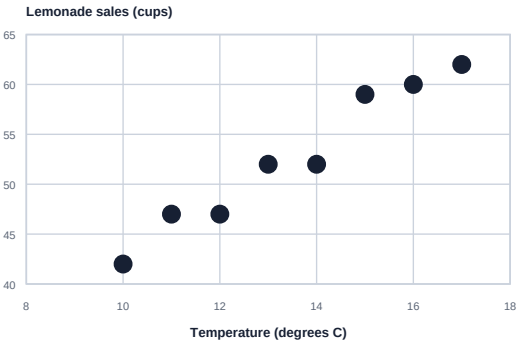


Linear Regression and Residuals

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

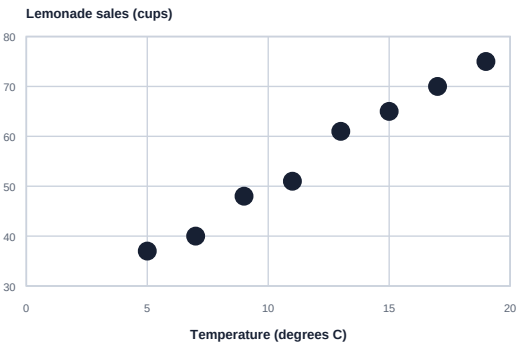
1. Use the least-squares line to predict lemonade sales when temperature is 14 degrees C. Identify interpolation or extrapolation.

x: Temperature (degrees C)	10	11	12	13	14	15	16	17
y: Lemonade sales (cups)	42	47	47	52	52	59	60	62



2. Find the ordinary least-squares line with an intercept, and draw that fitted line on the scatterplot.

x: Temperature (degrees C)	5	7	9	11	13	15	17	19
y: Lemonade sales (cups)	37	40	48	51	61	65	70	75

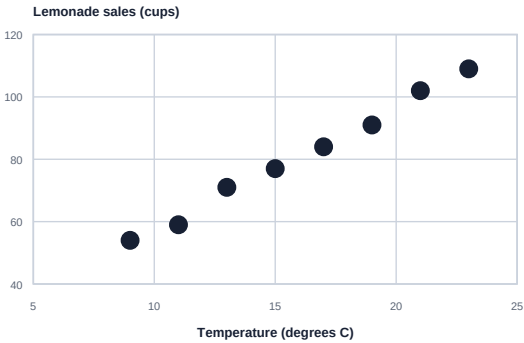


Linear Regression and Residuals

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

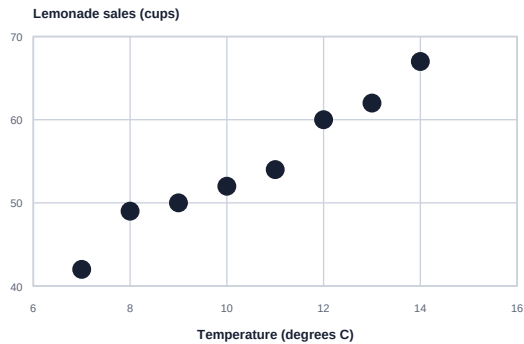
3. Interpret the fitted slope in context, then classify a prediction at x = 29 as interpolation or extrapolation and state a limitation.

x: Temperature (degrees C)	9	11	13	15	17	19	21	23
y: Lemonade sales (cups)	54	59	71	77	84	91	102	109



4. For the observation (12, 60), calculate the residual using observed minus predicted.

x: Temperature (degrees C)	7	8	9	10	11	12	13	14
y: Lemonade sales (cups)	42	49	50	52	54	60	62	67

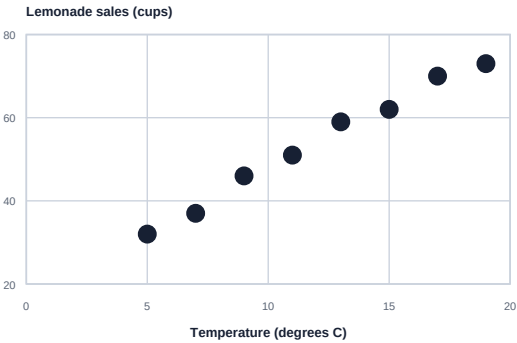


Linear Regression and Residuals

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

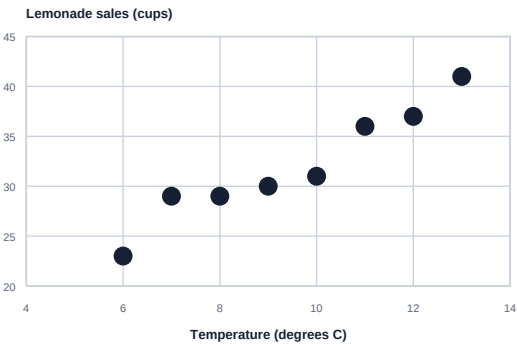
5. Use the least-squares line to predict lemonade sales when temperature is 23 degrees C. Identify interpolation or extrapolation.

x: Temperature (degrees C)	5	7	9	11	13	15	17	19
y: Lemonade sales (cups)	32	37	46	51	59	62	70	73



6. Find the ordinary least-squares line with an intercept, and draw that fitted line on the scatterplot.

x: Temperature (degrees C)	6	7	8	9	10	11	12	13
y: Lemonade sales (cups)	23	29	29	30	31	36	37	41



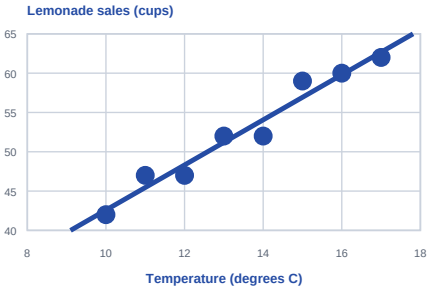
Linear Regression and Residuals

Worked Answer Key

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

1. Use the least-squares line to predict lemonade sales when temperature is 14 degrees C. Identify interpolation or extrapolation.

x: Temperature (degrees C)	10	11	12	13	14	15	16	17
y: Lemonade sales (cups)	42	47	47	52	52	59	60	62



Answer: 54.06 cups; interpolation

1. sum x = 108, sum y = 421, sum x² = 1500, sum xy = 5804; using these unrounded sums, b1 = 241/84 and b0 = 389/28.

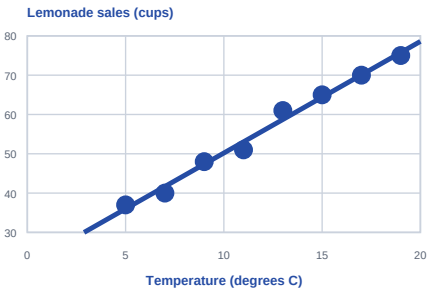
2. The fitted line is y-hat approximately 13.89 + 2.87x.

3. Using exact coefficients, y-hat = 389/28 + (241/84)(14) = 4541/84, approximately 54.06 cups.

4. 14 is within the observed x range [10, 17], so this is interpolation.

2. Find the ordinary least-squares line with an intercept, and draw that fitted line on the scatterplot.

x: Temperature (degrees C)	5	7	9	11	13	15	17	19
y: Lemonade sales (cups)	37	40	48	51	61	65	70	75



Answer: y-hat approximately 21.80 + 2.84x

1. sum x = 96, sum y = 447, sum x² = 1320, sum xy = 5841; using these unrounded sums, b1 = 159/56 and b0 = 1221/56.

2. b1 = [8(5841) - 96(447)]/[8(1320) - 96²] = 159/56 approximately 2.84; b0 = y-bar - b1(x-bar) = 1221/56 approximately 21.80.

3. The fitted line is y-hat approximately 21.80 + 2.84x; the answer-key plot uses the exact coefficients before final rounding.

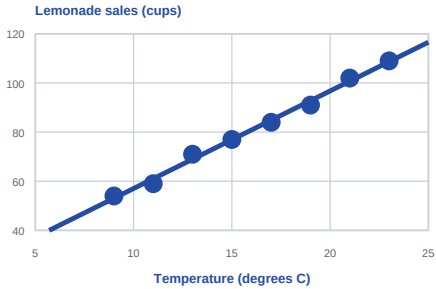
Linear Regression and Residuals

Worked Answer Key

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

3. Interpret the fitted slope in context, then classify a prediction at $x = 29$ as interpolation or extrapolation and state a limitation.

x: Temperature (degrees C)	9	11	13	15	17	19	21	23
y: Lemonade sales (cups)	54	59	71	77	84	91	102	109

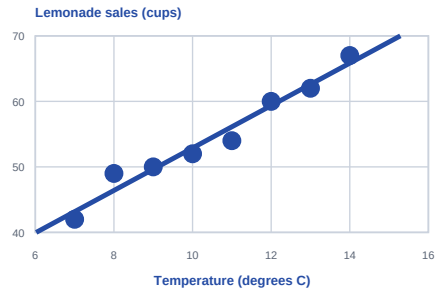


Answer: For each additional degree C, predicted sales increase by about 3.97 cups; $x = 29$ is extrapolation.

1. $\text{sum } x = 128$, $\text{sum } y = 647$, $\text{sum } x^2 = 2216$, $\text{sum } xy = 11019$; using these unrounded sums, $b_1 = 667/168$ and $b_0 = 2915/168$.
2. Slope interpretation: within this fitted sample, one additional degree C is associated with an increase of about 3.97 predicted cups sold.
3. Because 29 is outside $[9, 23]$, the prediction is extrapolation.
4. The line summarizes association in these observations; it does not guarantee future sales or prove temperature causes the change.

4. For the observation $(12, 60)$, calculate the residual using observed minus predicted.

x: Temperature (degrees C)	7	8	9	10	11	12	13	14
y: Lemonade sales (cups)	42	49	50	52	54	60	62	67



Answer: 0.64 cups

1. $\text{sum } x = 84$, $\text{sum } y = 436$, $\text{sum } x^2 = 924$, $\text{sum } xy = 4714$; using these unrounded sums, $b_1 = 68/21$ and $b_0 = 41/2$.
2. Using exact coefficients at $x = 12$, $y\text{-hat} = 41/2 + (68/21)(12) = 831/14$, approximately 59.36.
3. Residual = observed - predicted = $60 - (831/14) = 9/14$, approximately 0.64 cups.

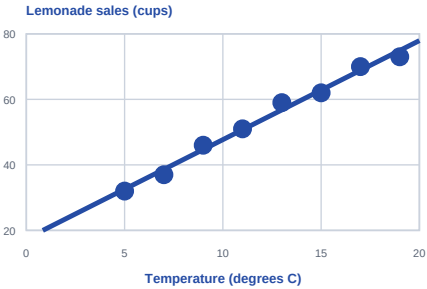
Linear Regression and Residuals

Worked Answer Key

Fit an ordinary least-squares line with an intercept from the displayed pairs. Keep full precision until the final answer; residual equals observed y minus predicted y.

5. Use the least-squares line to predict lemonade sales when temperature is 23 degrees C. Identify interpolation or extrapolation.

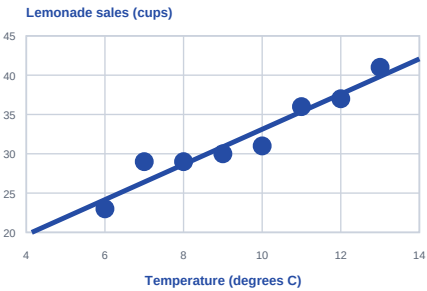
x: Temperature (degrees C)	5	7	9	11	13	15	17	19
y: Lemonade sales (cups)	32	37	46	51	59	62	70	73



- Answer: 87.01 cups; extrapolation
- sum $x = 96$, sum $y = 430$, sum $x^2 = 1320$, sum $xy = 5668$; using these unrounded sums, $b_1 = 127/42$ and $b_0 = 489/28$.
 - The fitted line is $\hat{y}$ -hat approximately $17.46 + 3.02x$.
 - Using exact coefficients, $\hat{y}$ -hat = $489/28 + (127/42)(23) = 7309/84$, approximately 87.01 cups.
 - 23 is outside the observed x range $[5, 19]$, so this is extrapolation and is less reliable.

6. Find the ordinary least-squares line with an intercept, and draw that fitted line on the scatterplot.

x: Temperature (degrees C)	6	7	8	9	10	11	12	13
y: Lemonade sales (cups)	23	29	29	30	31	36	37	41



- Answer: $\hat{y}$ -hat approximately $10.74 + 2.24x$
- sum $x = 76$, sum $y = 256$, sum $x^2 = 764$, sum $xy = 2526$; using these unrounded sums, $b_1 = 47/21$ and $b_0 = 451/42$.
 - $b_1 = [8(2526) - 76(256)]/[8(764) - 76^2] = 47/21$ approximately 2.24; $b_0 = \bar{y} - b_1(\bar{x}) = 451/42$ approximately 10.74.
 - The fitted line is $\hat{y}$ -hat approximately $10.74 + 2.24x$; the answer-key plot uses the exact coefficients before final rounding.