ADVANCED MATH / 01 UNDERSTAND

Exponential growth

An illustrated lesson ▪ Theory, reasoning and worked examples

Multiplicative change is the defining feature

An exponential model multiplies by the same factor over equal input intervals. In $A(t) = A0 \times b^t$, A0 is the initial amount and b is the multiplier per interval. If $b > 1$, the model grows; if $0 < b < 1$, it decays. The factor is positive in the growth and decay models discussed here.

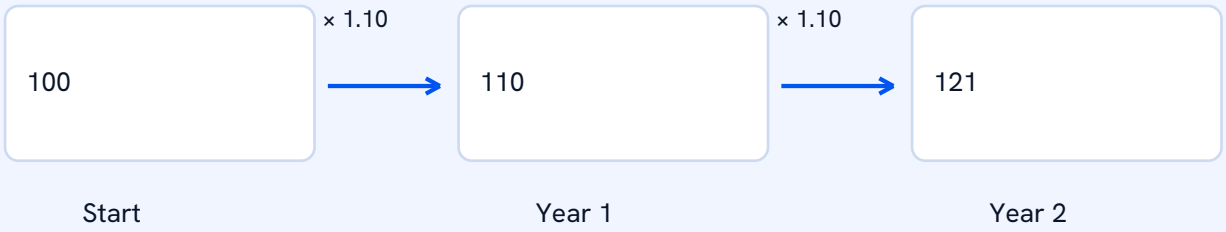
A rate is not the same as a factor

A 10% increase retains the original 100% and adds 10%, giving a factor of 1.10. A 10% decrease retains 90%, giving 0.90. The percent rate must be written as a decimal before adding to or subtracting from 1. A multiplier of 1.10 does not mean 110% growth.

The absolute increase changes

Starting with 100 and growing by 10% gives 110, then 121. The increases are 10 and 11 because each increase is calculated from the new amount. A linear model would add the same amount each interval. Tables of exponential data have constant ratios rather than constant differences.

THE SAME FACTOR; A DIFFERENT ABSOLUTE INCREASE



Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

Repeated percentage growth multiplies by the same factor each interval.

ADVANCED MATH / 02 BUILD THE METHOD

From idea to method

Match the exponent to the time unit

If an amount doubles every 3 years, a model in years is $A(t) = A0 \times 2^{(t/3)}$. The exponent counts completed doubling intervals, including fractional intervals when the model permits them. Using 2^t instead would describe doubling every year.

Find a factor from data

If a quantity grows from 80 to 100 in one equal interval, the multiplier is 100/80 = 1.25, equivalent to 25% growth. If that change took two intervals, the per-interval factor b must satisfy $b^2 = 1.25$. Dividing the total percentage by two is not exact compounding.

Keep precision until the end

Use the exact decimal factor through intermediate steps, then round only as requested. A population model can produce fractional predictions even though observed people or organisms are whole. Interpret the numerical result according to the model and the requested rounding rule.

WORKED EXAMPLE / DECAY OVER REPEATED INTERVALS

A sample begins at 400 grams and loses 20% of its mass each hour. Model its mass after 2 hours.

01 Set up the reasoning

The retained fraction is 1 - 0.20 = 0.80 each hour.

02 Apply the relationship

$M(t) = 400(0.8)^t$, so $M(2) = 400 \times 0.64 = 256$ grams.

03 Interpret and check

The first loss is 80 grams; the second is 64 grams. Equal percent losses are not equal absolute losses.

Keep these distinctions handy

Growth	Multiplier = 1 + rate as a decimal.
Decay	Multiplier = 1 - rate as a decimal.
Time interval	Exponent = elapsed time / length of one growth interval.

ADVANCED MATH / 03 CONNECT & REMEMBER

See the deeper pattern

Compare rates through equivalent forms

The forms $100(1.21)^t$ and $100(1.1)^{(2t)}$ are equivalent because $1.21 = 1.1^2$. They can describe a 21% increase per large interval or two 10% increases within it. Always identify the interval represented by the variable before interpreting a coefficient as a growth rate.

ONE MORE WORKED APPLICATION

A population model starts at 300 and increases by 10% each year. What value does the model predict after 2 years?

1. Use a growth factor of 1.10.

2. After one year: 330.

3. After two years: 363.

Answer: 363

Mistakes to recognize

▪ Use 0.85 for a 15% decrease, not -0.15.

▪ A percentage increase is calculated from the current amount each interval.

▪ Do not confuse the initial amount with the first observed amount when observation starts after time zero.

A quick understanding check

Does 10% growth twice equal 20% total growth?

Explanation: No. 1.10 × 1.10 = 1.21, which is 21% total growth.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Advanced Math, then look for exponential growth questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

Open your dashboard → | Explore the resource library →

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