

LESSON 43 | MEET THE IDEA

Exponential regression and the Unit 7 checkpoint

Tuesday, April 6, 2027 . 6:00–7:00 PM Central

By the end, I can...

Use technology to fit an exponential model, interpret its parameters and predictions, and review sequence and exponential skills.

Real measurements rarely have perfectly equal ratios. **Exponential regression** uses technology to fit an exponential curve to paired data. The curve need not pass through every dot.

Time t (hours)	Signal reading (units)
0	100
1	81
2	63
3	52
4	40
5	33

Our modeling question

A fictional signal weakens over five hours. Can an exponential model summarize these positive readings and estimate the signal between observations?
The dataset is a teaching example, not measurements from a real device.

The ratios $81/100 = 0.81$ and $63/81 \approx 0.778$ are close but not equal. They suggest considering decay; they do not make any one ratio an exact answer.

LESSON 43 | GUIDED TECHNOLOGY ACTIVITY

Perform the fit yourself

Use the teacher-approved graphing tool. The steps below use [Desmos Graphing Calculator](#). Start a fresh graph so a and b are not already assigned values.

Step	What to do
1 . Enter the data	Add a table. Enter times 0, 1, 2, 3, 4, 5 in x_1 and readings 100, 81, 63, 52, 40, 33 in y_1 . Keep each pair in the same row.
2 . Ask for regression	On a new expression line type: $y_1 \sim a b^{(x_1)}$ Underscores make subscripts. The tilde $\sim$ asks for a fit; an equals sign does not perform regression.
3 . Match the worked setting	Leave Log Mode off . This fits the original signal readings by minimizing squared vertical errors.
4 . Record the parameters	You should get about $a = 100.291$ and $b = 0.798844$. Keep the unrounded fitted values in the calculator.
5 . Inspect and predict	Enter $f(x) = a b^x$. Zoom to see the dots and curve together. Evaluate $f(2.5)$, then compare $f(3)$ with the observed reading.

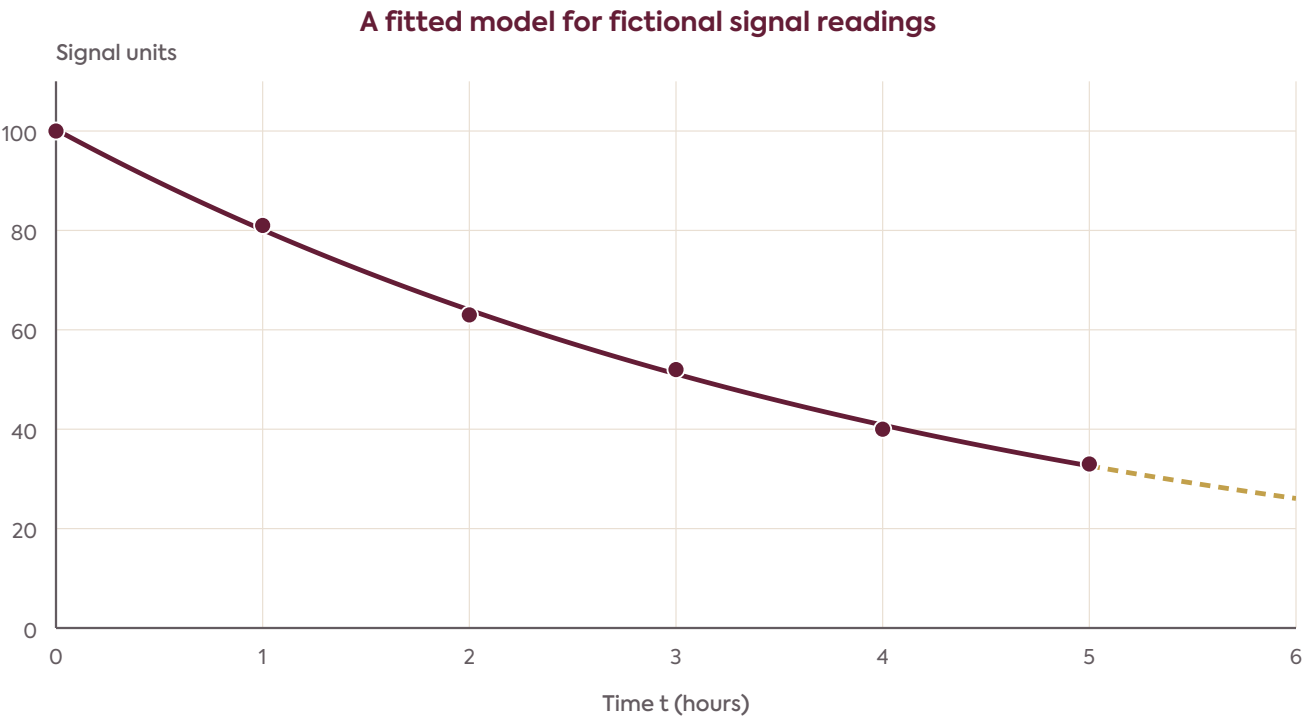
A different regression setting can give a different fit

Log Mode fits transformed data and may produce different coefficients. Other calculators can also use that approach. For these worked answers, use the original-data fit above. Do not treat a small method difference as an arithmetic mistake.

Official help: [Regressions](#) and [Log Mode](#). If results differ substantially, check every table entry and the model form first.

LESSON 43 | PARAMETERS HAVE MEANING

Explain the fitted curve



Our fitted model

$f(t) \approx 100.291(0.798844)^t$

t is hours since the first reading; f(t) is the predicted signal in units.
The displayed coefficients are rounded. Use the unrounded calculator parameters for predictions.

Parameter	Interpretation
$a \approx 100.291$	Predicted starting signal at $t = 0$. It is close to, but not exactly, the observed 100.
$b \approx 0.798844$	About 79.88% is retained each hour: a decrease of about 20.12% per hour.

The solid curve covers observed times 0–5 hours. The dashed part extends beyond the data. A close fit describes these readings; it does not guarantee future behavior or prove a cause.

LESSON 43 | ESTIMATE, COMPARE AND EXPLAIN

Predict carefully, then review the pattern

Input	Model estimate	Meaning
$t = 2.5$	$f(2.5) \approx 57.20$ units	Interpolation: between observed times.
$t = 3$	$f(3) \approx 51.13$ units	Observed value is 52; the fitted curve is not exact.
$t = 10$	$f(10) \approx 10.61$ units	Extrapolation: well beyond the 0–5 hour data interval.

A **residual** is observed minus predicted. At $t = 3$ it is $52 - 51.12656... \approx \mathbf{0.87 \text{ units}}$. A positive residual means the dot is above the fitted curve.

Turn the fitted model into an hourly sequence

If reading 1 corresponds to time 0, the predicted readings follow

$s_n = a b^{n-1}$, $n = 1, 2, \dots$, using the fitted a and b .

Equivalently, $s_1 = a$ and $s_n = b s_{n-1}$ for $n = 2, 3, \dots$.

Measured readings need not form an exact geometric sequence.

Today’s 60-minute lesson

5 minutes: retrieval . 15: model demonstration . 20: guided fitting and interpretation . 15: separate Unit 7 checkpoint . 5: next steps.

Use the following study checks for revision before or after class. Your teacher provides the graded checkpoint separately. It checks rules and indexing, percentage change, graph features, and model interpretation.

LESSON 43 | STUDY CHECKS BEFORE THE CHECKPOINT

Your turn

1. Fit the supplied signal data with Log Mode off. Record a and b to at least six significant figures, then interpret the hourly percent decrease.

2. Use the unrounded fit to estimate $f(2.5)$. Is this interpolation or extrapolation? Give units.

3. Estimate $f(3)$, then compute the residual for the observed reading 52. Explain its sign.

4. Estimate $f(10)$. Explain one reason that this estimate is less secure than $f(2.5)$.

5. Compare (a) 10, 15, 20, 25, ... and (b) 10, 15, 22.5, 33.75, For each, give both rules with first index $n = 1$.

6. For the unshifted fitted curve on $t \geq 0$, state the model range and asymptote. Would a very small prediction prove the actual signal can never be zero?

LESSON 43 | WORKED ANSWERS

Connect the method to the meaning

1. The original-data fit gives $a \approx 100.290847$, $b \approx 0.798843599$. The hourly decrease is $(1 - b) \times 100\% \approx 20.12\%$. It retains about 79.88%, not 20.12%.
2. $f(2.5) \approx 57.20$ signal units. This is **interpolation** because 2.5 lies between observed input values within 0–5 hours.
3. $f(3) \approx 51.13$ units. Using the unrounded prediction, residual = $52 - 51.12656... \approx +0.87$ units. The observed dot lies above the curve.
4. $f(10) \approx 10.61$ units. This is **extrapolation**; no readings were supplied after hour 5. The process or conditions may change, so the fitted pattern may not continue.
5. (a) Arithmetic, $d = 5$. Explicit: $a_n = 10 + 5(n - 1)$, $n = 1, 2, \dots$. Recursive: $a_1 = 10$; $a_n = a_{n-1} + 5$, $n = 2, 3, \dots$.
(b) Geometric, $r = 1.5$. Explicit: $b_n = 10(1.5)^{n-1}$, $n = 1, 2, \dots$. Recursive: $b_1 = 10$; $b_n = 1.5b_{n-1}$, $n = 2, 3, \dots$.
6. For $t \geq 0$, the model range is $0 < f(t) \leq a$, where $a \approx 100.290847$, and the horizontal asymptote is $y = 0$. This mathematical model never outputs zero; that does **not** prove the real process can never reach zero or stop following the model.

Choose your next practice

Class 39: differences and indexing. Class 40: ratios and sequence rules.

Class 41: multipliers and time units. Class 42: domains, ranges and asymptotes. Class 43: technology, parameters and prediction limits.

Chapter 8 begins Thursday, April 8, 2027: choosing linear, quadratic or exponential models. Curriculum focus: A.9E, with A.9A–D and A.12C–D revisited.