Extend 2-5 Algebra Lab: Correlation and Causation

Determine whether the following correlations possibly show causation. Write yes or no. If not, identify other lurking variables.

1. If Allison studies, she will get an A.

   SOLUTION:
   There is no causation. She will have to complete her assignments with high quality work, participate in class, understand the material, score high on her quizzes and tests, and meet any other requirements designated by her instructor.

2. When Lisa exercises, she is in a better mood.

   SOLUTION:
   There is no causation. She could have an argument with her family, her friends could do something to upset her, or something could happen at work.

3. The gun control laws have reduced violent crime.

   SOLUTION:
   There is no causation. More violent criminals could already be in prison, rehabilitation could be working, unemployment could be falling, or the economy could be improving.


   SOLUTION:
   Yes there is causation. There is medical research that smoking causes lung cancer. Thus there is a correlation that shows causation.

5. If we have a Level 2 snow emergency, we do not have school.

   SOLUTION:
   Yes there is causation. If it is state policy that when there is a Level 2 snow emergency, school is canceled, Level 2 emergency and school canceled are correlated.

6. Reading more increases one’s intelligence.

   SOLUTION:
   There is no causation. A person’s experiences in school, at the workplace, and in everyday life could improve his or her intelligence.

7. What do you think must be done to show that a correlation between two variables actually shows causation?

   SOLUTION:
   A large number of unbiased studies need to be completed that show a direct link between the variables and all of the lurking variables need to be eliminated from the studies.
Calculate the correlation coefficient and describe the correlation. Determine if causation is possible. Explain your reasoning.

<table>
<thead>
<tr>
<th>Car Value ($)</th>
<th>Miles per Gallon</th>
<th>Car Value ($)</th>
<th>Miles per Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>14,000</td>
<td>55</td>
<td>15,000</td>
<td>40</td>
</tr>
<tr>
<td>18,000</td>
<td>37</td>
<td>17,000</td>
<td>35</td>
</tr>
<tr>
<td>20,000</td>
<td>25</td>
<td>22,500</td>
<td>19</td>
</tr>
</tbody>
</table>

**SOLUTION:**
Enter Car values in L1 and Miles per Gallon in L2. From the Calc option under the Stat menu, select LinReg. If the correlation coefficient is not displaying, make sure you select DiagnosticOn from the CATELOG menu.

\[
\text{LinReg} \\
y = ax + b \\
a = -9.084735 \cdot 10^{-4} \\
b = 57.47522766 \\
r^2 = 0.542100808 \\
r = -0.7362744602
\]

The correlation coefficient is about 0.89, which is a strong positive correlation. However, no causation is possible because humidity, rain, time of day, and price of the ice cream are also factors.
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10. Enter year values in L1 and Sales in L2. From the Calc option under the Stat menu, select LinReg. If the correlation coefficient is not displaying, make sure you select DiagnosticOn from the CATELOG menu.

\[
\text{LinReg} \\
y=\hat{a}x+\hat{b} \\
\hat{a}=1189.812121 \\
\hat{b}=-2379378.709 \\
r^2=0.9909187662 \\
r=0.9954498274
\]

The correlation coefficient is about 0.99, which is a very strong positive correlation. However, no causation is possible because the popularity of the company, the products they sell, the economy, and the accessibility and user-friendliness of the company’s Web site are also factors.

11. Enter Number of Rings from Pith to Bank values in L1 and Age of Tree in L2. From the Calc option under the Stat menu, select LinReg. If the correlation coefficient is not displaying, make sure you select DiagnosticOn from the CATELOG menu.

\[
\text{LinReg} \\
y=\hat{a}x+\hat{b} \\
\hat{a}=1 \\
\hat{b}=0 \\
r^2=1 \\
r=1
\]

The correlation coefficient is 1.00, which is a very strong correlation. Causation does exist because the age of a tree is a direct cause for the number of rings from pith to bark.