

Variables That Change Together: Input and Output

Grade 6 math · Lesson · Standards: 6.EE.C.9

Quick answer: The independent variable is the quantity that is chosen or changes by itself, such as time. The dependent variable is the quantity that responds to it, such as distance. An equation like $d = 65t$ shows how the dependent variable is found from the independent one.

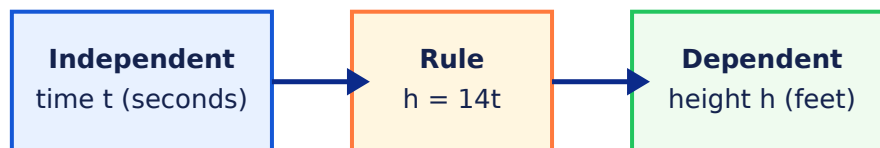
Standards: 6.EE.C.9 · **Level:** Grade 6

What are independent and dependent variables?

Two quantities often change together. Time passes and a drone climbs. A customer orders more tacos and the bill grows. A **variable** is a letter that stands for a quantity that can change.

Vocabulary

The **independent variable** is the quantity that changes on its own or is chosen first, such as time. The **dependent variable** is the quantity whose value depends on it, such as height.



The input is chosen; the output follows from the rule.

The input (independent variable) goes in, the output (dependent variable) comes out.

How do you write an equation for the relationship?

When one quantity grows at a steady rate, multiply the independent variable by that rate. A drone that climbs 14 feet every second reaches a height of $h = 14t$ feet after t seconds.

Equation pattern

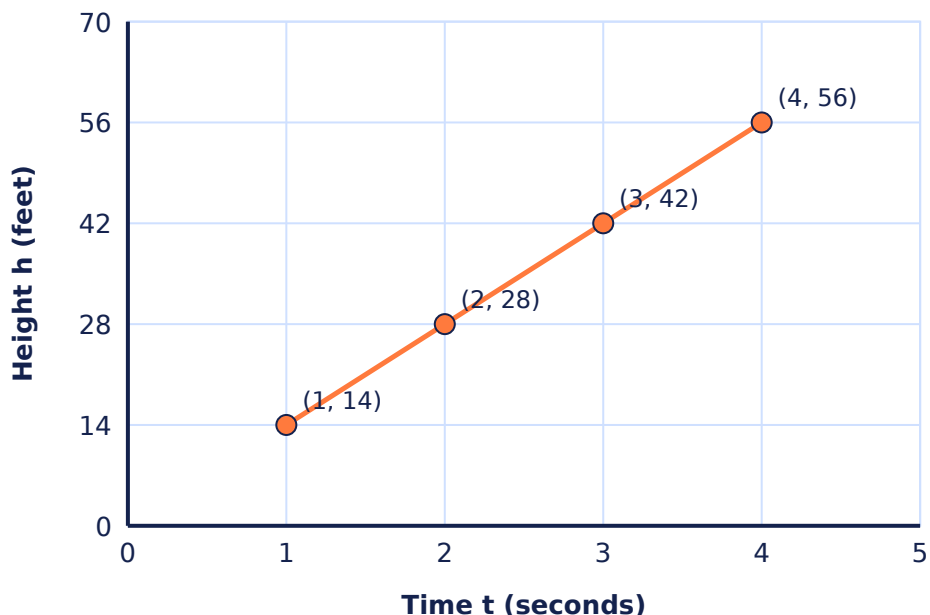
$$\text{dependent} = \text{rate} \times \text{independent}$$

If one quantity is always a fixed amount more than the other, add instead: $y = x + 5$.

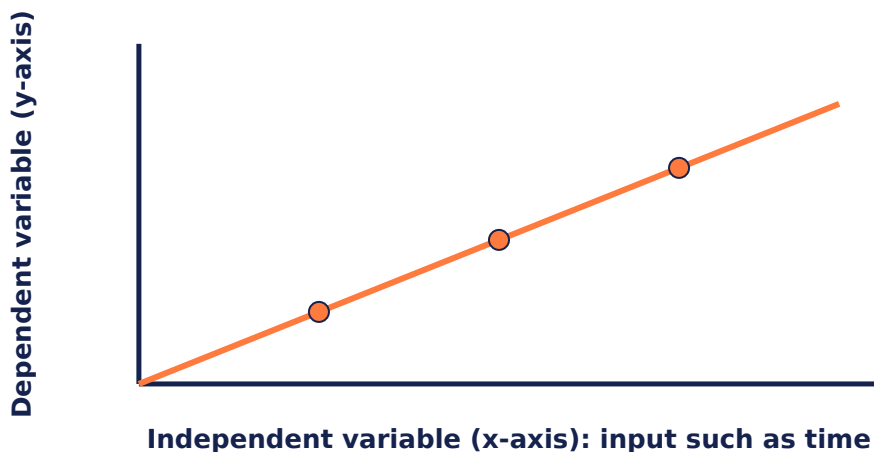
How do tables and graphs show the relationship?

A table lists input and output side by side. A graph plots each pair as a point, with the independent variable on the horizontal axis and the dependent variable on the vertical axis.

t (seconds)	1	2	3	4
h (feet)	14	28	42	56



The drone graph: each extra second adds 14 feet.



Independent variable on the horizontal axis, dependent variable on the vertical axis.

Method: from a story to equation, table and graph

1. Name the two quantities. Decide which one depends on the other.
2. Choose a letter for each and write the rule as an equation.
3. Substitute chosen inputs to build a table.
4. Plot each (input, output) pair with the input on the x-axis.

Worked example

A drone climbs 14 feet each second. Find its height after 9 seconds.

Time is independent and height is dependent. The equation is $h = 14t$. Substitute $t = 9$: $h = 14 \times 9 = \mathbf{126 \text{ feet}}$.

Common mistake

Putting the dependent variable on the horizontal axis. Ask which quantity depends on the other, and send that one up the vertical axis.

Mathbot's tip

Say the sentence "*output depends on input*". The word after "depends on" names the independent variable.

Key points to remember

- The independent variable is the input and goes on the horizontal x-axis.
- The dependent variable is the output and goes on the vertical y-axis.
- A steady rate gives an equation of the form $\text{dependent} = \text{rate} \times \text{independent}$.
- Tables, equations and graphs are three ways to show the same relationship.

Variables That Change Together: Input and Output: frequently asked questions

How can you tell which variable is independent?

Ask which quantity depends on the other. The one that can be chosen freely, such as hours worked, is independent. The one that is calculated from it, such as pay, is dependent.

Which axis does the independent variable use?

The independent variable goes on the horizontal x-axis. The dependent variable goes on the vertical y-axis.

How do you write an equation from a rate?

Multiply the independent variable by the rate. A rate of 65 miles per hour gives $d = 65t$, where d is the dependent variable.

Can a table and an equation describe the same relationship?

Yes. Each row of a table is one input and its output. Substituting that input into the equation must give the same output.

Is the independent variable always time?

No. Time is common, but the independent variable can be tickets sold, pounds bought or any quantity that is chosen first.