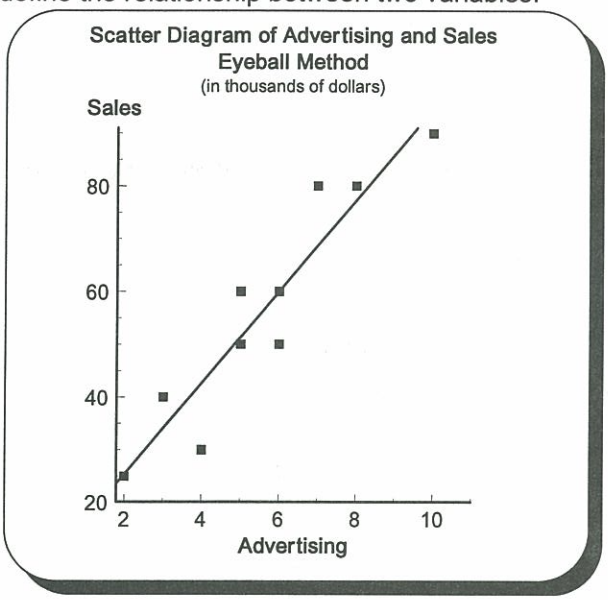
Chapter 24 Simple Linear Regression Analysis

I. Simple regression analysis defines the mathematical relationship between 2 variables.

A. A scatter diagram depicts the relationship between the independent variable (advertising) on the x-axis and a dependent variable (sales) on the y-axis (see graph).

B. A line through the scatter plot can be used to mathematically define this relationship.

1. The line can be estimated using the eyeball method by drawing a line with a ruler that divides the data in half.
2. A regression equation may be used to more exactly define the relationship between two variables.



Linda's Video Showcase
Advertising Expenditures and Sales Revenue

Advertising Expenditures (X) (000)	Sales Dollars (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

II. Determining a regression equation using the method of least squares

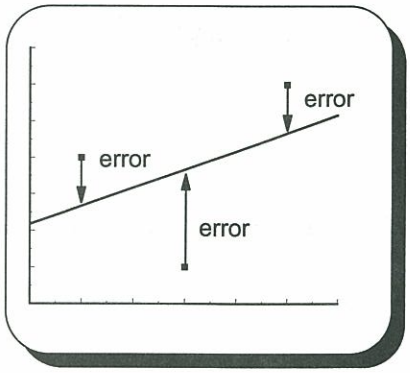
A. Many different lines can be drawn through a scatter plot using a ruler.

B. The method of least squares gives more consistent results.

C. This technique results in a straight line that minimizes the sum of the squared vertical deviations between the resulting line and the individual data. These deviations may be thought of as error.

D. This is the general form of the regression equation.

$\hat{y}_{.x} = a + bx$	$\hat{y}_{.x}$ is the estimated value of y based upon a given value for x. The period next to $\hat{y}$ is read "given" and this expression is read "y estimated given x."
where	**a** is the y-intercept (where the line crosses the y-axis).
	b is the slope of the line. It equals $\Delta y \div \Delta x$.



E. Determining the regression equation to 3 significant digits.

$$b = \frac{n(\sum XY) - (\sum X)(\sum Y)}{n(\sum X^2) - (\sum X)^2}$$

$$= \frac{10(3{,}600) - (56)(565)}{10(364) - (56)^2}$$

$$= \frac{4{,}360}{504} = 8.6507936$$

$$a = \bar{Y} - b\bar{x}$$

$$a = \frac{\sum Y}{n} - b\frac{\sum X}{n}$$

$$= \frac{565}{10} - 8.6507936\left(\frac{56}{10}\right)$$

$$= 8.055556$$

$$\hat{y}_{.x} = a + bx$$

$$\hat{y}_{.x} = 8.06 + 8.65x$$

F. The example to the right uses the regression equation to calculate estimated monthly sales when advertising expenditures are \$9,000.

$$\hat{y}_{.x} = 8.06 + 8.65x$$

$$\hat{y}_{.9} = 8.06 + 8.65(9)$$

$$\hat{y}_{.9} = 8.06 + 77.85 = 85.91 \text{ or } \$85,910$$