Time Series and Forecasting

Chapter 16

Learning Objectives

- Define the components of a time series.
- Determine a liner trend equation.
- Use a trend equation to forecast future time periods.

Time Series

What is a time series?

- a collection of data recorded over a period of time (weekly, monthly, quarterly)
- an analysis of history, it can be used by management to make current decisions and plans based on long-term forecasting
- Usually assumes past pattern to continue into the future

Components of Time Series

- Secular Trend – the smooth long term direction of a time series
- Cyclical Variation – the rise and fall of a time series over periods longer than one year
- Seasonal Variation – Patterns of change in a time series within a year which tends to repeat each year
- Irregular Variation – classified into:

  Episodic – unpredictable but identifiable

  Residual – also called chance fluctuation and unidentifiable

Cyclical Variation – Sample Chart

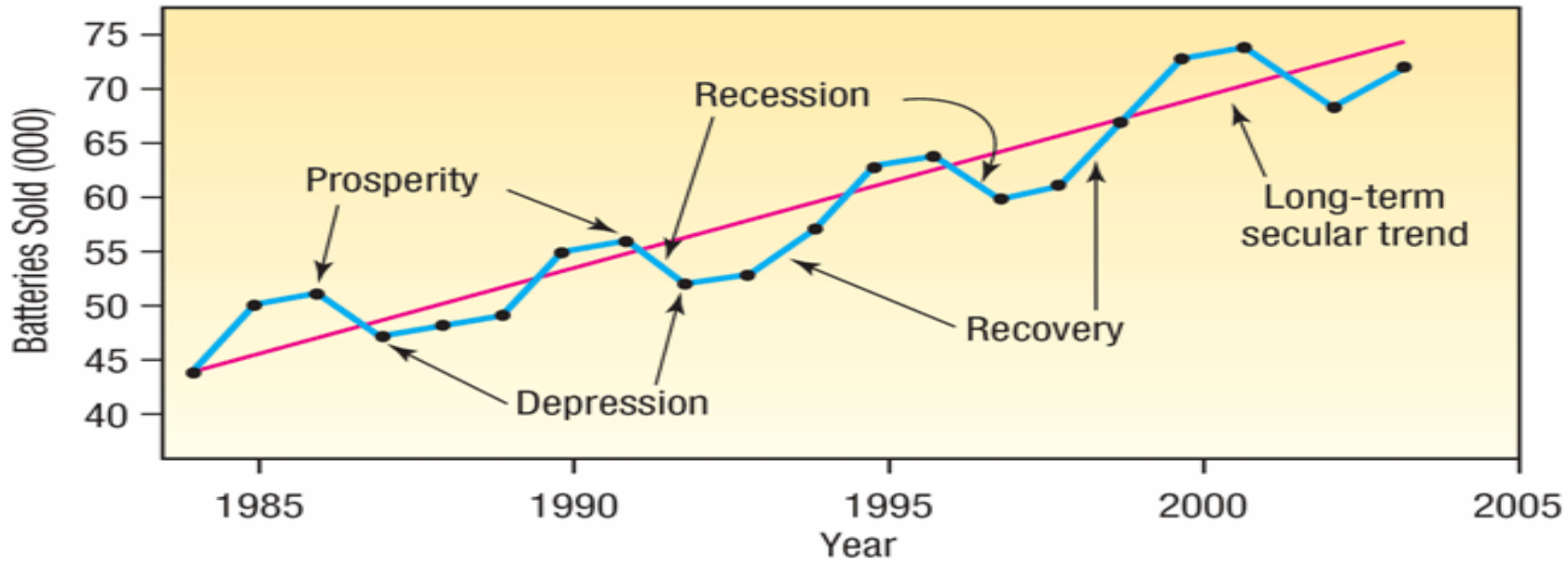

CHART 16–1 Batteries Sold by National Battery Retailers, Inc., from 1984 to 2004

Seasonal Variation – Sample Chart

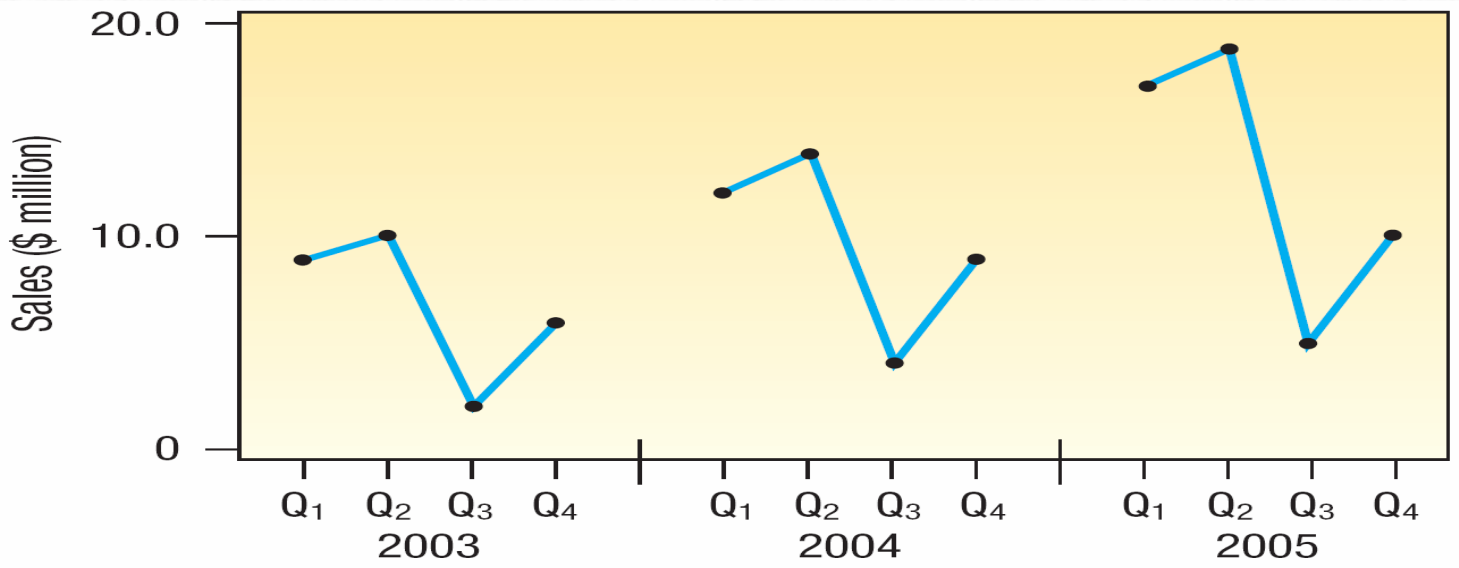

CHART 16–2 Sales of Baseball and Softball Equipment, Hercher Sporting Goods, 2003–2005 by Quarter

Liner Trend

- The long term trend of many business series often approximates a straight line

Linear Trend Equation : $\hat{Y} = a + bt$

where :

$\hat{Y}$ – read "Y hat", is the projected value of the variable of interest (response variable)

a – the Y - intercept (estimated value of Y when $t = 0$)

b – the slope of the line (average change in Y for each unit change in t)

t – any value of time (coded) that is selected

Linear Trend Plot

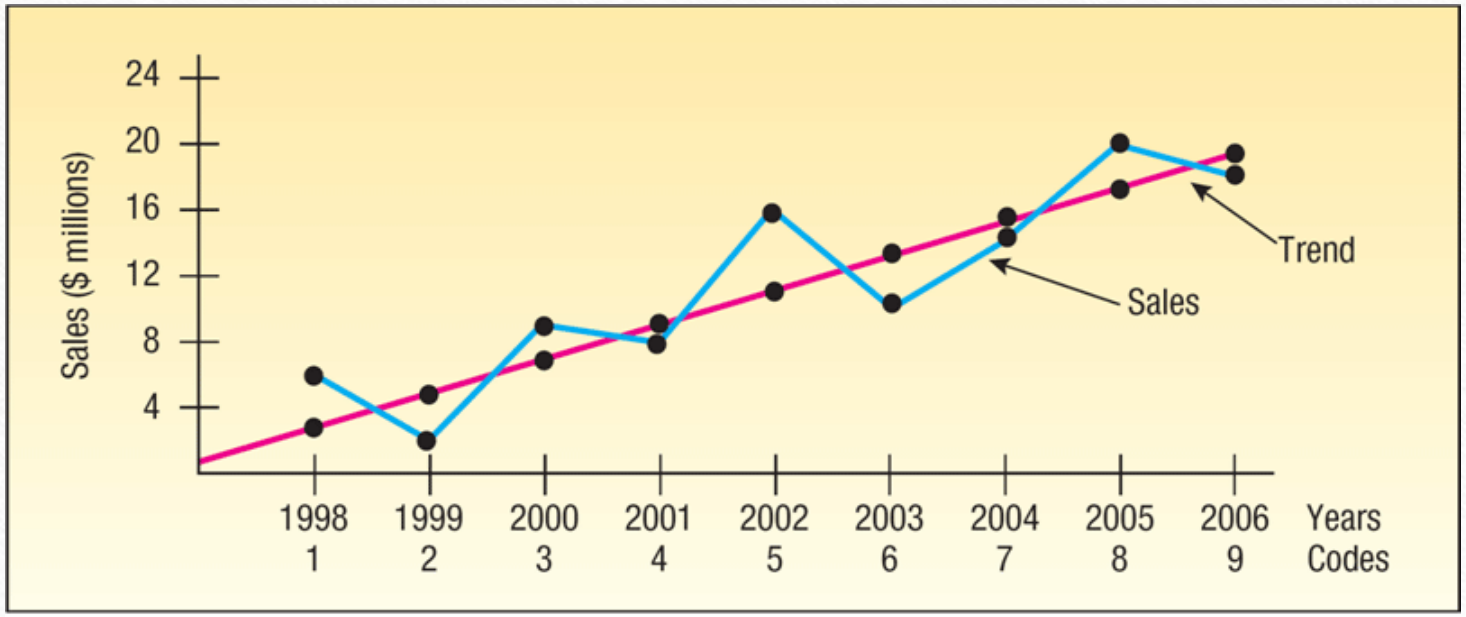

CHART 16–5 A Straight Line Fitted to Sales Data

Linear Trend – Using the Least Squares Method

- Use the least squares method in Simple Linear Regression (Chapter 13) to find the best linear relationship between 2 variables
- Code time (t) and use it as the independent variable
- E.g. let t be 1 for the first year, 2 for the second, and so on (if data are annual)

Example

- The sales of Jensen Foods, a small grocery chain located in southwest Texas, since 2002 are:

Determine the regression equation. How much are sales increasing each year? What is the sales forecast for 2012?

Year	Sales ($ mil.)
2002	7
2003	10
2004	9
2005	11
2006	13

Example 2

Self-Review 16–2 Annual production of king-size rockers by Wood Products Inc. since 2002 follows.

Year	Production (thousands)	Year	Production (thousands)
2002	4	2006	11
2003	8	2007	9
2004	[redacted]	2008	[redacted]
2005	8	2009	14

$$\sum yt = 365$$
$$\bar{y} = 8.75$$

(a) Plot the production data.
(b) Determine the least squares equation using a software package.
(c) Determine the points on the line for 2002 and 2009. Connect the two points to arrive at the line.
(d) Based on the linear trend equation, what is the estimated production for 2012?

Example 3

Listed below is the net sales in $ million for Home Depot Inc. and its subsidiaries from 1993 to 2009. 

Year	Net Sales	Year	Net Sales	Year	Net Sales
1993	$ 9,239	1999	$38,434	2005	$81,511
1994	12,477	2000	45,738	2006	90,837
1995	15,470	2001	53,553	2007	77,349
1996	19,535	2002	58,247	2008	71,300
1997	24,156	2003	64,816	2009	66,200
1998	30,219	2004	73,094		

Determine the least squares equation. On the basis of this information, what are the estimated sales for 2010 and 2011?

Example 4

The following table lists the annual amounts of glass cullet produced by Kimble Glass Works Inc.

Year	Code	Scrap (tons)	Year	Code	Scrap (tons)
2006	1	2	2009	4	5
2007	2	4	2010	5	6
2008	3	3			

Determine the least squares trend equation. Estimate the amount of scrap for the year 2012.