Exponential Regression

Use the site's regression tool or a graphing calculator for the fits. Check differences and ratios first, then fit, then read a and b in the story.

Name _____ Date _____

Words we use

say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Exponential regression	Finding the exponential curve that fits the data best.	Technology gives a and b for $y = a \cdot b^x$.
Roughly constant	Close to the same, not exact.	Real ratios wobble; look for steady, not identical.
Initial value, a	The model's value when x = 0.	Read it in the story: about 12 gnats at the start.
Growth factor	b bigger than 1: what the amount is multiplied by each step.	1.63 = 1 + 0.63: grows about 63%.
Decay factor	b between 0 and 1.	0.49 = 1 – 0.51: keeps about 49%.
Constant ratio	The exponential pattern from Unit 7: divide each output by the one before.	In real data it is only roughly constant.

Part A The gnats

HOURS	0	1	2	3	4
gnats	12	20	35	60	80
difference					
ratio					

1. Which family will you try? Give two pieces of evidence.

2. Fit an exponential with the regression tool or a calculator. Write the model, rounding a and b to two decimals.

3. What do a and b mean in the story?

Part B Use the gnats model

1. Predict the number of gnats at 3 hours. Compare with the actual count.

2. About when will there be 200 gnats? Fill in the table.

HOURS	4	5	5.5	5.7	6
model					

3. Is that prediction interpolation or extrapolation?

Part C The pennies

POUR	0	1	2	3	4	5
pennies left	300	164	100	46	20	8
ratio						

1. Before fitting: what model does the story suggest? Write the decay factor as a stacked fraction.

2. Fit an exponential. Write the model.

3. Why are the numbers close to the story's but not exactly the same?

Part D Line or exponential?

DATA (X = 0, 1, 2, 3, 4)	DIFFERENCES	RATIOS	FAMILY TO TRY
51, 59, 72, 79, 91			
5, 9, 19, 35, 74			

Part E Exit ticket

1. $y = 20 \cdot 1.25^{x}$, x in days: what do 20 and 1.25 mean?

2. What two things support choosing an exponential model?

Answer key

Part A. Differences 8, 15, 25, 20. Ratios 1.67, 1.75, 1.71, 1.33. 1. Exponential: the ratios are roughly constant and the plot bends upward. 2. $y = 12.48 \cdot 1.63^x$. 3. About 12 gnats at the start; growing about 63% each hour.

Part B. 1. About 54 (actual 60). 2. 88.1, 143.6, 183.3, 202.2, 234.1 with a and b rounded to two decimals (the unrounded model gives 88.3, 144.0, 184.0, 202.9, 235.0; either is fine): about 5.7 hours. 3. Extrapolation: the data stops at 4 hours.

Part C. Ratios 0.55, 0.61, 0.46, 0.43, 0.40. 1. $300 \cdot (\frac{1}{2})^x$. 2. About $y = 348 \cdot 0.49^x$. 3. Coin flips are random, so the data wobbles; regression fits all the points.

Part D. Differences 8, 13, 7, 12 (roughly 10): a line. Differences 4, 10, 16, 39; ratios 1.8, 2.1, 1.8, 2.1 (roughly 2): an exponential.

Part E. 1. About 20 at the start; growing about 25% a day. 2. The graph bends like an exponential, and the ratios are roughly constant.