1. Environmentalists would like to stop coal-burning companies from emitting mercury, because they believe it is contaminating the fish. Mercury is now at dangerous levels in many river fish. Coal-burning companies claim that they are not to blame -- the fish are getting mercury poisoning from some other source. To settle the matter, some data was collected about the mercury levels in various rivers and their proximity to coal-burning plants:

<table>
<thead>
<tr>
<th>Proximity to coal-burning plant (in miles)</th>
<th>Mercury level</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>60</td>
</tr>
<tr>
<td>150</td>
<td>65</td>
</tr>
<tr>
<td>20</td>
<td>96</td>
</tr>
<tr>
<td>670</td>
<td>41</td>
</tr>
</tbody>
</table>

For ease of calculation, here are some pre-computed values:

- \(\sum(x) = 1020\)
- \(\sum(y) = 262\)
- \(\sum(x\cdot y) = 49940\)
- \(\sum(x\cdot x) = 504200\)
- \(\sum(y\cdot y) = 18722\)
- \(\text{mean}(x) = 255\)
- \(\text{mean}(y) = 65.5\)

a) Find the correlation between proximity and mercury level.

Solution:

\[
r = \frac{4\cdot 49940 - 1020\cdot 262}{\sqrt{4\cdot 504200 - 1020^2}} \cdot \sqrt{4\cdot 18722 - 262^2} = -0.86
\]

b) Test whether there is significant evidence that proximity and mercury level are related at the .05 level.

Find \(b'\):

\[
b' = \frac{4\cdot 49940 - 1020\cdot 262}{4\cdot 504200 - 1020^2} = -0.069
\]

Find \(\sigma^2\):

\[
a' = y_{\text{bar}} - b'\cdot x_{\text{bar}} = 83.095
\]

\[
\text{ssyy'} = \sum((y_i - y'_{i})^2) = (60 - 70.675)^2 + (65-72.745)^2 + (96 - 81.715)^2 + (41 - 36.865)^2 = 395.1
\]

\[
\sigma^2 = \frac{\text{ssyy'}}{n-2} = 58277/2 = 197.55
\]

Test whether \(b = 0\):

\[
\text{ssxx} = \sum((x_i - x_{\text{bar}})^2) = 244100
\]
\[ t_{\text{obt}} = \frac{-0.069}{\sqrt{197.55}} = -2.43. \]

\[ \sqrt{244100} \]

At df=2, \( t_{\text{crit}} = 4.303 \), thus there is not significant enough evidence to conclude that the two are related.