III. Answer the following questions using this data that was collected to determine whether research and development expenditures affect profit.

A. The coefficient of correlation

\[ r = \frac{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{n(\Sigma X^2) - (\Sigma X)^2}[n(\Sigma Y^2) - (\Sigma Y)^2]} \]

\[ = \frac{6(2,010) - (35)(310)}{\sqrt{6(235) - (35)^2}[6(17,700) - (310)^2]} \]

\[ = \frac{(12,060) - (10,850)}{\sqrt{(1,410) - (1,225)][(106,200) - (96,100)]} \]

\[ = \frac{1,210}{\sqrt{[185][10,100]} = 1,210} = \frac{1,210}{1,367} = .885 \]

B. The coefficient of determination and the coefficient of nondetermination

\[ r^2 = (r)^2 = (.885)^2 = .783 \text{ or } 78.3\% \]

\[ \hat{r}^2 = 1 - r^2 = 1 - .783 = .217 \text{ or } 21.7\% \]

C. Could rho be zero at the .05 level of significance?

1. The null hypothesis and alternate hypothesis are \( H_0: \rho = 0 \text{ and } H_1: \rho \neq 0 \).
2. The level of significance will be .05 for this two-tail problem with \( n - 2 \) degrees of freedom.
3. The test statistic is \( r \).
4. If \( t \) from the test statistic is beyond the critical value of \( t \), the null hypothesis will be rejected.
5. Apply the decision rule.

\[ t = \frac{r - \rho}{\sqrt{1 - r^2}} \quad \left( \begin{array}{c} \frac{.885 - 0}{\sqrt{1 - (.885)^2}} \right) = 3.80 \text{ Reject } H_0 \text{ because } 3.80 > 2.776. \text{ The population coefficient of correlation could not be zero at the .05 significance level.} \]

IV. Interpret your answers to question III.

A. An \( r \) of .885 represents a high positive correlation.
B. Profit variability not explained by R & D is 21.7%.
B. Profit variability explained by R & D is 78.3%.
C. The population coefficient of correlation is not 0.

V. Draw a scatter diagram of the above data and use the eyeball method to estimate the regression curve.

R & D Expenditures and Profits

Note: Stars indicate coordinates determined using the regression equation from question V.I.C.

The line is not extended to the y-intercept because 3 is the lowest recorded R & D expenditure.