

LESSON 37 | MEET THE IDEA

Quadratic regression and real-world models

Tuesday, March 9, 2027 . 6:00–7:00 PM Central

By the end, I can...

Enter paired data into a graphing tool, fit a quadratic, interpret its vertex and predictions, and explain the limits of the model.

These **fictional data** describe height after an object is released. Time t is measured in seconds from release; height is measured in meters above the ground. The slight variation gives us practice fitting a curve.

Time t (seconds)	Height (meters)
0	1.05
0.5	2.15
1	2.95
1.5	3.45
2	2.95
2.5	2.15
3	1.05

Your task includes using technology

Enter the data and run a quadratic regression yourself. Record the fitted coefficients, display the curve with the points, and use your result to answer questions. The following pages guide the process.

A scatterplot helps you judge whether a quadratic is plausible. A curved pattern alone does not prove that a quadratic is the right model for every situation.

LESSON 37 | A DESMOS REGRESSION WORKFLOW

Fit the curve yourself

Open a fresh [Desmos Graphing Calculator](#). Use the teacher’s approved alternative if needed; choose a quadratic model $ax^2 + bx + c$.

Step	What to do
1. Enter	Create a table with columns x_1 and y_1 . Enter time in x_1 and height in y_1 , one pair per row.
2. Fit	On a new expression line, type the regression below. The tilde $\sim$ asks for a fit instead of an exact equation.
3. Record	Read and record the fitted values of a , b and c . Avoid assigning these letters values before fitting.
4. Inspect	Use Zoom Fit to see the data and curve. Check that all seven data pairs were entered correctly.
5. Predict	Define $h(x) = ax^2 + bx + c$ using the fitted parameters. Evaluate $h(1.25)$ and find the vertex.

Regression to enter

$y_1 \sim ax_1^2 + bx_1 + c$

Keyboard form: $y_1 \sim a x_1^2 + b x_1 + c$

The subscript 1 refers to the table columns. The x in $h(x)$ represents time.

My fitted values: $a =$ _____ $b =$ _____ $c =$ _____

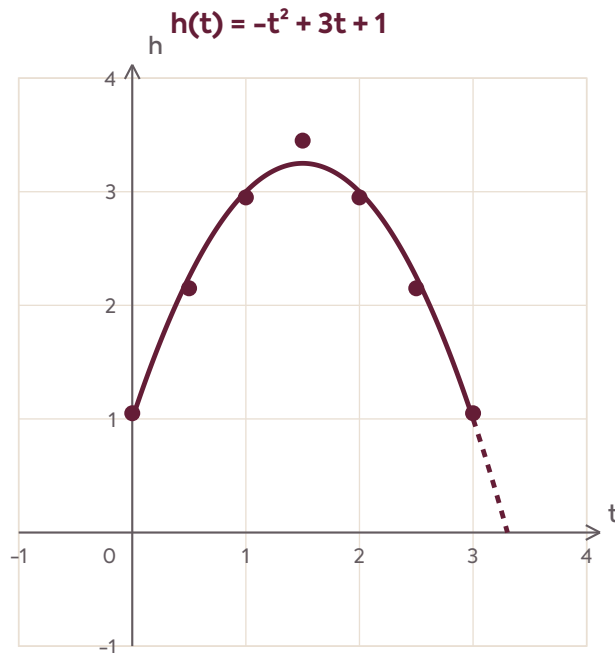
My predicted $h(1.25)$: _____ meters. Compare with the worked model next.

Workflow checked September 9, 2026. Official help: [Desmos regressions guide](#).

LESSON 37 | A MODEL IS AN ESTIMATE

Read what the fitted curve says

The fitted coefficients are approximately $a = -1$, $b = 3$, $c = 1$. Use the displayed model $h(t) = -t^2 + 3t + 1$ for the calculations in these notes.



Dots: the supplied data.

Solid curve: the fitted model over $0 \leq t \leq 3$.

Short dashed part: a prediction beyond the data.

t is measured in seconds.

h is measured in meters.

Find the model's highest point

$$h(t) = -(t - 1.5)^2 + 3.25$$

Vertex: (1.5, 3.25)

Rewrite in vertex form by completing the square.

The fitted maximum is 3.25 meters at 1.5 seconds.

The data value at $t = 1.5$ is 3.45 meters, slightly above the fitted curve. **Residual = observed value - predicted value:** $3.45 - 3.25 = 0.20$ meters. A best-fit curve need not pass through every point.

Over the observed time interval $0 \leq t \leq 3$, the displayed model has range $1 \leq h \leq 3.25$. That describes the model's outputs, not the minimum and maximum of the noisy data.

LESSON 37 | WITHIN AND BEYOND THE DATA

Predict with a sensible boundary

Estimate the height at 1.25 seconds

$$h(1.25) = -(1.25)^2 + 3(1.25) + 1$$

Substitute the time into the fitted model.

$$h(1.25) = 3.1875$$

The estimated height is about 3.19 meters.

This is interpolation: 1.25 is within the observed interval from 0 to 3 seconds.

Predict when the height reaches ground level

$$-t^2 + 3t + 1 = 0$$

Ground level means $h = 0$.

$$t^2 - 3t - 1 = 0$$

Multiply both sides by -1 .

$$t = (3 \pm \sqrt{(13)})/2$$

Use the quadratic formula.

$$t \approx 3.30 \text{ or } t \approx -0.30$$

Time starts at release, so reject the negative root.

Label this landing time as an extrapolation

The latest data point is at 3 seconds. A landing time of about 3.30 seconds goes beyond the data. It is a tentative prediction, assuming the model remains suitable until landing. Do not treat it as an observed fact.

If that assumption is made, the flight interval is $0 \leq t \leq (3 + \sqrt{(13)})/2$ and the modeled height range is $0 \leq h \leq 3.25$. Do not extend this flight model to negative heights after landing.

LESSON 37 | USE YOUR FITTED MODEL

Your turn

Use the supplied dataset and the graphing tool. Keep unrounded coefficients in the tool; round reported heights and times to two decimal places where appropriate.

1. Run a quadratic regression and record a , b and c . Show the data points and fitted curve on the same graph.

2. Give the model's maximum height and the time it occurs. How does this differ from the largest supplied height value?

3. Predict $h(1.25)$. Is this interpolation or extrapolation? Explain.

4. Use the displayed model to find when the height is 3 meters. Explain why there are two times.

5. Find the predicted landing time. Explain which root you reject, why the prediction extends beyond the data, and why $h(10)$ is not a sensible flight prediction.

LESSON 37 | WORKED ANSWERS

Check the calculation and its meaning

1. $a \approx -1$, $b \approx 3$, $c \approx 1$, giving $h(t) = -t^2 + 3t + 1$. Your plot should show seven points close to a downward-opening parabola. A different result is a reason to check data entry and the regression expression.
2. Vertex form is $h(t) = -(t - 1.5)^2 + 3.25$. The **fitted maximum is 3.25 meters at 1.50 seconds**. The largest supplied value is **3.45 meters**, also at 1.50 seconds; the model does not match every observation exactly.
3. $h(1.25) = -1.5625 + 3.75 + 1 = 3.1875$, or **about 3.19 meters**. It is **interpolation** because 1.25 lies between 0 and 3 seconds.
4. $-t^2 + 3t + 1 = 3$ gives $t^2 - 3t + 2 = 0$.
 $(t - 1)(t - 2) = 0$, so **$t = 1$ or 2 seconds**. The model reaches 3 meters once while rising and once while falling.
5. The roots are $(3 \pm \sqrt{13})/2$. Reject about -0.30 seconds because time begins at release. The possible landing time is **about 3.30 seconds**, beyond the observed 0–3 second interval. Also, $h(10) = -100 + 30 + 1 = -69$ meters; extending this flight model far past landing is inappropriate.

A close fit is not a guarantee

For these data, R^2 is about 0.987. It summarizes how closely this fitted model matches these data; it does not establish cause and effect or guarantee accurate extrapolation. Always inspect the graph, units and context.

Curriculum focus: A.8B. Next class: compare the four solving methods and review your evidence before the Unit 6 checkpoint.