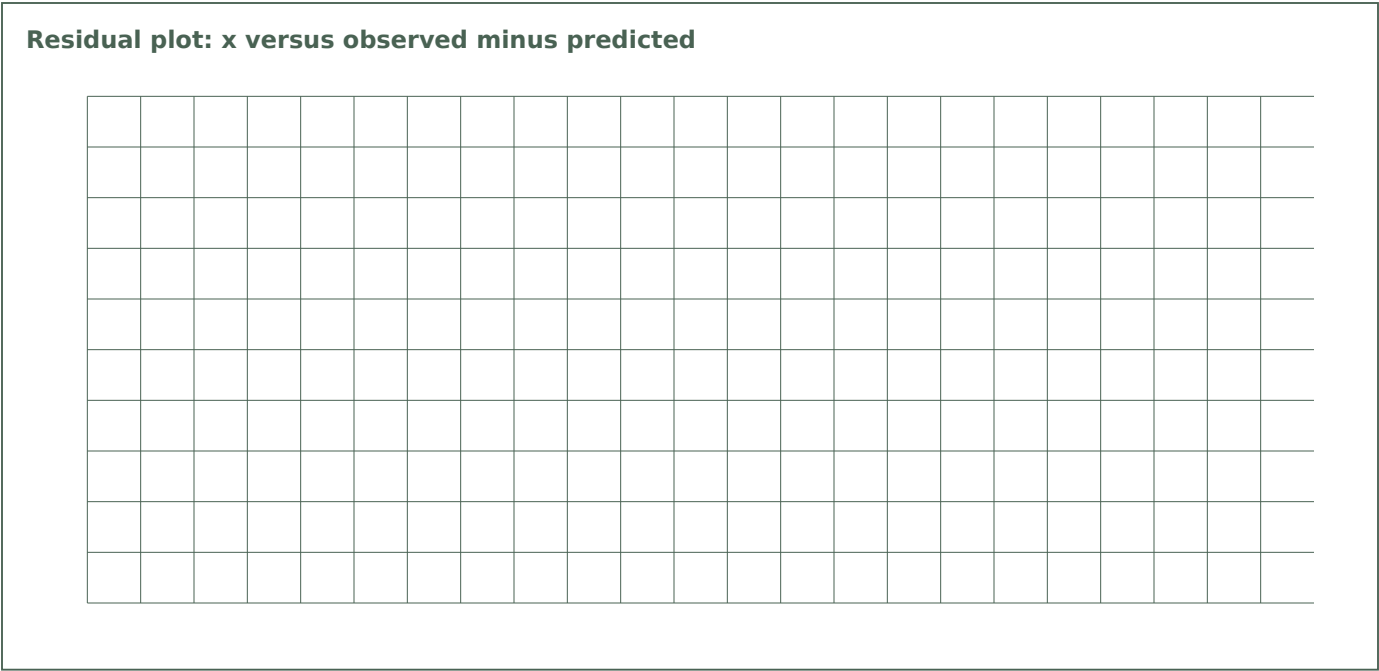
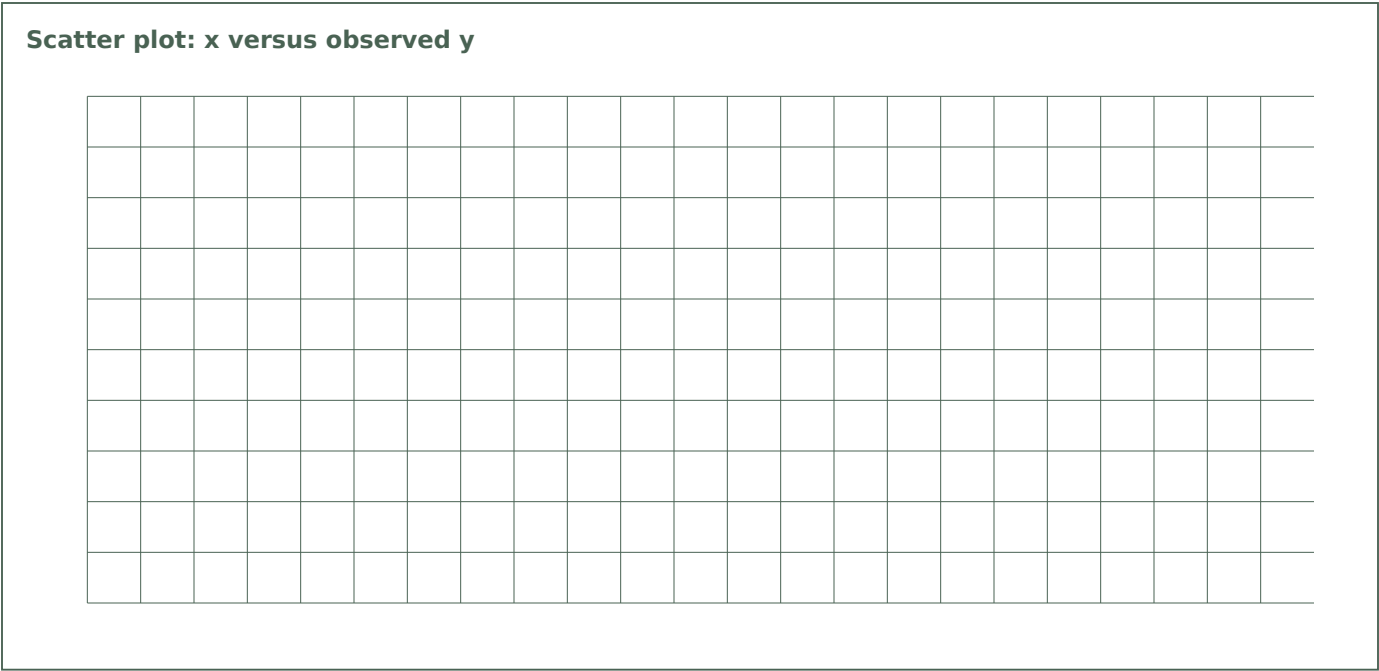
Tool / commands / ranges / settings / full-precision output

Calculations, prediction and evidence-based conclusion

STUDENT CONSTRUCTION

001 • Separate graph workspaces

Use your data and actual tool output from the preceding page. Label axes and units; choose useful scales. Preserve the residual zero line. Attach larger output if needed.



WARM-UP

002 • Construct and explain

Target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

All data are fictional test-rig measurements: x minutes; y mm.

x: 1, 2, 3, 4, 5, 6

y: 40, 44.5, 49, 50, 53, 58.5

Use school-approved technology to construct a scatter plot and fit a least-squares line. Record slope, intercept, commands/settings, and the fitted equation. Predict y at $x = 1.66$. Calculate all residuals, construct a residual plot, and assess linear fit using both graphs. Describe direction and form with units; explain what least squares minimizes.

Tool / commands / ranges / settings / full-precision output

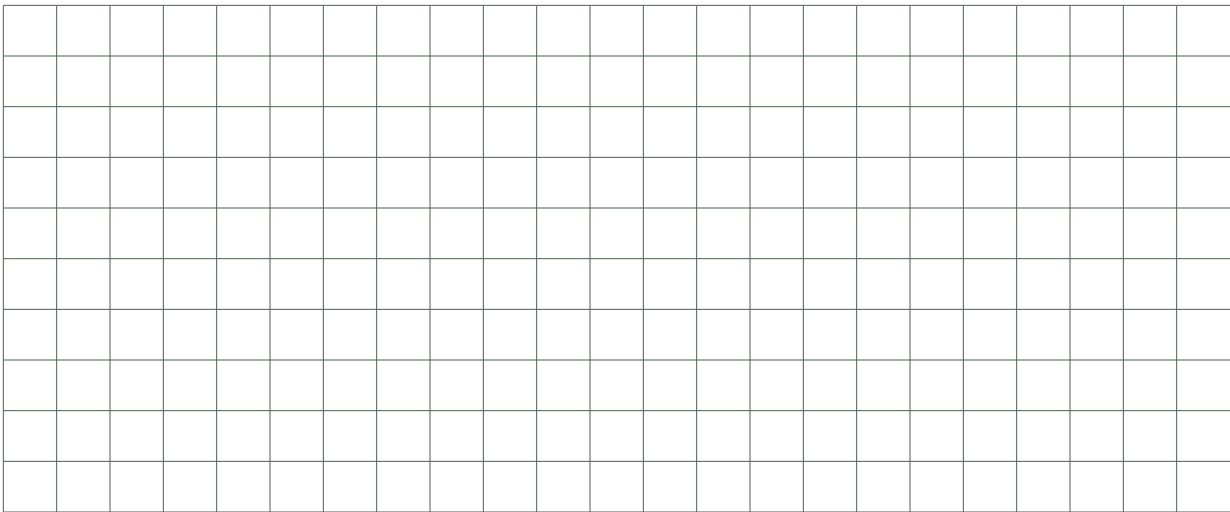
Calculations, prediction and evidence-based conclusion

STUDENT CONSTRUCTION

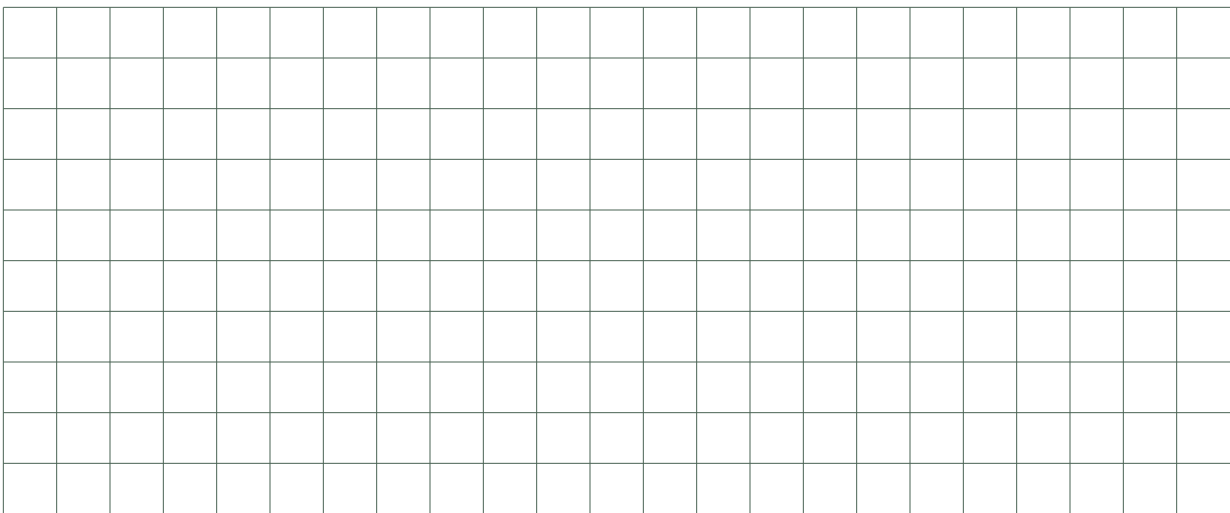
002 • Separate graph workspaces

Use your data and actual tool output from the preceding page. Label axes and units; choose useful scales. Preserve the residual zero line. Attach larger output if needed.

Scatter plot: x versus observed y



Residual plot: x versus observed minus predicted



WORKED TEACHER KEY

M01 • Reasoning and evidence

Target: Fit a least-squares line with technology and use predictions.

Answer: A. 1.171

$\bar{x} = 3.5$, $\bar{y} = 22.2$; $S_{xx} = 17.5$, $S_{xy} = 20.5$, $S_{yy} = 31.5$. Slope = $S_{xy}/S_{xx} = 1.171$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 18.1$. $\hat{y} = 1.171x + 18.1$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.873$. Residuals $y - \hat{y}$, in x order: -1.571, 0.457, 1.486, 0.514, 0.543, -1.429. $SSE = 7.486 \text{ mm}^2$. Use full precision internally.

- A. Matches the computed result and its interpretation.
- B. “-1.171” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.
- C. “0.195” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.
- D. “18.1” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.

WORKED TEACHER KEY

M02 • Reasoning and evidence

Target: Fit a least-squares line with technology and use predictions.

Answer: C. 34.033

$\bar{x} = 3.5$, $\bar{y} = 34.033$; $S_{xx} = 17.5$, $S_{xy} = 50.5$, $S_{yy} = 149.333$. Slope = $S_{xy}/S_{xx} = 2.886$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 23.933$. $\hat{y} = 2.886x + 23.933$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.988$. Residuals $y - \hat{y}$, in x order: -0.619, 0.695, 1.01, -1.176, -0.362, 0.452. SSE = 3.605 mm². Use full precision internally. Substitute $x = 3.5$: $\hat{y} = 34.033$ mm.

- A. “33.6” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.
- B. “26.819” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.
- C. Matches the computed result and its interpretation.
- D. “23.933” is inconsistent with the computation or contextual reasoning above; selection alone does not establish why it was chosen.

WORKED TEACHER KEY

001 • Reasoning and evidence

Target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

$\bar{x} = 3.5$, $\bar{y} = 39.3$; $S_{xx} = 17.5$, $S_{xy} = 68$, $S_{yy} = 268.6$. Slope = $S_{xy}/S_{xx} = 3.886$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 25.7$. $\hat{y} = 3.886x + 25.7$. $r = S_{xy}/\sqrt{S_{xx} \cdot S_{yy}} = 0.992$. Residuals $y - \hat{y}$, in x order: 0.214, -1.371, 1.043, 0.957, -0.629, -0.214. $SSE = 4.371 \text{ mm}^2$. Use full precision internally. At $x = 1.53$, $\hat{y} = 31.645 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Assess separately: representation, calculations or design logic, reasoning, and contextual interpretation. For technology tasks, require actual tool use with recorded settings; unsupported copied output is insufficient evidence of the technology target. Accept valid alternative diagrams, explanations and equivalently precise computations.

WORKED TEACHER KEY

002 • Reasoning and evidence

Target: Represent paired quantitative data and describe direction and form.; Fit a least-squares line with technology and use predictions.; Compute and analyze residuals to assess linear fit.

$\bar{x} = 3.5$, $\bar{y} = 49.167$; $S_{xx} = 17.5$, $S_{xy} = 59.5$, $S_{yy} = 208.333$. Slope = $S_{xy}/S_{xx} = 3.4$; intercept = $\bar{y} - \text{slope} \cdot \bar{x} = 37.267$. $\hat{y} = 3.4x + 37.267$. $r = S_{xy}/\sqrt{(S_{xx} \cdot S_{yy})} = 0.985$. Residuals $y - \hat{y}$, in x order: -0.667, 0.433, 1.533, -0.867, -1.267, 0.833. $SSE = 6.033 \text{ mm}^2$. Use full precision internally. At $x = 1.66$, $\hat{y} = 42.911 \text{ mm}$. The scatter is approximately straight with small residuals on both sides of zero and no pronounced curve. A linear model is reasonable for these six observations, but the small fictional sample cannot guarantee future accuracy or a causal relationship. Least squares minimizes the sum of squared vertical residuals, not the sum of signed residuals. Require actual technology evidence.

Assess separately: representation, calculations or design logic, reasoning, and contextual interpretation. For technology tasks, require actual tool use with recorded settings; unsupported copied output is insufficient evidence of the technology target. Accept valid alternative diagrams, explanations and equivalently precise computations.