Independent and Dependent Variables

**Independent Variable**
- the variable that represents the domain
- the variable that affects the other variable

**Example**
Which of the variables is the independent variable in the following scenario: the height, \( h \), in feet of a football \( t \) seconds after it is kicked.

**Answer:** Since the height depends on how long after the ball is kicked, time, \( t \), is the independent variable.

**Dependent Variable**
- the variable that represents the range
- the variable that is affected by the other variable

**Example**
How is the amount of money earned during a week at a job related to the number of hours worked during the week?

**Answer:** The more hours worked during the week, the more money is earned. So, the amount of money is the dependent variable, and time is the independent variable.

So, the question is “How do you know if a change in the independent variable causes the dependent variable to increase or decrease?” To answer this question, you need to look at either the problem or the equation that relates the two variables.

**Finding the Relationship Between Variables in Problems**
The problem may have key words that describe if a change in the independent variable will cause the dependent variable to increase or decrease. Or, the problem will give examples that allow you to find a pattern or equation to determine the answer.
Example

A TV store sells about 100 TV’s at the price of $500 per TV. For each $25 increase in price, about 5 fewer televisions are sold. How much should the TV store charge per TV in order to maximize their profit?

Answer: This problem deals with how a change in price affects the number of TV’s sold, which affects the profit. The price (or change in price) is the independent variable. So, you can make a table in a spreadsheet to answer this question. Since a spreadsheet allows you to copy formulas, it will be pretty simple.

- Let the first column represent the price of the TV.
- Let the second column represent the number of TV’s sold.
- Let the third column equal the total sales, which is found by multiplying the cell in the first column by the cell in the second column.

Fill in the first row of values given in the problem. The total sales cells are calculated by multiplying the price times the # sold.

Add $25 to the price of the TV for the next row.
Subtract 5 TV’s from the previous amount for the next row.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Price of TV</td>
<td># of TV’s sold</td>
</tr>
<tr>
<td>2</td>
<td>$500</td>
<td>100</td>
</tr>
</tbody>
</table>

Copy the red, green, and pink cells until you have enough information to come up with an answer.

You can see that the total sales decreases as the price of the TV increases. So the best price would be to leave the price at $500.

You could create an equation for this problem, but sometimes it is easier to just make a spreadsheet to find the answer.
**Finding the Relationship Between Variables in Equations**

You can definitely determine how variables are related by looking at the equation. However, the equation will only tell you if the dependent variable is going to increase or decrease by increasing the independent variable in the long run.

- If the leading coefficient is positive, the dependent variable will increase as the independent variable increases over time.
- If the leading coefficient is negative, the dependent variable will decrease as the independent variable increases over time.

**THIS DOES NOT MEAN THAT THE DEPENDENT VARIABLE WILL ALWAYS BE INCREASING OR DECREASING. IT JUST MEANS THAT AS THE INDEPENDENT VARIABLE GET INFINITELY LARGE, THE DEPENDENT VARIABLE WILL EITHER DECREASE OR INCREASE.**

**Example**

Will the dependent variable increase or decrease over time with the given function \( f(x) = -0.012x^2 + 4x + 2 \)?

**Answer:** Since the leading coefficient is -0.012, the dependent variable will **DECREASE** over time (as \( x \) gets very large).

However, if you are looking at a change between the dependent variable as \( x \) increases from 1 to 2, the dependent variable is actually increasing. Take a look at the graph of the function:

![Normal Default Window](Image1)

![Zoomed Out Window](Image2)

That is why it is also important to understand what the graphs of these functions are supposed to look like. In the normal default window, the graph looks like a line when it is actually a parabola. The graph will also give a good idea over which domains the dependent variable is increasing or decreasing.