RATIOMERA

Exercise Sheet

Simple Linear Regression

Ratiomera Statistics

This sheet contains 100 exercises organized into 10 learning-objective groups. Work through each exercise before consulting its matching complete solution. Show the relevant formula or rule, substituted values, units, and an interpretation. All settings, values, data, and software outputs are constructed teaching material; they are not empirical findings.

Part I: Theory

A08: Weak Evidence and Careful Interpretation

`T05-A08-V01`: Weekly practice and reasoning

A simple regression reports $n = 28$, slope $b_1 = 0.16$, $SE = 0.14$, $t = 1.11$, and two-sided $p = 0.276$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

`T05-A08-V02`: Archive experience and retrieval time

A simple regression reports $n = 34$, slope $b_1 = -0.12$, $SE = 0.11$, $t = -1.08$, and two-sided $p = 0.288$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

`T05-A08-V03`: Museum visits and knowledge

A simple regression reports $n = 40$, slope $b_1 = 0.1$, $SE = 0.09$, $t = 1.09$, and two-sided $p = 0.283$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

`T05-A08-V04`: Reading time and comprehension

A simple regression reports $n = 46$, slope $b_1 = 0.08$, $SE = 0.08$, $t = 0.99$, and two-sided $p = 0.329$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

`T05-A08-V05`: Route familiarity and navigation errors

A simple regression reports $n = 52$, slope $b_1 = -0.07$, $SE = 0.07$, $t = -1.0$, and two-sided $p = 0.323$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

`T05-A08-V06`: Workshop attendance and confidence

A simple regression reports $n = 60$, slope $b_1 = 0.06$, $SE = 0.06$, $t = 0.99$, and two-sided $p = 0.326$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

T05-A08-V07: Notification load and focus

A simple regression reports $n = 70$, slope $b_1 = -0.05$, $SE = 0.05$, $t = -0.99$, and two-sided $p = 0.326$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

T05-A08-V08: Search practice and accuracy

A simple regression reports $n = 80$, slope $b_1 = 0.05$, $SE = 0.05$, $t = 1.0$, and two-sided $p = 0.32$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

T05-A08-V09: Travel distance and visit duration

A simple regression reports $n = 90$, slope $b_1 = 0.04$, $SE = 0.04$, $t = 0.99$, and two-sided $p = 0.325$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

T05-A08-V10: Discussion participation and reasoning

A simple regression reports $n = 100$, slope $b_1 = -0.04$, $SE = 0.04$, $t = -1.0$, and two-sided $p = 0.32$. (a) State the 5% decision. (b) Form the approximate 95% interval $b_1 \pm 2SE$. (c) Calculate $R^2 = t^2/(t^2 + n - 2)$. (d) Write a careful conclusion that distinguishes the estimated direction, weak statistical evidence, small explained variation, uncertainty, and absence of causal proof.

A09: Residual Distribution Checks

T05-A09-V01: Weekly practice and reasoning

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 2), (-2.0, 7), (-1.0, 15), (0.0, 22), (1.0, 15), (2.0, 7), (3.0, 2); its initial visual description is ‘roughly symmetric’. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

T05-A09-V02: Archive experience and retrieval time

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 18), (-2.0, 20), (-1.0, 14), (0.0, 8), (1.0, 4), (2.0, 2), (3.0, 1); its initial visual description is ‘strong right tail’. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

T05-A09-V03: Museum visits and knowledge

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 1), (-2.0, 6), (-1.0, 14), (0.0, 20), (1.0, 14), (2.0, 6), (3.0, 1); its initial visual description is ‘roughly symmetric’. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

T05-A09-V04: Reading time and comprehension

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-4.0, 3), (-3.0, 8), (-2.0, 16), (-1.0, 22), (0.0, 15), (1.0, 5), (2.0, 1), (3.0, 0), (4.0, 1); its initial visual description is ‘one extreme upper bin’. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V05`: Route familiarity and navigation errors

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 5), (-2.0, 9), (-1.0, 12), (0.0, 13), (1.0, 12), (2.0, 9), (3.0, 5); its initial visual description is 'flat shoulders'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V06`: Workshop attendance and confidence

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 1), (-2.0, 2), (-1.0, 4), (0.0, 8), (1.0, 14), (2.0, 20), (3.0, 18); its initial visual description is 'strong left tail'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V07`: Notification load and focus

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 2), (-2.0, 8), (-1.0, 17), (0.0, 24), (1.0, 17), (2.0, 8), (3.0, 2); its initial visual description is 'roughly symmetric'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V08`: Search practice and accuracy

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.5, 3), (-2.5, 12), (-1.5, 18), (-0.5, 7), (0.5, 6), (1.5, 17), (2.5, 11), (3.5, 3); its initial visual description is 'two peaks'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V09`: Travel distance and visit duration

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 5), (-2.0, 7), (-1.0, 12), (0.0, 20), (1.0, 12), (2.0, 7), (3.0, 5); its initial visual description is 'roughly symmetric with heavy tails'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

`T05-A09-V10`: Discussion participation and reasoning

A hypothetical residual histogram uses equal-width bins. From left to right, the bin-center and count coordinates are (-3.0, 1), (-2.0, 4), (-1.0, 10), (0.0, 30), (1.0, 10), (2.0, 4), (3.0, 1); its initial visual description is 'strong center'. (a) Complete the histogram by drawing one bar at every listed center with the listed height. (b) Decide whether approximate residual normality looks plausible or whether skewness, unusual tails, multiple peaks, or an outlier needs attention. (c) Explain which regression quantities rely most directly on this distributional check and why a histogram alone cannot assess linearity or constant variance.

A10: Residual-versus-Fitted Patterns

`T05-A10-V01`: Weekly practice and reasoning

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [−0.1, 0.2, −0.2, 0.1, 0.0] and the residual standard deviations are [2.1, 2.0, 2.2, 2.1, 2.0]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of reasoning score against weekly practice hours that has an approximately straight center with a similar vertical spread from left to right. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, −0.1), (2, 0.2), (3, −0.2), (4, 0.1), (5, 0.0). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V02`: Archive experience and retrieval time

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [2.4, 0.6, −1.0, 0.5, 2.3] and the residual standard deviations are [1.5, 1.6, 1.7, 1.6, 1.5]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of retrieval time against months of archive experience that has a visibly curved center rather than one adequate straight line. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 2.4), (2, 0.6), (3, −1.0), (4, 0.5), (5, 2.3). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V03`: Museum visits and knowledge

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [0.0, 0.1, −0.1, 0.2, 0.0] and the residual standard deviations are [0.8, 1.2, 1.8, 2.6, 3.5]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of historical-knowledge score against museum visits this year that has an approximately straight center whose vertical spread shows increasing spread. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 0.0), (2, 0.1), (3, −0.1), (4, 0.2), (5, 0.0). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V04`: Reading time and comprehension

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [−2.0, −0.7, 0.8, 0.4, −1.8] and the residual standard deviations are [1.4, 1.5, 1.6, 1.5, 1.4]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of comprehension score against weekly reading time that has a visibly curved center rather than one adequate straight line. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, −2.0), (2, −0.7), (3, 0.8), (4, 0.4), (5, −1.8). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V05`: Route familiarity and navigation errors

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [0.1, −0.1, 0.0, 0.1, −0.1] and the residual standard deviations are [3.2, 2.6, 1.9, 1.3, 0.8]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of navigation-error count against route-familiarity score that has an approximately straight center whose vertical spread shows decreasing spread. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 0.1), (2, −0.1), (3, 0.0), (4, 0.1), (5, −0.1). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c)

Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V06`: Workshop attendance and confidence

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [0.2, −0.2, 0.1, −0.1, 0.0] and the residual standard deviations are [1.8, 1.9, 1.7, 1.8, 1.9]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of confidence score against workshop sessions attended that has an approximately straight center with a similar vertical spread from left to right. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 0.2), (2, −0.2), (3, 0.1), (4, −0.1), (5, 0.0). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V07`: Notification load and focus

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [−1.5, −0.4, 0.6, 0.3, −1.4] and the residual standard deviations are [1.2, 1.3, 1.4, 1.3, 1.2]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of focus score against daily notification count that has a visibly curved center rather than one adequate straight line. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, −1.5), (2, −0.4), (3, 0.6), (4, 0.3), (5, −1.4). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V08`: Search practice and accuracy

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [0.0, 0.1, 0.0, −0.1, 0.1] and the residual standard deviations are [0.7, 1.1, 1.7, 2.4, 3.2]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of search-accuracy score against completed search-practice sets that has an approximately straight center whose vertical spread shows increasing spread. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 0.0), (2, 0.1), (3, 0.0), (4, −0.1), (5, 0.1). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V09`: Travel distance and visit duration

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [0.1, 0.0, −0.1, 0.0, 0.1] and the residual standard deviations are [2.0, 2.1, 1.9, 2.0, 2.1]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of visit duration against travel distance that has an approximately straight center with a similar vertical spread from left to right. Label both axes and add the fitted straight line that would be checked. (b) Now plot the residual mean coordinates (1, 0.1), (2, 0.0), (3, −0.1), (4, 0.0), (5, 0.1). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

`T05-A10-V10`: Discussion participation and reasoning

Across five increasing fitted-value bands numbered 1 through 5, the mean residuals are [1.8, 0.5, −0.9, 0.4, 1.7] and the residual standard deviations are [1.3, 1.4, 1.5, 1.4, 1.3]. (a) Before drawing residuals, sketch a plausible original-data scatterplot of reasoning score against discussion contributions that has a visibly curved center rather than one adequate straight line. Label both axes and add the fitted straight line that would be checked.

(b) Now plot the residual mean coordinates (1, 1.8), (2, 0.5), (3, −0.9), (4, 0.4), (5, 1.7). At each point, draw a vertical one-standard-deviation bar from mean minus spread to mean plus spread. (c) Compare the original-data and residual views, then identify whether the main residual pattern is a random horizontal band, curvature, increasing spread, or decreasing spread. (d) State which linear-model condition is challenged and one reasonable next diagnostic or modeling step.

Part II: Calculator Practice

A01: Least-Squares Coefficients from Raw Sums

`T05-A01-V01`: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (2, 58), (3, 60), (4, 65), (5, 67), (6, 71), (7, 73), (8, 78), (9, 80). Here X is weekly practice hours and Y is reasoning score. The calculation summaries are $n = 8$, $\sum x = 44$, $\sum y = 552$, $\sum x^2 = 284$, and $\sum xy = 3172$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 6$ hours and verify that this is an in-range prediction.

`T05-A01-V02`: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (2, 68), (4, 64), (6, 61), (8, 57), (10, 55), (12, 50), (14, 48), (16, 45). Here X is months of archive experience and Y is retrieval time. The calculation summaries are $n = 8$, $\sum x = 72$, $\sum y = 448$, $\sum x^2 = 816$, and $\sum xy = 3756$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 9$ months and verify that this is an in-range prediction.

`T05-A01-V03`: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (0, 45), (1, 48), (2, 52), (3, 56), (4, 61), (5, 65), (6, 68), (7, 74). Here X is museum visits this year and Y is historical-knowledge score. The calculation summaries are $n = 8$, $\sum x = 28$, $\sum y = 469$, $\sum x^2 = 140$, and $\sum xy = 1815$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 4$ visits and verify that this is an in-range prediction.

`T05-A01-V04`: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (1, 52), (2, 56), (3, 60), (4, 63), (5, 69), (6, 72), (7, 76), (8, 81). Here X is weekly reading time and Y is comprehension score. The calculation summaries are $n = 8$, $\sum x = 36$, $\sum y = 529$, $\sum x^2 = 204$, and $\sum xy = 2553$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$.

(c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 5$ hours and verify that this is an in-range prediction.

T05-A01-V05: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (2, 14), (3, 12), (4, 11), (5, 9), (6, 8), (7, 6), (8, 5), (9, 4). Here X is route-familiarity score and Y is navigation-error count. The calculation summaries are $n = 8$, $\sum x = 44$, $\sum y = 69$, $\sum x^2 = 284$, and $\sum xy = 319$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - \left(\sum x\right)^2/n$, and $S_{xy} = \sum xy - \left(\sum x\right)\left(\sum y\right)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 6$ points and verify that this is an in-range prediction.

T05-A01-V06: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (0, 38), (1, 43), (2, 47), (3, 53), (4, 56), (5, 62), (6, 65), (7, 70). Here X is workshop sessions attended and Y is confidence score. The calculation summaries are $n = 8$, $\sum x = 28$, $\sum y = 434$, $\sum x^2 = 140$, and $\sum xy = 1710$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - \left(\sum x\right)^2/n$, and $S_{xy} = \sum xy - \left(\sum x\right)\left(\sum y\right)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 4$ sessions and verify that this is an in-range prediction.

T05-A01-V07: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (10, 88), (20, 84), (30, 79), (40, 73), (50, 69), (60, 64), (70, 58), (80, 54). Here X is daily notification count and Y is focus score. The calculation summaries are $n = 8$, $\sum x = 360$, $\sum y = 569$, $\sum x^2 = 20400$, and $\sum xy = 23520$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - \left(\sum x\right)^2/n$, and $S_{xy} = \sum xy - \left(\sum x\right)\left(\sum y\right)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 45$ notifications and verify that this is an in-range prediction.

T05-A01-V08: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (1, 55), (2, 59), (3, 63), (4, 68), (5, 72), (6, 77), (7, 81), (8, 86). Here X is completed search-practice sets and Y is search-accuracy score. The calculation summaries are $n = 8$, $\sum x = 36$, $\sum y = 561$, $\sum x^2 = 204$, and $\sum xy = 2711$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - \left(\sum x\right)^2/n$, and $S_{xy} = \sum xy - \left(\sum x\right)\left(\sum y\right)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 5$ sets and verify that this is an in-range prediction.

T05-A01-V09: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (2, 65), (4, 70), (6, 75), (8, 82), (10, 88), (12, 94), (14, 101), (16, 107). Here X is travel distance and Y is visit duration. The calculation summaries are $n = 8$, $\sum x = 72$, $\sum y = 682$, $\sum x^2 = 816$, and $\sum xy = 6650$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 9$ kilometers and verify that this is an in-range prediction.

`T05-A01-V10`: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A hypothetical dataset contains these ordered pairs (X, Y): (0, 50), (1, 54), (2, 58), (3, 61), (4, 66), (5, 69), (6, 73), (7, 78). Here X is discussion contributions and Y is reasoning score. The calculation summaries are $n = 8$, $\sum x = 28$, $\sum y = 509$, $\sum x^2 = 140$, and $\sum xy = 1946$. (a) Plot the coordinates, report the observed X range, and describe whether an approximately straight upward or downward pattern is plausible and whether any listed point is visibly isolated. (b) Calculate $\bar{x}$, $\bar{y}$, $S_{xx} = \sum x^2 - (\sum x)^2/n$, and $S_{xy} = \sum xy - (\sum x)(\sum y)/n$. (c) Find $b_1 = S_{xy}/S_{xx}$ and $b_0 = \bar{y} - b_1\bar{x}$ and interpret both coefficients with units and appropriate scope. (d) Predict Y at $X = 4$ contributions and verify that this is an in-range prediction.

A02: From Means, Standard Deviations, and Covariance to a Line

`T05-A02-V01`: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 5.5$, $\bar{y} = 68$, $s_x = 2.2$, $s_y = 8.0$, and sample covariance $s_{xy} = 11.0$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict reasoning score when weekly practice hours equals 7.0 hours. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V02`: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 18$, $\bar{y} = 42$, $s_x = 6.0$, $s_y = 9.0$, and sample covariance $s_{xy} = -36.0$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict retrieval time when months of archive experience equals 24 months. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V03`: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 4.5$, $\bar{y} = 62$, $s_x = 1.8$, $s_y = 10.0$, and sample covariance $s_{xy} = 13.5$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict historical-knowledge score when museum visits this year equals 6 visits. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V04`: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 7$, $\bar{y} = 74$, $s_x = 2.5$, $s_y = 9.0$, and sample covariance $s_{xy} = 15.75$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict comprehension score when weekly reading time equals 9 hours. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V05`: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 55$, $\bar{y} = 8$, $s_x = 12.0$, $s_y = 3.0$, and sample covariance $s_{xy} = -25.2$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict navigation-error count when route-familiarity score equals 65 points. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V06`: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 3.5$, $\bar{y} = 51$, $s_x = 1.5$, $s_y = 7.0$, and sample covariance $s_{xy} = 7.35$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict confidence score when workshop sessions attended equals 5 sessions. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V07`: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 48$, $\bar{y} = 70$, $s_x = 15.0$, $s_y = 11.0$, and sample covariance $s_{xy} = -82.5$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict focus score when daily notification count equals 35 notifications. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V08`: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 6$, $\bar{y} = 76$, $s_x = 2.0$, $s_y = 8.0$, and sample covariance $s_{xy} = 11.2$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict search-accuracy score when completed search-practice sets equals 9 sets. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V09`: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 14$, $\bar{y} = 95$, $s_x = 5.0$, $s_y = 18.0$, and sample covariance $s_{xy} = 54.0$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict visit duration when travel distance equals 18 kilometers. (d) Explain how correlation and slope use the same joint variation but answer different questions.

`T05-A02-V10`: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Summary statistics are $\bar{x} = 8$, $\bar{y} = 67$, $s_x = 3.0$, $s_y = 10.0$, and sample covariance $s_{xy} = 18.0$. (a) Calculate Pearson's $r = s_{xy}/(s_x s_y)$. (b) Find the regression slope $b_1 = s_{xy}/s_x^2$ and intercept. (c) Predict reasoning score when discussion contributions equals 11 contributions. (d) Explain how correlation and slope use the same joint variation but answer different questions.

A03: Unstandardized and Standardized Slopes

T05-A03-V01: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 42 + (3.2)X$, with $s_x = 1.5$ hours and $s_y = 8.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 2$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

T05-A03-V02: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 75 + (-1.2)X$, with $s_x = 6.0$ months and $s_y = 9.0$ minutes. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 20$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

T05-A03-V03: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 48 + (4.5)X$, with $s_x = 1.8$ visits and $s_y = 10.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 3$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

T05-A03-V04: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 55 + (2.8)X$, with $s_x = 2.5$ hours and $s_y = 9.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 8$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

T05-A03-V05: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 18 + (-0.12)X$, with $s_x = 12.0$ points and $s_y = 3.0$ errors. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 60$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

T05-A03-V06: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 35 + (3.5)X$, with $s_x = 1.5$ sessions and $s_y = 7.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 4$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

`T05-A03-V07`: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 82 + (-0.3)X$, with $s_x = 15.0$ notifications and $s_y = 11.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 50$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

`T05-A03-V08`: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 60 + (4.0)X$, with $s_x = 2.0$ sets and $s_y = 8.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 7$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

`T05-A03-V09`: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 50 + (2.4)X$, with $s_x = 5.0$ kilometers and $s_y = 18.0$ minutes. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 16$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

`T05-A03-V10`: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A fitted model is $\hat{Y} = 40 + (3.0)X$, with $s_x = 3.0$ contributions and $s_y = 10.0$ points. (a) Interpret the unstandardized slope in original units and calculate the fitted value at $X = 10$. (b) Calculate the standardized slope $\beta^* = b_1 s_x / s_y$. (c) Explain what one predictor standard deviation means in the standardized interpretation and why the two slope numbers should not be compared without their scales.

A04: Comparing Two Simple-Regression Outputs

`T05-A04-V01`: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use reasoning score as the outcome. Output A, with weekly practice hours as predictor, reports: intercept estimate 38; predictor estimate 2.6, $SE = 0.7$, $t = 3.71$, standardized slope $\beta^* = 0.49$. Output B, with guided-study sessions as predictor, reports: intercept estimate 45; predictor estimate 3.1, $SE = 0.9$, $t = 3.44$, standardized slope $\beta^* = 0.58$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V02`: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use retrieval time as the outcome. Output A, with months of archive experience as predictor, reports: intercept estimate 80; predictor estimate −1.5, $SE = 0.5$, $t = -3.00$, standardized slope

$\beta^* = -0.46$. Output B, with retrieval-practice sessions as predictor, reports: intercept estimate 70; predictor estimate −2.2, $SE = 0.8$, $t = -2.75$, standardized slope $\beta^* = -0.35$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V03`: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use historical-knowledge score as the outcome. Output A, with museum visits this year as predictor, reports: intercept estimate 45; predictor estimate 4.2, $SE = 1.1$, $t = 3.82$, standardized slope $\beta^* = 0.58$. Output B, with history-reading sessions as predictor, reports: intercept estimate 50; predictor estimate 3.6, $SE = 1.0$, $t = 3.60$, standardized slope $\beta^* = 0.44$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V04`: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use comprehension score as the outcome. Output A, with weekly reading time as predictor, reports: intercept estimate 52; predictor estimate 3.0, $SE = 0.9$, $t = 3.33$, standardized slope $\beta^* = 0.4$. Output B, with annotated pages per week as predictor, reports: intercept estimate 48; predictor estimate 0.9, $SE = 0.3$, $t = 3.00$, standardized slope $\beta^* = 0.55$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V05`: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use navigation-error count as the outcome. Output A, with route-familiarity score as predictor, reports: intercept estimate 15; predictor estimate −0.1, $SE = 0.04$, $t = -2.50$, standardized slope $\beta^* = -0.35$. Output B, with prior route attempts as predictor, reports: intercept estimate 13; predictor estimate −0.55, $SE = 0.16$, $t = -3.44$, standardized slope $\beta^* = -0.62$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V06`: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use confidence score as the outcome. Output A, with workshop sessions attended as predictor, reports: intercept estimate 33; predictor estimate 3.8, $SE = 1.0$, $t = 3.80$, standardized slope $\beta^* = 0.55$. Output B, with peer-feedback sessions as predictor, reports: intercept estimate 40; predictor estimate 2.7, $SE = 0.8$, $t = 3.38$, standardized slope $\beta^* = 0.47$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V07`: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use focus score as the outcome. Output A, with daily notification count as predictor, reports: intercept estimate 85; predictor estimate −0.28, $SE = 0.08$, $t = -3.50$, standardized slope $\beta^* = -0.42$. Output B, with scheduled focus blocks as predictor, reports: intercept estimate 78; predictor estimate 2.4, $SE = 0.7$, $t = 3.43$, standardized slope $\beta^* = 0.51$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V08`: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use search-accuracy score as the outcome. Output A, with completed search-practice sets as predictor, reports: intercept estimate 58; predictor estimate 4.4, $SE = 1.2$, $t = 3.67$, standardized slope $\beta^* = 0.63$. Output B, with months of archive experience as predictor, reports: intercept estimate 62; predictor estimate 1.5, $SE = 0.5$, $t = 3.00$, standardized slope $\beta^* = 0.39$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V09`: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use visit duration as the outcome. Output A, with travel distance as predictor, reports: intercept estimate 47; predictor estimate 2.1, $SE = 0.8$, $t = 2.62$, standardized slope $\beta^* = 0.38$. Output B, with planned stops as predictor, reports: intercept estimate 55; predictor estimate 4.5, $SE = 1.1$, $t = 4.09$, standardized slope $\beta^* = 0.66$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

`T05-A04-V10`: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two separate simple regressions use reasoning score as the outcome. Output A, with discussion contributions as predictor, reports: intercept estimate 43; predictor estimate 2.7, $SE = 0.9$, $t = 3.00$, standardized slope $\beta^* = 0.45$. Output B, with preparation time as predictor, reports: intercept estimate 49; predictor estimate 3.4, $SE = 1.0$, $t = 3.40$, standardized slope $\beta^* = 0.52$. (a) Locate the two predictor coefficients and distinguish them from the intercepts. (b) Interpret each unstandardized slope with its original units. (c) Compare the directions and absolute standardized slopes. (d) Explain why the unstandardized slopes should not be ranked directly when predictor units differ and why neither separate model proves causation.

A05: Coefficients and Explained Variation

`T05-A05-V01`: Weekly practice and reasoning

A centered calculation gives $S_{xy} = 120$, $S_{xx} = 180$, total sum of squares $SST = 720$, error sum of squares $SSE = 640.0000$, and intercept $b_0 = 40$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 8$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V02: Archive experience and retrieval time

A centered calculation gives $S_{xy} = -84$, $S_{xx} = 210$, total sum of squares $SST = 630$, error sum of squares $SSE = 596.4000$, and intercept $b_0 = 42$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 20$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V03: Museum visits and knowledge

A centered calculation gives $S_{xy} = 144$, $S_{xx} = 240$, total sum of squares $SST = 840$, error sum of squares $SSE = 753.6000$, and intercept $b_0 = 36$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 6$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V04: Reading time and comprehension

A centered calculation gives $S_{xy} = 135$, $S_{xx} = 225$, total sum of squares $SST = 900$, error sum of squares $SSE = 819.0000$, and intercept $b_0 = 50$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 9$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V05: Route familiarity and navigation errors

A centered calculation gives $S_{xy} = -66$, $S_{xx} = 132$, total sum of squares $SST = 528$, error sum of squares $SSE = 495.0000$, and intercept $b_0 = 44$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 60$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V06: Workshop attendance and confidence

A centered calculation gives $S_{xy} = 114$, $S_{xx} = 190$, total sum of squares $SST = 760$, error sum of squares $SSE = 691.6000$, and intercept $b_0 = 38$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 5$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V07: Notification load and focus

A centered calculation gives $S_{xy} = -96$, $S_{xx} = 240$, total sum of squares $SST = 960$, error sum of squares $SSE = 921.6000$, and intercept $b_0 = 48$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 45$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V08: Search practice and accuracy

A centered calculation gives $S_{xy} = 138$, $S_{xx} = 230$, total sum of squares $SST = 920$, error sum of squares $SSE = 837.2000$, and intercept $b_0 = 46$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 8$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V09: Travel distance and visit duration

A centered calculation gives $S_{xy} = 104$, $S_{xx} = 208$, total sum of squares $SST = 832$, error sum of squares $SSE = 780.0000$, and intercept $b_0 = 52$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 18$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

T05-A05-V10: Discussion participation and reasoning

A centered calculation gives $S_{xy} = 100$, $S_{xx} = 200$, total sum of squares $SST = 800$, error sum of squares $SSE = 750.0000$, and intercept $b_0 = 40$. (a) Calculate b_1. (b) Find $SSR = SST - SSE$ and $R^2 = SSR/SST$. (c) Verify that $SSR = b_1 S_{xy}$, predict at $X = 10$, and interpret R^2 as sample variation explained by the fitted line rather than as the proportion of people whose outcomes were predicted correctly.

A06: Slope Tests and Confidence Intervals

`T05-A06-V01`: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 24$ cases, the estimated weekly practice hours slope is $b_1 = 2.4$ with $SE(b_1) = 0.75$. Use the t distribution with $df = n - 2 = 22$ and the displayed 95% critical value 2.0739. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

`T05-A06-V02`: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 30$ cases, the estimated months of archive experience slope is $b_1 = -1.6$ with $SE(b_1) = 0.6$. Use the t distribution with $df = n - 2 = 28$ and the displayed 95% critical value 2.0484. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

`T05-A06-V03`: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 36$ cases, the estimated museum visits this year slope is $b_1 = 3.1$ with $SE(b_1) = 1.05$. Use the t distribution with $df = n - 2 = 34$ and the displayed 95% critical value 2.0322. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

`T05-A06-V04`: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 42$ cases, the estimated weekly reading time slope is $b_1 = 2.0$ with $SE(b_1) = 0.68$. Use the t distribution with $df = n - 2 = 40$ and the displayed 95% critical value 2.0211. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

`T05-A06-V05`: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 50$ cases, the estimated route-familiarity score slope is $b_1 = -0.11$ with $SE(b_1) = 0.05$. Use the t distribution with $df = n - 2 = 48$ and the displayed 95% critical value 2.0106. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

`T05-A06-V06`: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 60$ cases, the estimated workshop sessions attended slope is $b_1 = 2.8$ with $SE(b_1) = 0.9$. Use the t distribution with $df = n - 2 = 58$ and the displayed 95% critical value 2.0017. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

T05-A06-V07: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 70$ cases, the estimated daily notification count slope is $b_1 = -0.24$ with $SE(b_1) = 0.1$. Use the t distribution with $df = n - 2 = 68$ and the displayed 95% critical value 1.9955. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

T05-A06-V08: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 80$ cases, the estimated completed search-practice sets slope is $b_1 = 3.6$ with $SE(b_1) = 1.1$. Use the t distribution with $df = n - 2 = 78$ and the displayed 95% critical value 1.9908. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

T05-A06-V09: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 90$ cases, the estimated travel distance slope is $b_1 = 1.5$ with $SE(b_1) = 0.72$. Use the t distribution with $df = n - 2 = 88$ and the displayed 95% critical value 1.9873. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

T05-A06-V10: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

For $n = 100$ cases, the estimated discussion contributions slope is $b_1 = 1.2$ with $SE(b_1) = 0.62$. Use the t distribution with $df = n - 2 = 98$ and the displayed 95% critical value 1.9845. (a) Test $H_0 : \beta_1 = 0$ with $t = b_1/SE(b_1)$ and calculate the exact two-sided t-distribution p-value. (b) Construct the 95% interval $b_1 \pm t^* SE$. (c) Explain why the interval and two-sided decision agree and interpret the slope with units.

A07: The Simple-Regression Model Test through R-Squared

T05-A07-V01: Weekly practice and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 20$ has $R^2 = 0.28$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 18) = 4.414$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

T05-A07-V02: Archive experience and retrieval time

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 25$ has $R^2 = 0.22$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 23) = 4.279$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V03`: Museum visits and knowledge

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 30$ has $R^2 = 0.18$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 28) = 4.196$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V04`: Reading time and comprehension

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 35$ has $R^2 = 0.15$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 33) = 4.139$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V05`: Route familiarity and navigation errors

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 40$ has $R^2 = 0.12$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 38) = 4.098$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V06`: Workshop attendance and confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 50$ has $R^2 = 0.1$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 48) = 4.043$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V07`: Notification load and focus

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 60$ has $R^2 = 0.08$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 58) = 4.007$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V08`: Search practice and accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 75$ has $R^2 = 0.07$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 73) = 3.972$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V09`: Travel distance and visit duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 90$ has $R^2 = 0.06$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 88) = 3.949$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.

`T05-A07-V10`: Discussion participation and reasoning

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple regression with $n = 120$ has $R^2 = 0.05$. (a) State the global model null in terms of β_1 and, equivalently, population explained variation. (b) Calculate $F = [R^2/1]/[(1 - R^2)/(n - 2)]$. (c) Compare it with $F_{0.95}(1, 118) = 3.921$ and interpret the decision. (d) Explain why this one-predictor F test matches the two-sided slope test.