

# Independent and dependent variables

For a function  $f(x)$ , the independent variable is  $x$ , and we usually use  $y$  as the dependent variable. You always plug in a value of  $x$ , and your function returns to you a value of  $y$  based on the value you gave it for  $x$ . Remember that for a relation to be a function, there's only one possible output  $y$  for any input  $x$ .

Specifically, we could say:

The value of the independent variable is the “input” (both input and independent start with “in,” which may help you remember that they go together). The input value can always be chosen.

The value of the dependent variable is the “output.” The value of the dependent variable “depends” on the value of the independent value. The output is determined by the input.

Writing a statement of “output depends on input” is often helpful when trying to identify which variable is independent and which is dependent.

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## Example

A train travels at a constant speed of 45 mph. The distance traveled can be calculated by measuring the amount of time and using the equation  $d = 45t$ , where  $d$  is the distance in miles and  $t$  is the time in hours. Which variable is the dependent variable?



How far the train has traveled (distance) depends on how long the train has been moving (time). Also notice that in the equation,  $d$  is isolated. We could even rewrite the equation as  $d(t) = 45t$ , which makes it clear that  $t$  is the input and  $d$  is the output. Since  $d$  depends on  $t$ ,  $d$  is the dependent variable.

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Let's try another example of independent and dependent variables.

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### Example

Each month a water bill is calculated from the number of gallons of water used during that month. Which variable is the independent variable?

The amount of the water bill depends on the number of gallons of water used. The input is the number of gallons, and the output is the amount of the water bill. The input is the independent variable, and therefore the number of gallons of water used is the independent variable.

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