

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:

Proximity to coal-burning plant (in miles)	Mercury level
180	60
150	65
20	96
670	41

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

$$\begin{aligned} \text{sum}(x) &= 1020 \\ \text{sum}(y) &= 262 \\ \text{sum}(x*y) &= 49940 \\ \text{sum}(x*x) &= 504200 \\ \text{sum}(y*y) &= 18722 \\ \text{mean}(x) &= 255 \\ \text{mean}(y) &= 65.5 \end{aligned}$$

- a) Find the correlation between proximity and mercury level.

Solution:

$$r = (4*49940 - 1020*262) / (\text{sqrt}(4*504200 - 1020^2) \text{sqrt}(4*18722 - 262^2)) = -0.86$$

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

Find b' :

$$b' = (4*49940 - 1020*262) / (4*504200 - 1020^2) = -.069$$

Find σ^2 ,

$$\begin{aligned} a' &= y_{\text{bar}} - b'*x_{\text{bar}} = 83.095 \\ \text{ssyy}' &= \text{sum}((y_i - y'_{i})^2) = (60 - 70.675)^2 + (65 - 72.745)^2 + (96 - 81.715)^2 + (41 - 36.865)^2 = 395.1 \\ \sigma^2 &= \text{ssyy}' / (n-2) = 58277 / 2 = 197.55 \end{aligned}$$

Test whether $b = 0$:

$$\text{ssxx} = \text{sum}((x_i - x_{\text{bar}})^2) = 244100$$

$$t\text{-obt} = \frac{-0.069}{\frac{\sqrt{197.55}}{\sqrt{244100}}} = -2.43.$$

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