C.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum X^2) - (\sum X)^2][n(\sum Y^2) - (\sum Y)^2]}}$$

$$= \frac{10(3,600) - (56)(565)}{\sqrt{[10(364) - (56)^2][10(36,225) - (565)^2]}}$$

$$= \frac{(36,000) - (31,640)}{\sqrt{[(3,640) - (3,136)][(362,250) - (319,225)]}}$$

$$= \frac{4,360}{\sqrt{[504][43,025]}}$$

$r = .936$

| Advertising Expenditures (x) (000) | Sales Revenue (y) (000) | $x^2$ | XY | $y^2$ |
|---|---|---|---|---|
| 5 | 50 | 25 | 250 | 2,500 |
| 2 | 25 | 4 | 50 | 625 |
| 7 | 80 | 49 | 560 | 6,400 |
| 6 | 50 | 36 | 300 | 2,500 |
| 10 | 90 | 100 | 900 | 8,100 |
| 4 | 30 | 16 | 120 | 900 |
| 6 | 60 | 36 | 360 | 3,600 |
| 5 | 60 | 25 | 300 | 3,600 |
| 3 | 40 | 9 | 120 | 1,600 |
| 8 | 80 | 64 | 640 | 6,400 |
| 56 | 565 | 364 | 3,600 | 36,225 |

## IV. Coefficient of determination ($r^2$)

A. The coefficient of determination measures the total variation of the dependent variable (sales revenue) accounted for by variation of the independent variable (advertising expenditures).

B. Approximately 88% of the variability in Linda's Video Showcase sales revenue is accounted for by advertising expenditure variability.

$r^2 = (r)^2 = (.936)^2 = .876$

## V. Coefficient of nondetermination ($\tilde{r}^2$)

A. The coefficient of nondetermination measures the total variation of the dependent variable (sales revenue) not accounted for by variation of the independent variable (advertising expenditures).

B. Approximately 12% of the variability in Linda's Video Showcase sales revenue is not accounted for by advertising expenditure variability.

$\tilde{r}^2 = 1 - r^2 = 1 - .876 = .124$

**Note:** Advertising is not the only variable affecting sales. Multiple correlation and regression, not covered by **Quick Notes**, analyze the relationship between more than one independent variable and a dependent variable.

**A note of caution.** We have proven a high mathematical (linear) relationship between these 2 variables. We have not proven a cause-effect relationship.

## VI. Measuring the significance of the coefficient of correlation

A. To be significant, the population coefficient of correlation (ρ, the Greek letter for rho) cannot be zero.

B. It must be determined whether r is large enough, given some level of significance, to indicate ρ is not zero.

C. The 5-step approach to hypothesis testing

1. The null hypothesis and alternate hypothesis are $H_o: \rho = 0$ *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. Two is subtracted because two variables, x and y, are being estimated.
3. The relevant statistic is r.

$df = n - 2 = 10 - 2 = 8 \rightarrow t = 2.306$

$$t = \frac{r - \rho}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

**Note:** A large r leads to a large t and a large t leads to rejecting the null hypothesis. ρ is 0 because the $H_0$ is assumed to be true.

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.

$$t = \frac{r - \rho}{\sqrt{\frac{1 - r^2}{n - 2}}} = \frac{.936 - 0}{\sqrt{\frac{1 - (.936)^2}{10 - 2}}} \doteq 7.52$$

Reject $H_0$ because 7.52 > 2.306. This sample is not from a population with a coefficient of correlation equal to zero.