CHAPTER

9

Risk and Return

Lessons from Market History

PART THREE

With the S&P 500 index up about 3 percent and the NASDAQ stock market index up about 1.4 percent in 2005, stock market performance overall was well below average. However, it was a great year for investors in pharmaceutical manufacturer ViroPharma, Inc., which gained a whopping 469 percent! And investors in Hansen Natural, makers of Monster energy drinks, had to be energized by the 333 percent gain of that stock. Of course, not all stocks increased in value. Stock in video game manufacturer Majesco Entertainment fell 92 percent during the year, and stock in Aphton, a biotechnology company, dropped 89 percent. These examples show that there were tremendous potential profits to be made during 2005, but there was also the risk of losing money—lots of it. So what should you, as a stock market investor, expect when you invest your own money? In this chapter, we study eight decades of market history to find out.

9.1 Returns

Dollar Returns

Suppose the Video Concept Company has several thousand shares of stock outstanding and you are a shareholder. Further suppose that you purchased some of the shares of stock in the company at the beginning of the year; it is now year-end and you want to figure out how well you have done on your investment. The return you get on an investment in stocks, like that in bonds or any other investment, comes in two forms.

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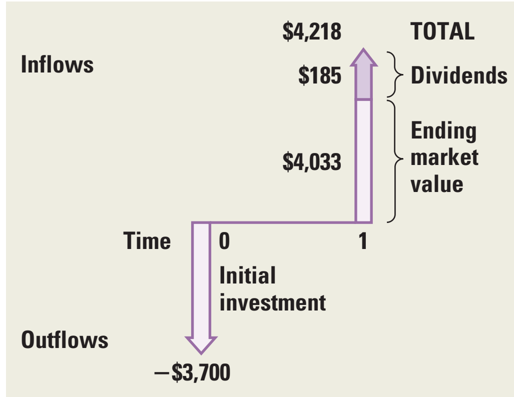
First, over the year most companies pay dividends to shareholders. As the owner of stock in the Video Concept Company, you are a part owner of the company. If the company is profitable, it generally will distribute some of its profits to the shareholders. Therefore, as the owner of shares of stock, you will receive some cash, called a *dividend,* during the year. This cash is the *income component* of your return. In addition to the dividends, the other part of your return is the *capital gain*—or, if it is negative, the *capital loss* (negative capital gain)—on the investment.

For example, suppose we are considering the cash flows of the investment in Figure 9.1, showing that you purchased 100 shares of stock at the beginning of the year at a price of $37 per share. Your total investment, then, was:

$$C_0 = \$37 \times 100 = \$3{,}700$$

Figure 9.1
Dollar Returns



Suppose that over the year the stock paid a dividend of $1.85 per share. During the year, then, you received income of:

$$\text{Div} = \$1.85 \times 100 = \$185$$

Suppose, finally, that at the end of the year the market price of the stock is $40.33 per share. Because the stock increased in price, you had a capital gain of:

$$\text{Gain} = (\$40.33 - \$37) \times 100 = \$333$$

The capital gain, like the dividend, is part of the return that shareholders require to maintain their investment in the Video Concept Company. Of course, if the price of Video Concept stock had dropped in value to, say, $34.78, you would have recorded this capital loss:

$$\text{Loss} = (\$34.78 - \$37) \times 100 = -\$222$$

The *total dollar return* on your investment is the sum of the dividend income and the capital gain or loss on the investment:

$$\text{Total dollar return} = \text{Dividend income} + \text{Capital gain (or loss)}$$

(From now on we will refer to *capital losses* as *negative capital gains* and not distinguish them.) In our first example the total dollar return is given by:

$$\text{Total dollar return} = \$185 + \$333 = \$518$$

Notice that if you sold the stock at the end of the year, your total amount of cash would be the initial investment plus the total dollar return. In the preceding example you would have:

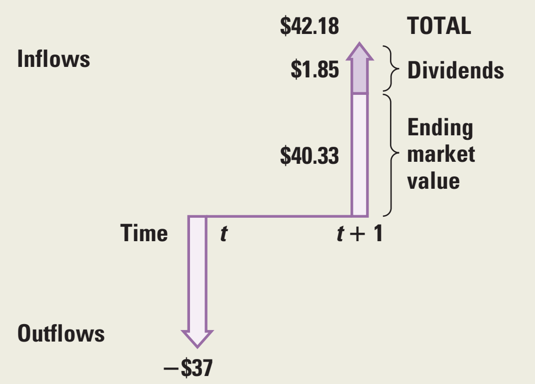
$$\begin{aligned} \text{Total cash if stock is sold} &= \text{Initial investment} + \text{Total dollar return} \\ &= \$3{,}700 + \$518 \\ &= \$4{,}218 \end{aligned}$$

As a check, notice that this is the same as the proceeds from the sale of stock plus the dividends:

$$\begin{aligned} &\text{Proceeds from stock sale} + \text{Dividends} \\ &= \$40.33 \times 100 + \$185 \\ &= \$4{,}033 + \$185 \\ &= \$4{,}218 \end{aligned}$$

Figure 9.2

Percentage Returns



$$\text{Percentage return} = \frac{\text{Dividends paid at end of period} + \text{Change in market value over period}}{\text{Beginning market value}}$$

$$1 + \text{Percentage return} = \frac{\text{Dividends paid at end of period} + \text{Market value at end of period}}{\text{Beginning market value}}$$

Suppose, however, that you hold your Video Concept stock and don't sell it at year-end. Should you still consider the capital gain as part of your return? Does this violate our previous present value rule that only cash matters?

The answer to the first question is a strong yes, and the answer to the second question is an equally strong no. The capital gain is every bit as much a part of your return as is the dividend, and you should certainly count it as part of your total return. That you have decided to hold onto the stock and not sell or *realize* the gain or the loss in no way changes the fact that, if you want to, you could get the cash value of the stock. After all, you could always sell the stock at year-end and immediately buy it back. The total amount of cash you would have at year-end would be the $518 gain plus your initial investment of $3,700. You would not lose this return when you bought back 100 shares of stock. In fact, you would be in exactly the same position as if you had not sold the stock (assuming, of course, that there are no tax consequences and no brokerage commissions from selling the stock).

Percentage Returns

It is more convenient to summarize the information about returns in percentage terms than in dollars because the percentages apply to any amount invested. The question we want to answer is this: How much return do we get for each dollar invested? To find this out, let t stand for the year we are looking at, let P_t be the price of the stock at the beginning of the year, and let Div_{t+1} be the dividend paid on the stock during the year. Consider the cash flows in Figure 9.2.

Go to **www.smartmoney.com/marketmap** for a Java applet that shows today's returns by market sector.

In our example, the price at the beginning of the year was $37 per share and the dividend paid during the year on each share was $1.85. Hence the percentage income return, sometimes called the *dividend yield*, is:

$$\begin{aligned}\text{Dividend yield} &= \text{Div}_{t+1}/P_t \\ &= \$1.85/\$37 \\ &= .05 \\ &= 5\%\end{aligned}$$

The **capital gain** (or loss) is the change in the price of the stock divided by the initial price. Letting P_{t+1} be the price of the stock at year-end, we can compute the capital gain as follows:

$$\begin{aligned} \text{Capital gain} &= (P_{t+1} - P_t)/P_t \\ &= (\$40.33 - \$37)/\$37 \\ &= \$3.33/\$37 \\ &= .09 \\ &= 9\% \end{aligned}$$

Combining these two results, we find that the *total return* on the investment in Video Concept stock over the year, which we will label R_{t+1}, was:

$$\begin{aligned} R_{t+1} &= \frac{\text{Div}_{t+1}}{P_t} + \frac{(P_{t+1} - P_t)}{P_t} \\ &= 5\% + 9\% \\ &= 14\% \end{aligned}$$

From now on, we will refer to returns in percentage terms.

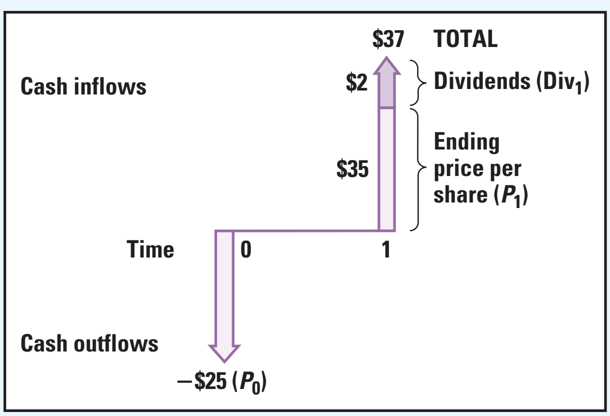
To give a more concrete example, stock in Goldman Sachs (GS), the well-known financial services company, began 2005 at \$102.90 a share. Goldman Sachs paid dividends of \$1.00 during 2005, and the stock price at the end of the year was \$127.47. What was the return on GS for the year? For practice, see if you agree that the answer is 24.85 percent. Of course, negative returns occur as well. For example, in 2005, General Motor's stock price at the beginning of the year was \$37.64 per share, and dividends of \$2.00 were paid. The stock ended the year at \$19.42 per share. Verify that the loss was 43.09 percent for the year.

EXAMPLE 9.1

Calculating Returns Suppose a stock begins the year with a price of \$25 per share and ends with a price of \$35 per share. During the year it paid a \$2 dividend per share. What are its dividend yield, its capital gain, and its total return for the year? We can imagine the cash flows in Figure 9.3.

$$\begin{aligned} R_1 &= \frac{\text{Div}_1}{P_0} + \frac{P_1 - P_0}{P_0} \\ &= \frac{\$2}{\$25} + \frac{\$35 - 25}{\$25} = \frac{\$12}{\$25} \\ &= 8\% \;\; + 40\% \quad\;\; = 48\% \end{aligned}$$

Figure 9.3 **Cash Flow—An Investment Example**



(*continued*)

Thus, the stock's dividend yield, its capital gain yield, and its total return are 8 percent, 40 percent, and 48 percent, respectively.

Suppose you had \$5,000 invested. The total dollar return you would have received on an investment in the stock is $\$5,000 \times .48 = \$2,400$. If you know the total dollar return on the stock, you do not need to know how many shares you would have had to purchase to figure out how much money you would have made on the \$5,000 investment. You just use the total dollar return.

9.2 Holding Period Returns

A famous set of studies dealing with rates of return on common stocks, bonds, and Treasury bills was conducted by Roger Ibbotson and Rex Sinquefield.[1] They present year-by-year historical rates of return for the following five important types of financial instruments in the United States:

1. *Large-company common stocks*: The common stock portfolio is based on the Standard & Poor's (S&P) composite index. At present the S&P composite includes 500 of the largest (in terms of market value) stocks in the United States.
2. *Small-company common stocks*: This is a portfolio corresponding to the bottom fifth of stocks traded on the New York Stock Exchange in which stocks are ranked by market value (that is, the price of the stock multiplied by the number of shares outstanding).
3. *Long-term corporate bonds*: This is a portfolio of high-quality corporate bonds with a 20-year maturity.
4. *Long-term U.S. government bonds*: This is based on U.S. government bonds with a maturity of 20 years.
5. *U.S. Treasury bills*: This is based on Treasury bills with a three-month maturity.

For more about market history, visit **www.globalfindata.com.**

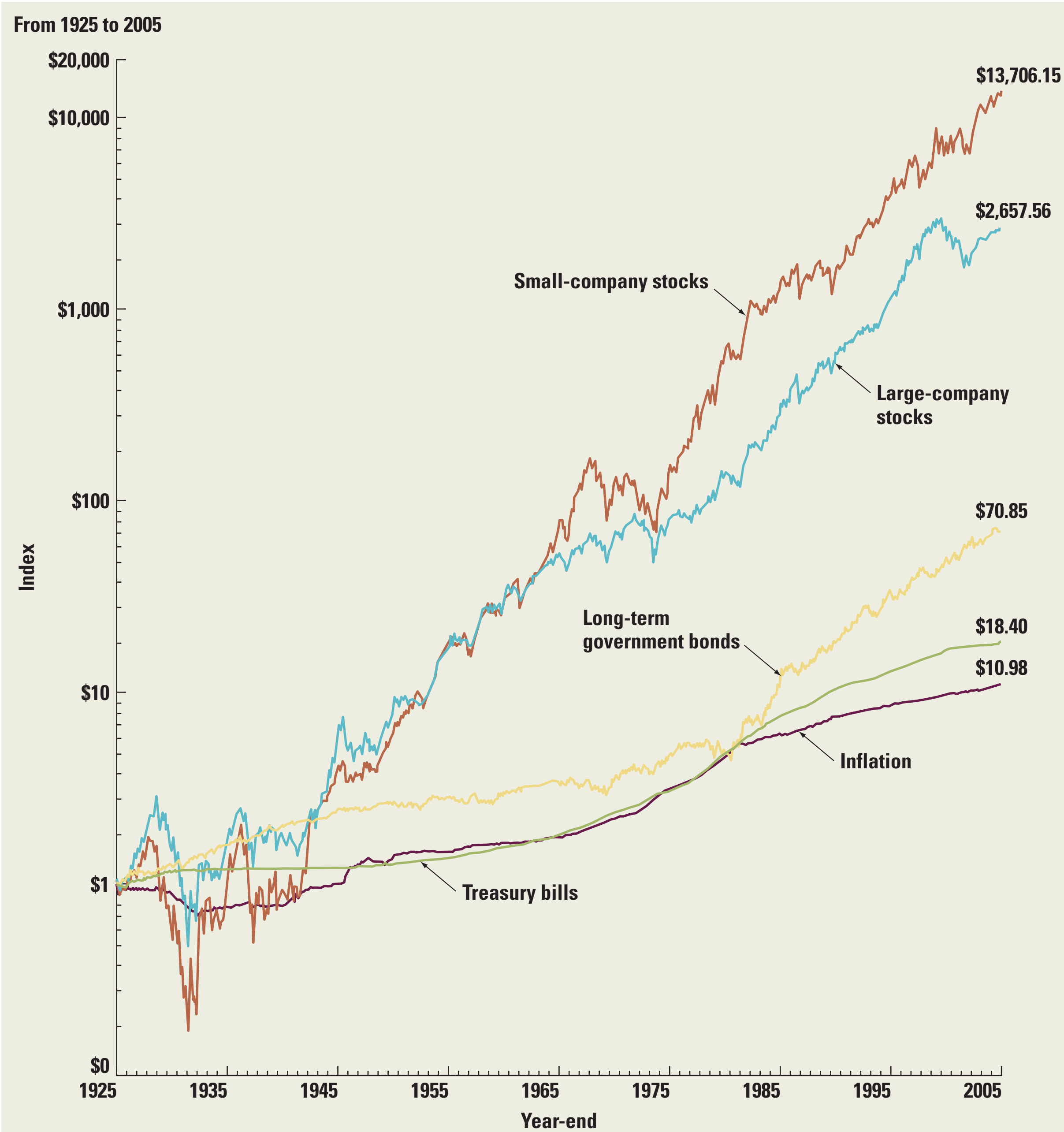
None of the returns are adjusted for taxes or transaction costs. In addition to the year-by-year returns on financial instruments, the year-to-year change in the consumer price index is computed. This is a basic measure of inflation. We can calculate year-by-year real returns by subtracting annual inflation.

Before looking closely at the different portfolio returns, we graphically present the returns and risks available from U.S. capital markets in the 80-year period from 1926 to 2005. Figure 9.4 shows the growth of \$1 invested at the beginning of 1926. Notice that the vertical axis is logarithmic, so that equal distances measure the same percentage change. The figure shows that if \$1 were invested in large-company common stocks and all dividends were reinvested, the dollar would have grown to \$2,657.56 by the end of 2005. The biggest growth was in the small stock portfolio. If \$1 were invested in small stocks in 1926, the investment would have grown to \$13,706.15. However, when you look carefully at Figure 9.4, you can see great variability in the returns on small stocks, especially in the earlier part of the period. A dollar in long-term government bonds was very stable as compared with a dollar in common stocks. Figures 9.5 to 9.8 plot each year-to-year percentage return as a vertical bar drawn from the horizontal axis for large-company common stocks, for small-company stocks, for long-term bonds and Treasury bills, and for inflation, respectively.

Figure 9.4 gives the growth of a dollar investment in the stock market from 1926 through 2005. In other words, it shows what the worth of the investment would have been if

[1] The most recent update of this work is *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*™ (Chicago: Ibbotson Associates).

Figure 9.4 **Wealth Indexes of Investments in the U.S. Capital Markets (Year-End 1925 = $1.00)**



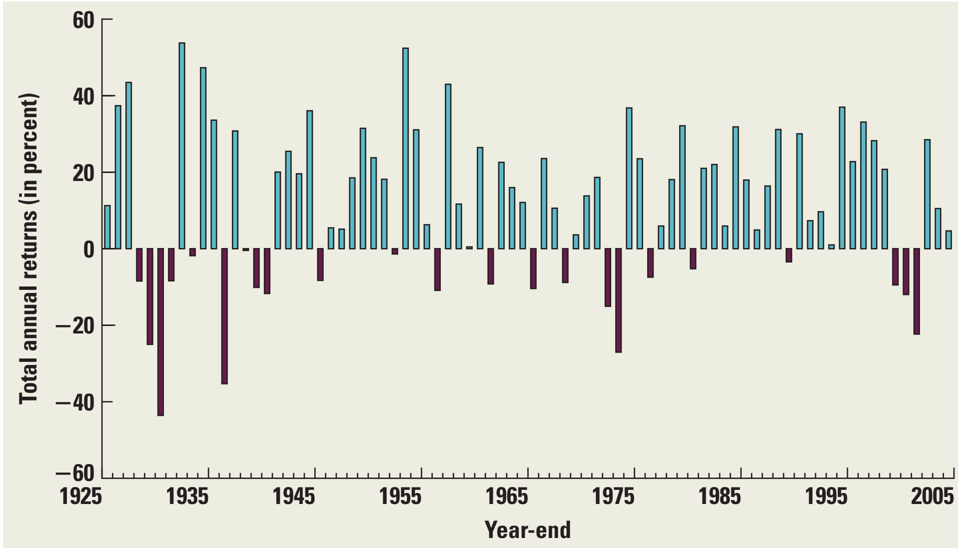
Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook,*™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

the dollar had been left in the stock market and if each year the dividends from the previous year had been reinvested in more stock. If R_t is the return in year t (expressed in decimals), the value you would have at the end of year $\mathcal{T}$ is the product of 1 plus the return in each of the years:

$$(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_t) \times \cdots \times (1 + R_{\mathcal{T}})$$

Figure 9.5

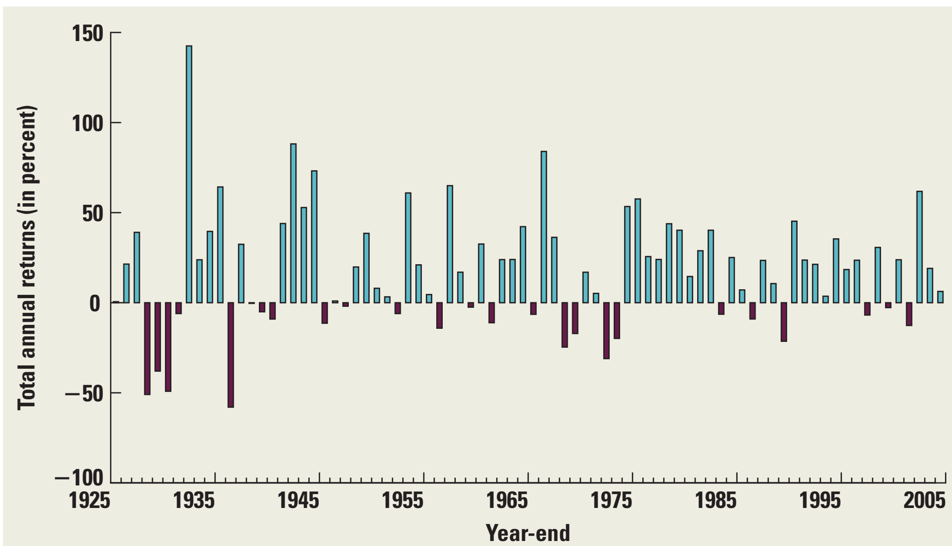
Year-by-Year Total Returns on Large-Company Common Stocks



Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

Figure 9.6

Year-by-Year Total Returns on Small-Company Common Stocks



Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

Go to **bigcharts.marketwatch.com** to see both intraday and long-term charts.

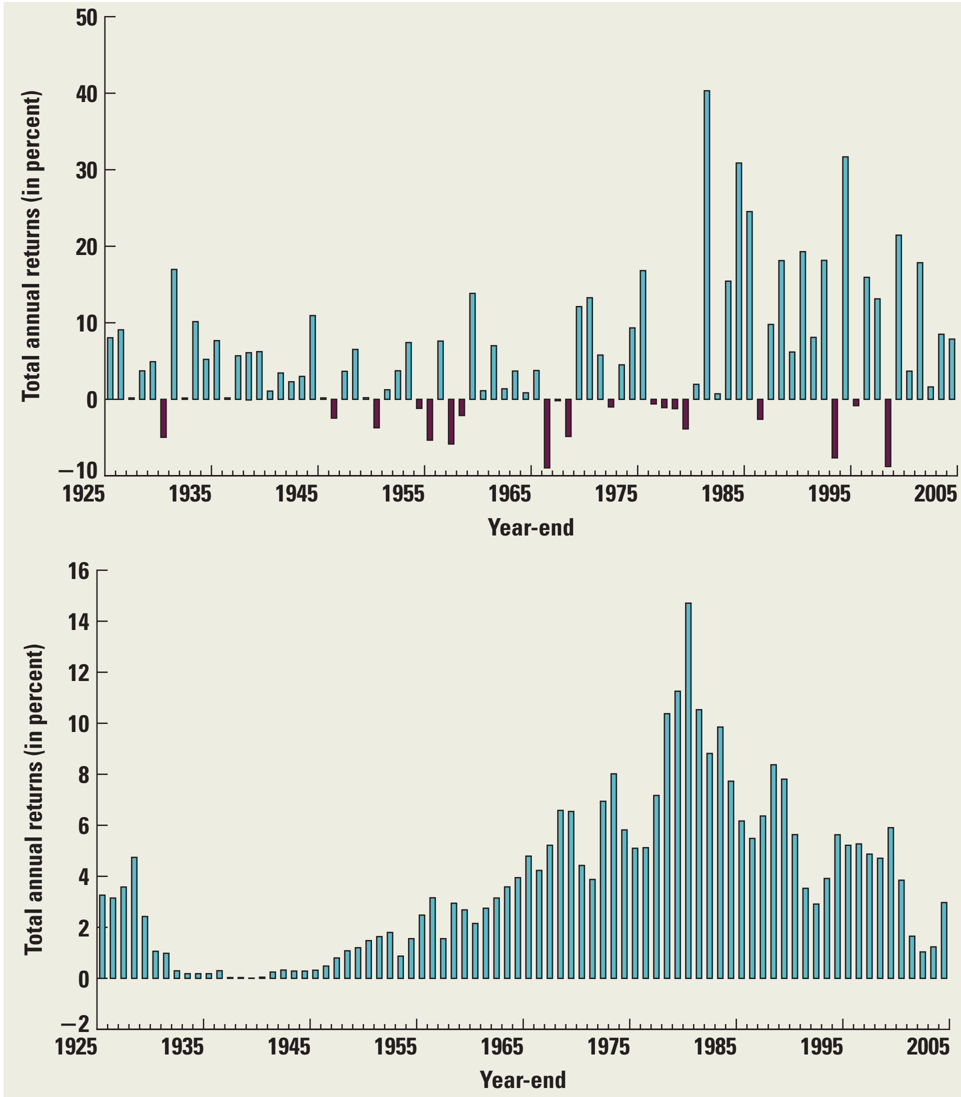
For example, if the returns were 11 percent, −5 percent, and 9 percent in a three-year period, an investment of $1 at the beginning of the period would be worth:

$$\begin{aligned}(1 + R_1) \times (1 + R_2) \times (1 + R_3) &= (\$1 + .11) \times (\$1 - .05) \times (\$1 + .09)\\ &= \$1.11 \times \$.95 \times \$1.09\\ &= \$1.15\end{aligned}$$

at the end of the three years. Notice that .15 or 15 percent is the total return and that it includes the return from reinvesting the first-year dividends in the stock market for two more years and reinvesting the second-year dividends for the final year. The 15 percent is called a three-year **holding period return**. Table 9.1 gives the annual returns each year for selected investments from 1926 to 2005. From this table, you can determine holding period returns for any combination of years.

Figure 9.7

Year-by-Year Total Returns on Bonds and Bills



Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

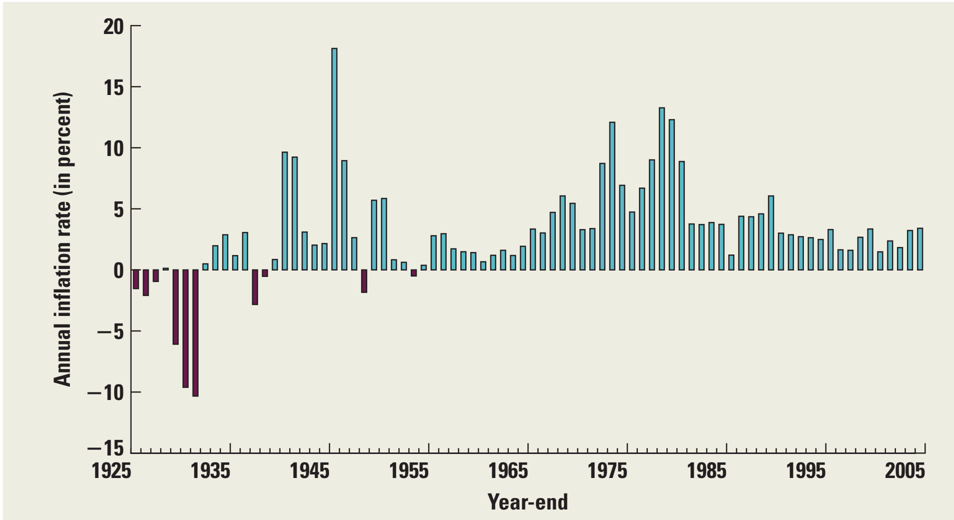
9.3 Return Statistics

The history of capital market returns is too complicated to be handled in its undigested form. To use the history, we must first find some manageable ways of describing it, dramatically condensing the detailed data into a few simple statements.

This is where two important numbers summarizing the history come in. The first and most natural number is some single measure that best describes the past annual returns on the stock market. In other words, what is our best estimate of the return that an investor could have realized in a particular year over the 1926 to 2005 period? This is the *average return*.

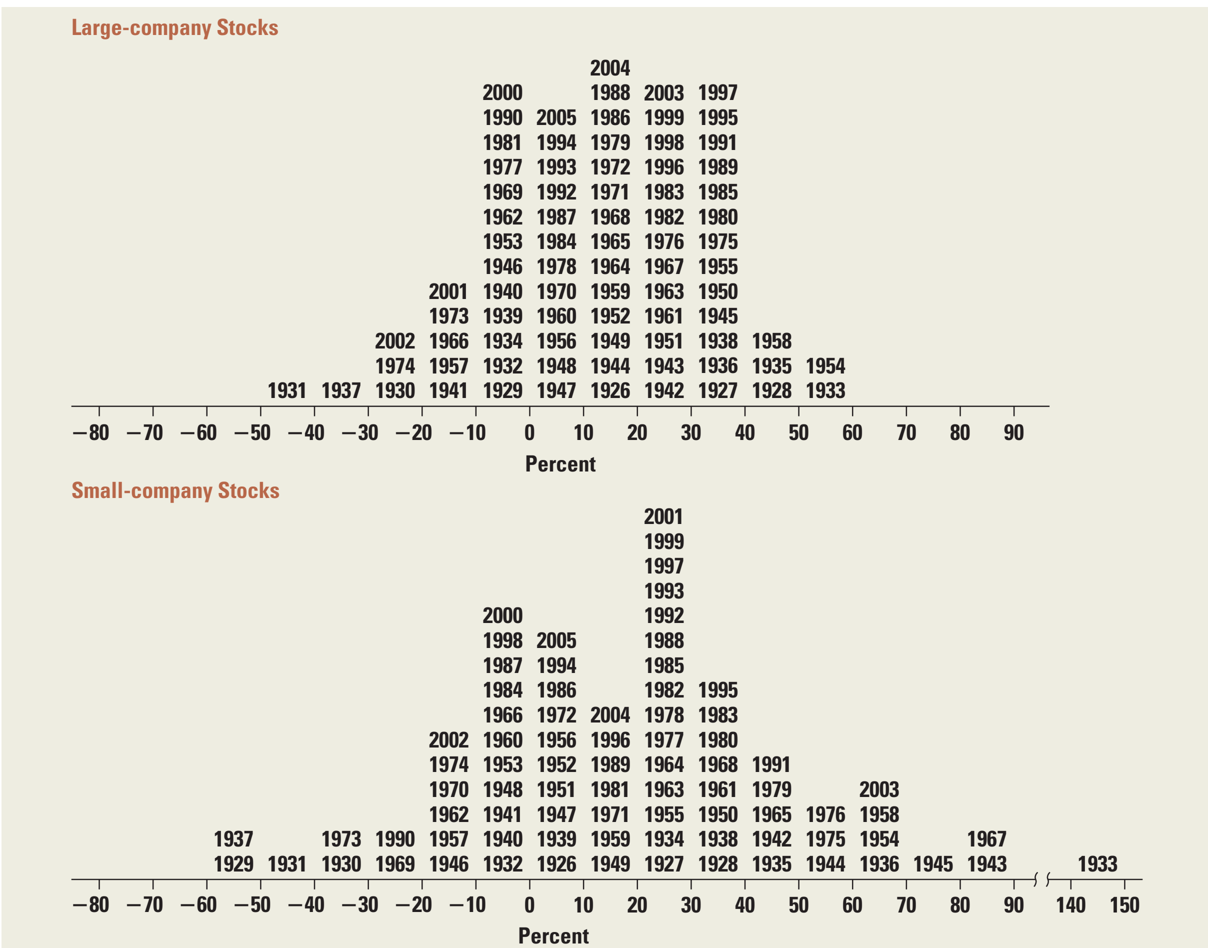
Figure 9.9 plots the histogram of the yearly stock market returns given in Table 9.1. This plot is the **frequency distribution** of the numbers. The height of the graph gives the number of sample observations in the range on the horizontal axis.

Figure 9.8
Year-by-Year Inflation



Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

Figure 9.9 Histogram of Returns on Common Stocks, 1926–2005



Redrawn from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

Table 9.1

Year-by-Year Total Returns, 1926–2005

Year	Large-Company Stocks	Long-Term Government Bonds	U.S. Treasury Bills	Consumer Price Index
1926	13.75%	5.69%	3.30%	−1.12%
1927	35.70	6.58	3.15	−2.26
1928	45.08	1.15	4.05	−1.16
1929	−8.80	4.39	4.47	0.58
1930	−25.13	4.47	2.27	−6.40
1931	−43.60	−2.15	1.15	−9.32
1932	−8.75	8.51	0.88	−10.27
1933	52.95	1.92	0.52	0.76
1934	−2.31	7.59	0.27	1.52
1935	46.79	4.20	0.17	2.99
1936	32.49	5.13	0.17	1.45
1937	−35.45	1.44	0.27	2.86
1938	31.63	4.21	0.06	−2.78
1939	−1.43	3.84	0.04	0.00
1940	−10.36	5.70	0.04	0.71
1941	−12.02	0.47	0.14	9.93
1942	20.75	1.80	0.34	9.03
1943	25.38	2.01	0.38	2.96
1944	19.49	2.27	0.38	2.30
1945	36.21	5.29	0.38	2.25
1946	−8.42	0.54	0.38	18.13
1947	5.05	−1.02	0.62	8.84
1948	4.99	2.66	1.06	2.99
1949	17.81	4.58	1.12	−2.07
1950	30.05	−0.98	1.22	5.93
1951	23.79	−0.20	1.56	6.00
1952	18.39	2.43	1.75	0.75
1953	−1.07	2.28	1.87	0.75
1954	52.23	3.08	0.93	−0.74
1955	31.62	−0.73	1.80	0.37
1956	6.91	−1.72	2.66	2.99
1957	−10.50	6.82	3.28	2.90
1958	43.57	−1.72	1.71	1.76
1959	12.01	−2.02	3.48	1.73
1960	0.47	11.21	2.81	1.36
1961	26.84	2.20	2.40	0.67
1962	−8.75	5.72	2.82	1.33
1963	22.70	1.79	3.23	1.64
1964	16.43	3.71	3.62	0.97
1965	12.38	0.93	4.06	1.92
1966	−10.06	5.12	4.94	3.46
1967	23.98	−2.86	4.39	3.04
1968	11.03	2.25	5.49	4.72
1969	−8.43	−5.63	6.90	6.20
1970	3.94	18.92	6.50	5.57
1971	14.30	11.24	4.36	3.27
1972	18.99	2.39	4.23	3.41
1973	−14.69	3.30	7.29	8.71
1974	−26.47	4.00	7.99	12.34
1975	37.23	5.52	5.87	6.94

(continued)

Table 9.1
Year-by-Year Total Returns, 1926–2005
(concluded)

Year	Large-Company Stocks	Long-Term Government Bonds	U.S. Treasury Bills	Consumer Price Index
1976	23.93%	15.56%	5.07%	4.86%
1977	−7.16	0.38	5.45	6.70
1978	6.57	−1.26	7.64	9.02
1979	18.61	1.26	10.56	13.29
1980	32.50	−2.48	12.10	12.52
1981	−4.92	4.04	14.60	8.92
1982	21.55	44.28	10.94	3.83
1983	22.56	1.29	8.99	3.79
1984	6.27	15.29	9.90	3.95
1985	31.73	32.27	7.71	3.80
1986	18.67	22.39	6.09	1.10
1987	5.25	−3.03	5.88	4.43
1988	16.61	6.84	6.94	4.42
1989	31.69	18.54	8.44	4.65
1990	−3.10	7.74	7.69	6.11
1991	30.46	19.36	5.43	3.06
1992	7.62	7.34	3.48	2.90
1993	10.08	13.06	3.03	2.75
1994	1.32	−7.32	4.39	2.67
1995	37.58	25.94	5.61	2.54
1996	22.96	0.13	5.14	3.32
1997	33.36	12.02	5.19	1.70
1998	28.58	14.45	4.86	1.61
1999	21.04	−7.51	4.80	2.68
2000	−9.10	17.22	5.98	3.39
2001	−11.89	5.51	3.33	1.55
2002	−22.10	15.15	1.61	2.4
2003	28.89	2.01	0.94	1.9
2004	10.88	8.12	1.14	3.3
2005	4.91	6.89	2.79	3.4

SOURCE: Author calculations based on data obtained from *Global Financial Data*, Bloomberg, Standard and Poor's, and other sources.

Given a frequency distribution like that in Figure 9.9, we can calculate the **average** or **mean** of the distribution. To compute the average of the distribution, we add up all of the values and divide by the total (T) number (80 in our case because we have 80 years of data). The bar over the R is used to represent the mean, and the formula is the ordinary formula for the average:

$$\text{Mean} = \bar{R} = \frac{(R_1 + \cdots + R_T)}{T}$$

The mean of the 80 annual large-company stocks returns from 1926 to 2005 is 12.2 percent.

EXAMPLE 9.2

Calculating Average Returns Suppose the returns on common stock from 1926 to 1929 are .1370, .3580, .4514, and −.0888, respectively. The average, or mean, return over these four years is:

$$\bar{R} = \frac{.1370 + .3580 + .4514 - .0888}{4} = .2144 \text{ or } 21.44\%$$

9.4 Average Stock Returns and Risk-Free Returns

Now that we have computed the average return on the stock market, it seems sensible to compare it with the returns on other securities. The most obvious comparison is with the low-variability returns in the government bond market. These are free of most of the volatility we see in the stock market.

The government borrows money by issuing bonds, which the investing public holds. As we discussed in an earlier chapter, these bonds come in many forms, and the ones we will look at here are called *Treasury bills*, or *T-bills*. Once a week the government sells some bills at an auction. A typical bill is a pure discount bond that will mature in a year or less. Because the government can raise taxes to pay for the debt it incurs—a trick that many of us would like to be able to perform—this debt is virtually free of the risk of default. Thus we will call this the *risk-free return* over a short time (one year or less).

An interesting comparison, then, is between the virtually risk-free return on T-bills and the very risky return on common stocks. This difference between risky returns and risk-free returns is often called the *excess return on the risky asset*. It is called *excess* because it is the additional return resulting from the riskiness of common stocks and is interpreted as an equity **risk premium**.

Table 9.2 shows the average stock return, bond return, T-bill return, and inflation rate for the period from 1926 through 2005. From this we can derive excess returns. The average excess return from large-company common stocks for the entire period was 8.5 percent (12.3 percent – 3.8 percent).

One of the most significant observations of stock market data is this long-term excess of the stock return over the risk-free return. An investor for this period was rewarded for investment in the stock market with an extra or excess return over what would have been achieved by simply investing in T-bills.

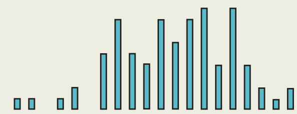
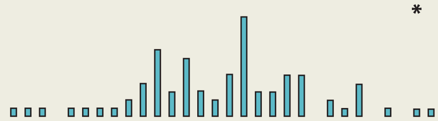
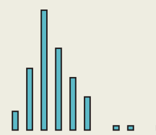
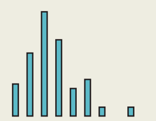
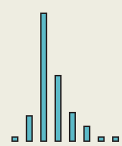
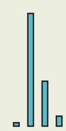
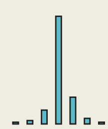
Why was there such a reward? Does it mean that it never pays to invest in T-bills and that someone who invested in them instead of in the stock market needs a course in finance? A complete answer to these questions lies at the heart of modern finance, and Chapter 10 is devoted entirely to this. However, part of the answer can be found in the variability of the various types of investments. We see in Table 9.1 many years when an investment in T-bills achieved higher returns than an investment in large common stocks. Also, we note that the returns from an investment in common stocks are frequently negative, whereas an investment in T-bills never produces a negative return. So, we now turn our attention to measuring the variability of returns and an introductory discussion of risk.

We first look more closely at Table 9.2. We see that the standard deviation of T-bills is substantially less than that of common stocks. This suggests that the risk of T-bills is less than that of common stocks. Because the answer turns on the riskiness of investments in common stock, we next turn our attention to measuring this risk.

9.5 Risk Statistics

The second number that we use to characterize the distribution of returns is a measure of the risk in returns. There is no universally agreed-upon definition of risk. One way to think about the risk of returns on common stock is in terms of how spread out the frequency distribution in Figure 9.9 is. The spread, or dispersion, of a distribution is a measure of how much a particular return can deviate from the mean return. If the distribution

Table 9.2 **Total Annual Returns, 1926–2005**

Series	Arithmetic Mean	Risk Premium (relative to U.S. Treasury bills)	Standard Deviation	Distribution
Large-company stocks	12.3%	8.5%	20.2%	
Small-company stocks	17.4	13.6	32.9	* 
Long-term corporate bonds	6.2	2.4	8.5	
Long-term government	5.8	2.0	9.2	
Intermediate-term government	5.5	1.7	5.7	
U.S. Treasury bills	3.8		3.1	
Inflation	3.1		4.3	
				−90% 0% 90%

*The 1933 small-company stock total return was 142.9 percent.

SOURCE: Modified from *Stocks, Bonds, Bills and Inflation: 2006 Yearbook*,™ annual updates work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Ibbotson Associates).

is very spread out, the returns that will occur are very uncertain. By contrast, a distribution whose returns are all within a few percentage points of each other is tight, and the returns are less uncertain. The measures of risk we will discuss are variance and standard deviation.

Variance

The **variance** and its square root, the **standard deviation**, are the most common measures of variability or dispersion. We will use Var and σ^2 to denote the variance and SD and σ to represent the standard deviation. σ is, of course, the Greek letter sigma.

EXAMPLE 9.3

Volatility Suppose the returns on common stocks from 1926 to 1929 are (in decimals) .1370, .3580, .4514, and −.0888, respectively. The variance of this sample is computed as follows:

$$\text{Var} = \frac{1}{T-1}[(R_1 - \bar{R})^2 + (R_2 - \bar{R})^2 + (R_3 - \bar{R})^2 + (R_4 - \bar{R})^2]$$

$$.0582 = \frac{1}{3}[(.1370 - .2144)^2 + (.3580 - .2144)^2 + (.4514 - .2144)^2 + (-.0888 - .2144)^2]$$

$$\text{SD} = \sqrt{.0582} = .2413 \text{ or } 24.13\%$$

This formula tells us just what to do: Take the T individual returns (R_1, R_2, . . .) and subtract the average return $\bar{R}$, square the result, and add them up. Finally, this total must be divided by the number of returns less one ($T - 1$). The standard deviation is always just the square root of the variance.

Using the stock returns for the 80-year period from 1926 through 2005 in this formula, the resulting standard deviation of large stock returns is 20.2 percent. The standard deviation is the standard statistical measure of the spread of a sample, and it will be the measure we use most of the time. Its interpretation is facilitated by a discussion of the normal distribution.

Standard deviations are widely reported for mutual funds. For example, the Fidelity Magellan Fund is one of the largest mutual funds in the United States. How volatile is it? To find out, we went to www.morningstar.com, entered the ticker symbol FMAGX, and hit the "Risk/Measures" link. Here is what we found:

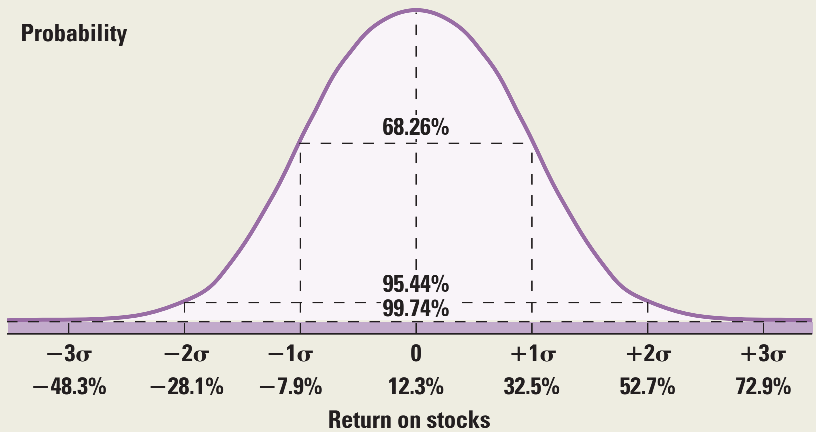
Fidelity Magellan FMAGX See Fund Family Data ▸▸

Volatility Measurements	Trailing 3-Yr through 12-31-05 | *Trailing 5-Yr through 12-31-05		
Standard Deviation	8.89	Sharpe Ratio	1.17
Mean	12.61	Bear Market Decile Rank*	7

Modern Portfolio Theory Statistics		Trailing 3-Yr through 12-31-05
	Standard Index S&P 500	**Best Fit Index** S&P 500
R-Squared	96	96
Beta	0.95	0.95
Alpha	-1.01	-1.01

Over the last three years, the standard deviation of the return on the Fidelity Magellan Fund was 8.89 percent. When you consider the average stock has a standard deviation of about 50 percent, this seems like a low number. But the Magellan fund is a relatively well-diversified portfolio, so this is an illustration of the power of diversification, a subject we will discuss in detail later. The mean is the average return; so over the last three years, investors in the Magellan Fund earned a 12.61 percent return per year. Also under the Volatility Measurements section, you will see the Sharpe ratio. The Sharpe ratio is calculated as the risk premium of the asset divided by the standard deviation. As such, it is a measure of return to the level of risk taken (as measured by standard deviation). The "beta" for the Fidelity Magellan Fund is .95. We will have more to say about this number—lots more—in the next chapter.

Figure 9.10
The Normal Distribution



In the case of a normal distribution, there is a 68.26 percent probability that a return will be within one standard deviation of the mean. In this example, there is a 68.26 percent probability that a yearly return will be between –7.9 percent and 32.5 percent.

There is a 95.44 percent probability that a return will be within two standard deviations of the mean. In this example, there is a 95.44 percent probability that a yearly return will be between –28.1 percent and 52.7 percent.

Finally, there is a 99.74 percent probability that a return will be within three standard deviations of the mean. In this example, there is a 99.74 percent probability that a yearly return will be between –48.3 percent and 72.99 percent.

Normal Distribution and Its Implications for Standard Deviation

A large enough sample drawn from a **normal distribution** looks like the bell-shaped curve drawn in Figure 9.10. As you can see, this distribution is *symmetric* about its mean, not *skewed,* and has a much cleaner shape than the actual distribution of yearly returns drawn in Figure 9.9. Of course, if we had been able to observe stock market returns for 1,000 years, we might have filled in a lot of the jumps and jerks in Figure 9.9 and had a smoother curve.

In classical statistics, the normal distribution plays a central role, and the standard deviation is the usual way to represent the spread of a normal distribution. For the normal distribution, the probability of having a return that is above or below the mean by a certain amount depends only on the standard deviation. For example, the probability of having a return that is within one standard deviation of the mean of the distribution is approximately .68 or 2/3, and the probability of having a return that is within two standard deviations of the mean is approximately .95.

The 20.2 percent standard deviation we found for stock returns from 1926 through 2005 can now be interpreted in the following way: If stock returns are roughly normally distributed, the probability that a yearly return will fall within 20.2 percent of the mean of 12.3 percent will be approximately 2/3. That is, about 2/3 of the yearly returns will be between −7.9 percent and 32.5 percent. (Note that −7.9 = 12.3 − 20.2 and 32.5 = 12.3 + 20.2.) The probability that the return in any year will fall within two standard deviations is about .95. That is, about 95 percent of yearly returns will be between −28.1 percent and 52.7 percent.

9.6 More on Average Returns

Thus far in this chapter we have looked closely at simple average returns. But there is another way of computing an average return. The fact that average returns are calculated two different ways leads to some confusion, so our goal in this section is to explain the two approaches and also the circumstances under which each is appropriate.

Arithmetic versus Geometric Averages

Let's start with a simple example. Suppose you buy a particular stock for \$100. Unfortunately, the first year you own it, it falls to \$50. The second year you own it, it rises back to \$100, leaving you where you started (no dividends were paid).

What was your average return on this investment? Common sense seems to say that your average return must be exactly zero because you started with \$100 and ended with \$100. But if we calculate the returns year-by-year, we see that you lost 50 percent the first year (you lost half of your money). The second year, you made 100 percent (you doubled your money). Your average return over the two years was thus (−50 percent + 100 percent)/2 = 25 percent!

So which is correct, 0 percent or 25 percent? The answer is that both are correct; they just answer different questions. The 0 percent is called the **geometric average return**. The 25 percent is called the **arithmetic average return**. The geometric average return answers the question, *"What was your average compound return per year over a particular period?"* The arithmetic average return answers the question, *"What was your return in an average year over a particular period?"*

Notice that in previous sections, the average returns we calculated were all arithmetic averages, so we already know how to calculate them. What we need to do now is (1) learn how to calculate geometric averages and (2) learn the circumstances under which one average is more meaningful than the other.

Calculating Geometric Average Returns

First, to illustrate how we calculate a geometric average return, suppose a particular investment had annual returns of 10 percent, 12 percent, 3 percent, and −9 percent over the last four years. The geometric average return over this four-year period is calculated as $(1.10 \times 1.12 \times 1.03 \times .91)^{1/4} - 1 = 3.66$ percent. In contrast, the average arithmetic return we have been calculating is $(.10 + .12 + .03 - .09)/4 = 4.0$ percent.

In general, if we have T years of returns, the geometric average return over these T years is calculated using this formula:

$$\text{Geometric average return} = [(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_T)]^{1/T} - 1 \qquad \textbf{(9.1)}$$

This formula tells us that four steps are required:

1. Take each of the T annual returns $R_1, R_2, \ldots, R_T$ and add 1 to each (after converting them to decimals).
2. Multiply all the numbers from step 1 together.
3. Take the result from step 2 and raise it to the power of $1/T$.
4. Finally, subtract 1 from the result of step 3. The result is the geometric average return.

EXAMPLE 9.4

Calculating the Geometric Average Return Calculate the geometric average return for S&P 500 large-cap stocks for 1926–1930 using the numbers given here.

First convert percentages to decimal returns, add 1, and then calculate their product:

S&P 500 Returns	Product
13.75%	1.1375
35.70	× 1.3570
45.08	× 1.4508
−8.80	× .9120
−25.13	× .7487
	1.5291

(*continued*)

Notice that the number 1.5291 is what our investment is worth after five years if we started with a $1 investment. The geometric average return is then calculated as:

$$\text{Geometric average return} = 1.5291^{1/5} - 1 = .0887, \text{ or } 8.87\%$$

Thus the geometric average return is about 8.87 percent in this example. Here is a tip: If you are using a financial calculator, you can put $1 in as the present value, $1.5291 as the future value, and 5 as the number of periods. Then solve for the unknown rate. You should get the same answer we did.

You may have noticed in our examples thus far that the geometric average returns seem to be smaller. It turns out that this will always be true (as long as the returns are not all identical, in which case the two "averages" would be the same). To illustrate, Table 9.3 shows the arithmetic averages and standard deviations from Table 9.2, along with the geometric average returns.

As shown in Table 9.3, the geometric averages are all smaller, but the magnitude of the difference varies quite a bit. The reason is that the difference is greater for more volatile investments. In fact, there is a useful approximation. Assuming all the numbers are expressed in decimals (as opposed to percentages), the geometric average return is approximately equal to the arithmetic average return minus half the variance. For example, looking at the large-company stocks, the arithmetic average is 12.3 and the standard deviation is 20.2, implying that the variance is .0408. The approximate geometric average is thus 12.3% − .0408/2 = 10.26%, which is quite close to the actual value.

EXAMPLE 9.5

More Geometric Averages Take a look back at Figure 9.4. There we showed the value of a $1 investment after 80 years. Use the value for the large-company stock investment to check the geometric average in Table 9.3.

In Figure 9.4, the large-company investment grew to $2,657.56 over 80 years. The geometric average return is thus:

$$\text{Geometric average return} = \$2{,}657.56^{1/80} - 1 = .1036, \text{ or } 10.4\%$$

This 10.4 percent is the value shown in Table 9.3. For practice, check some of the other numbers in Table 9.3 the same way.

Arithmetic Average Return or Geometric Average Return?

When we look at historical returns, the difference between the geometric and arithmetic average returns isn't too hard to understand. To put it slightly differently, the geometric average tells you what you actually earned per year on average, compounded annually. The arithmetic average tells you what you earned in a typical year. You should use whichever one answers the question you want answered.

A somewhat trickier question concerns forecasting the future, and there's a lot of confusion about this point among analysts and financial planners. The problem is this: If we

Table 9.3

Geometric versus Arithmetic Average Returns: 1926–2005

Series	Geometric Mean	Arithmetic Mean	Standard Deviation
Large-company stocks	10.4%	12.3%	20.2%
Small-company stocks	12.6	17.4	32.9
Long-term corporate bonds	5.9	6.2	8.5
Long-term government bonds	5.5	5.8	9.2
Intermediate-term government bonds	5.3	5.5	5.7
U.S. Treasury bills	3.7	3.8	3.1
Inflation	3.0	3.1	4.3

have *estimates* of both the arithmetic and geometric average returns, then the arithmetic average is probably too high for longer periods and the geometric average is probably too low for shorter periods.

The good news is that there is a simple way of combining the two averages, which we will call *Blume's formula*.[2] Suppose we calculated geometric and arithmetic return averages from $\mathcal{N}$ years of data and we wish to use these averages to form a $\mathcal{T}$-year average return forecast, $R(\mathcal{T})$, where $\mathcal{T}$ is less than $\mathcal{N}$. Here's how we do it:

$$R(\mathcal{T}) = \frac{\mathcal{T}-1}{\mathcal{N}-1} \times \text{Geometric average} + \frac{\mathcal{N}-\mathcal{T}}{\mathcal{N}-1} \times \text{Arithmetic average} \tag{9.2}$$

For example, suppose that from 25 years of annual returns data, we calculate an arithmetic average return of 12 percent and a geometric average return of 9 percent. From these averages, we wish to make 1-year, 5-year, and 10-year average return forecasts. These three average return forecasts are calculated as follows:

$$R(1) = \frac{1-1}{24} \times 9\% + \frac{25-1}{24} \times 12\% = 12\%$$

$$R(5) = \frac{5-1}{24} \times 9\% + \frac{25-5}{24} \times 12\% = 11.5\%$$

$$R(10) = \frac{10-1}{24} \times 9\% + \frac{25-10}{24} \times 12\% = 10.875\%$$

Thus, we see that 1-year, 5-year, and 10-year forecasts are 12 percent, 11.5 percent, and 10.875 percent, respectively.

This concludes our discussion of geometric versus arithmetic averages. One last note: In the future, when we say "average return," we mean arithmetic average unless we explicitly say otherwise.

[2]This elegant result is due to Marshal Blume ("Unbiased Estimates of Long-Run Expected Rates of Return," *Journal of the American Statistical Association*, September 1974, pp. 634–638).

Summary and Conclusions

1. This chapter presented returns for a number of different asset classes. The general conclusion is that stocks have outperformed bonds over most of the 20th century, though stocks have also exhibited more risk.
2. The statistical measures in this chapter are necessary building blocks for the material of the next three chapters. In particular, standard deviation and variance measure the variability of the return on an individual security and on portfolios of securities. In the next chapter, we will argue that standard deviation and variance are appropriate measures of the risk of an individual security if an investor's portfolio is composed of that security only.

Concept Questions

1. **Investment Selection** Given that ViroPharma was up by almost 469 percent for 2005, why didn't all investors hold ViroPharma?
2. **Investment Selection** Given that Majesco Entertainment was down by 92 percent for 2005, why did some investors hold the stock? Why didn't they sell out before the price declined so sharply?
3. **Risk and Return** We have seen that over long periods stock investments have tended to substantially outperform bond investments. However, it is not at all uncommon to observe investors with long horizons holding their investments entirely in bonds. Are such investors irrational?
4. **Stocks versus Gambling** Critically evaluate the following statement: Playing the stock market is like gambling. Such speculative investing has no social value, other than the pleasure people get from this form of gambling.

5. **Effects of Inflation** Look at Table 9.1 and Figure 9.7 in the text. When were T-bill rates at their highest over the period from 1926 through 2005? Why do you think they were so high during this period? What relationship underlies your answer?
6. **Risk Premiums** Is it possible for the risk premium to be negative before an investment is undertaken? Can the risk premium be negative after the fact? Explain.
7. **Returns** Two years ago, General Materials' and Standard Fixtures' stock prices were the same. During the first year, General Materials' stock price increased by 10 percent while Standard Fixtures' stock price decreased by 10 percent. During the second year, General Materials' stock price decreased by 10 percent and Standard Fixtures' stock price increased by 10 percent. Do these two stocks have the same price today? Explain.
8. **Returns** Two years ago, the Lake Minerals and Small Town Furniture stock prices were the same. The annual return for both stocks over the past two years was 10 percent. Lake Minerals' stock price increased 10 percent each year. Small Town Furniture's stock price increased 25 percent in the first year and lost 5 percent last year. Do these two stocks have the same price today?
9. **Arithmetic versus Geometric Returns** What is the difference between arithmetic and geometric returns? Suppose you have invested in a stock for the last 10 years. Which number is more important to you, the arithmetic or geometric return?
10. **Historical Returns** The historical asset class returns presented in the chapter are not adjusted for inflation. What would happen to the estimated risk premium if we did account for inflation? The returns are also not adjusted for taxes. What would happen to the returns if we accounted for taxes? What would happen to the volatility?

Questions and Problems

BASIC
(Questions 1–20)

1. **Calculating Returns** Suppose a stock had an initial price of $83 per share, paid a dividend of $1.40 per share during the year, and had an ending share price of $91. Compute the percentage total return.
2. **Calculating Yields** In Problem 1, what was the dividend yield? The capital gains yield?
3. **Calculating Returns** Rework Problems 1 and 2 assuming the ending share price is $76.
4. **Calculating Returns** Suppose you bought a 9 percent coupon bond one year ago for $1,120. The bond sells for $1,074 today.
   a. Assuming a $1,000 face value, what was your total dollar return on this investment over the past year?
   b. What was your total nominal rate of return on this investment over the past year?
   c. If the inflation rate last year was 3 percent, what was your total real rate of return on this investment?
5. **Nominal versus Real Returns** What was the arithmetic average annual return on large-company stocks from 1926 through 2005
   a. In nominal terms?
   b. In real terms?
6. **Bond Returns** What is the historical real return on long-term government bonds? On long-term corporate bonds?
7. **Calculating Returns and Variability** Using the following returns, calculate the average returns, the variances, and the standard deviations for X and Y:

	Returns	
Year	**X**	**Y**
1	11%	36%
2	6	−7
3	−8	21
4	28	−12
5	13	43

8. **Risk Premiums** Refer to Table 9.1 in the text and look at the period from 1973 through 1978.
   a. Calculate the arithmetic average returns for large-company stocks and T-bills over this period.
   b. Calculate the standard deviation of the returns for large-company stocks and T-bills over this period.
   c. Calculate the observed risk premium in each year for the large-company stocks versus the T-bills. What was the arithmetic average risk premium over this period? What was the standard deviation of the risk premium over this period?

9. **Calculating Returns and Variability** You've observed the following returns on Mary Ann Data Corporation's stock over the past five years: 216 percent, 21 percent, 4 percent, 16 percent, and 19 percent.
   a. What was the arithmetic average return on Mary Ann's stock over this five-year period?
   b. What was the variance of Mary Ann's returns over this period? The standard deviation?

10. **Calculating Real Returns and Risk Premiums** In Problem 9, suppose the average inflation rate over this period was 4.2 percent and the average T-bill rate over the period was 5.1 percent.
    a. What was the average real return on Mary Ann's stock?
    b. What was the average nominal risk premium on Mary Ann's stock?

11. **Calculating Real Rates** Given the information in Problem 10, what was the average real risk-free rate over this time period? What was the average real risk premium?

12. **Holding Period Return** A stock has had returns of −4.91 percent, 21.67 percent, 22.57 percent, 6.19 percent, and 31.85 percent over the past five years, respectively. What was the holding period return for the stock?

13. **Calculating Returns** You purchased a zero coupon bond one year ago for \$152.37. The market interest rate is now 10 percent. If the bond had 20 years to maturity when you originally purchased it, what was your total return for the past year?

14. **Calculating Returns** You bought a share of 5 percent preferred stock for \$84.12 last year. The market price for your stock is now \$80.27. What is your total return for last year?

15. **Calculating Returns** You bought a stock three months ago for \$38.65 per share. The stock paid no dividends. The current share price is \$42.02. What is the APR of your investment? The EAR?

16. **Calculating Real Returns** Refer to Table 9.1. What was the average real return for Treasury bills from 1926 through 1932?

17. **Return Distributions** Refer back to Figure 9.10. What range of returns would you expect to see 68 percent of the time for long-term corporate bonds? What about 95 percent of the time?

18. **Return Distributions** Refer back to Figure 9.10. What range of returns would you expect to see 68 percent of the time for large-company stocks? What about 95 percent of the time?

19. **Blume's Formula** Over a 30-year period an asset had an arithmetic return of 12.8 percent and a geometric return of 10.7 percent. Using Blume's formula, what is your best estimate of the future annual returns over 5 years? 10 years? 20 years?

20. **Blume's Formula** Assume that the historical return on large-company stocks is a predictor of the future returns. What return would you estimate for large-company stocks over the next year? The next 5 years? 20 years? 30 years?

INTERMEDIATE (Questions 21–28)

21. **Calculating Returns and Variability** You find a certain stock that had returns of 8 percent, −13 percent, −7 percent, and 29 percent for four of the last five years. If the average return of the stock over this period was 11 percent, what was the stock's return for the missing year? What is the standard deviation of the stock's returns?

22. **Arithmetic and Geometric Returns** A stock has had returns of 29 percent, 14 percent, 23 percent, −8 percent, 9 percent, and −14 percent over the last six years. What are the arithmetic and geometric returns for the stock?

23. **Arithmetic and Geometric Returns** A stock has had the following year-end prices and dividends:

Year	Price	Dividend
1	$43.12	—
2	49.07	$0.55
3	51.19	0.60
4	47.24	0.63
5	56.09	0.72
6	67.21	0.81

What are the arithmetic and geometric returns for the stock?

24. **Calculating Returns** Refer to Table 9.1 in the text and look at the period from 1973 through 1980.
   a. Calculate the average return for Treasury bills and the average annual inflation rate (consumer price index) for this period.
   b. Calculate the standard deviation of Treasury bill returns and inflation over this period.
   c. Calculate the real return for each year. What is the average real return for Treasury bills?
   d. Many people consider Treasury bills to be risk-free. What do these calculations tell you about the potential risks of Treasury bills?

25. **Calculating Investment Returns** You bought one of Bergen Manufacturing Co.'s 8 percent coupon bonds one year ago for $1,028.50. These bonds make annual payments and mature six years from now. Suppose you decide to sell your bonds today, when the required return on the bonds is 7 percent. If the inflation rate was 4.8 percent over the past year, what would be your total real return on the investment?

26. **Using Return Distributions** Suppose the returns on long-term government bonds are normally distributed. Based on the historical record, what is the approximate probability that your return on these bonds will be less than −3.5 percent in a given year? What range of returns would you expect to see 95 percent of the time? What range would you expect to see 99 percent of the time?

27. **Using Return Distributions** Assuming that the returns from holding small-company stocks are normally distributed, what is the approximate probability that your money will double in value in a single year? Triple in value?

28. **Distributions** In the previous problem, what is the probability that the return is less than −100 percent? (Think.) What are the implications for the distribution of returns?

CHALLENGE (Questions 29–30)

29. **Using Probability Distributions** Suppose the returns on large-company stocks are normally distributed. Based on the historical record, use the cumulative normal probability table (rounded to the nearest table value) in Chapter 22 to determine the probability that in any given year you will lose money by investing in common stock.

30. **Using Probability Distributions** Suppose the returns on long-term corporate bonds and T-bills are normally distributed. Based on the historical record, use the cumulative normal probability table (rounded to the nearest table value) in Chapter 22 to answer the following questions:
   a. What is the probability that in any given year, the return on long-term corporate bonds will be greater than 10 percent? Less than 0 percent?
   b. What is the probability that in any given year, the return on T-bills will be greater than 10 percent? Less than 0 percent?
   c. In 1979, the return on long-term corporate bonds was −4.18 percent. How likely is it that this low of a return will recur at some point in the future? T-bills had a return of 10.32 percent in this same year. How likely is it that this high of a return on T-bills will recur at some point in the future?

S&P Problems

STANDARD & POOR'S

www.mhhe.com/edumarketinsight

1. **Calculating Yields** Download the historical stock prices for Duke Energy (DUK) under the "Mthly. Adj. Prices" link. Find the closing stock price for the beginning and end of the prior two years. Now use the annual financial statements to find the dividend for each of these years. What was the capital gains yield and dividend yield for Duke Energy stock for each of these years? Now calculate the capital gains yield and dividend yield for Abercrombie & Fitch (ANF). How do the returns for these two companies compare?
2. **Calculating Average Returns** Download the Monthly Adjusted Prices for Microsoft (MSFT). What is the return on the stock over the past 12 months? Now use the 1 Month Total Return and calculate the average monthly return. Is this one-twelfth of the annual return you calculated? Why or why not? What is the monthly standard deviation of Microsoft's stock over the past year?

Mini Case

A Job at East Coast Yachts

You recently graduated from college, and your job search led you to East Coast Yachts. Because you felt the company's business was seaworthy, you accepted a job offer. The first day on the job, while you are finishing your employment paperwork, Dan Ervin, who works in Finance, stops by to inform you about the company's 401(k) plan.

A 401(k) plan is a retirement plan offered by many companies. Such plans are tax-deferred savings vehicles, meaning that any deposits you make into the plan are deducted from your current pretax income, so no current taxes are paid on the money. For example, assume your salary will be $50,000 per year. If you contribute $3,000 to the 401(k) plan, you will pay taxes on only $47,000 in income. There are also no taxes paid on any capital gains or income while you are invested in the plan, but you do pay taxes when you withdraw money at retirement. As is fairly common, the company also has a 5 percent match. This means that the company will match your contribution up to 5 percent of your salary, but you must contribute to get the match.

The 401(k) plan has several options for investments, most of which are mutual funds. A mutual fund is a portfolio of assets. When you purchase shares in a mutual fund, you are actually purchasing partial ownership of the fund's assets. The return of the fund is the weighted average of the return of the assets owned by the fund, minus any expenses. The largest expense is typically the management fee, paid to the fund manager. The management fee is compensation for the manager, who makes all of the investment decisions for the fund.

East Coast Yachts uses Bledsoe Financial Services as its 401(k) plan administrator. Here are the investment options offered for employees:

Company Stock One option in the 401(k) plan is stock in East Coast Yachts. The company is currently privately held. However, when you interviewed with the owner, Larissa Warren, she informed you the company stock was expected to go public in the next three to four years. Until then, a company stock price is simply set each year by the board of directors.

Bledsoe S&P 500 Index Fund This mutual fund tracks the S&P 500. Stocks in the fund are weighted exactly the same as the S&P 500. This means the fund return is approximately the return on the S&P 500, minus expenses. Because an index fund purchases assets based on the compensation of the index it is following, the fund manager is not required to research stocks and make investment decisions. The result is that the fund expenses are usually low. The Bledsoe S&P 500 Index Fund charges expenses of .15 percent of assets per year.

Bledsoe Small-Cap Fund This fund primarily invests in small-capitalization stocks. As such, the returns of the fund are more volatile. The fund can also invest 10 percent of its assets in companies based outside the United States. This fund charges 1.70 percent in expenses.

Bledsoe Large-Company Stock Fund This fund invests primarily in large-capitalization stocks of companies based in the United States. The fund is managed by Evan Bledsoe and has outperformed the market in six of the last eight years. The fund charges 1.50 percent in expenses.

Bledsoe Bond Fund This fund invests in long-term corporate bonds issued by U.S.–domiciled companies. The fund is restricted to investments in bonds with an investment-grade credit rating. This fund charges 1.40 percent in expenses.

Bledsoe Money Market Fund This fund invests in short-term, high–credit quality debt instruments, which include Treasury bills. As such, the return on the money market fund is only slightly higher than the return on Treasury bills. Because of the credit quality and short-term nature of the investments, there is only a very slight risk of negative return. The fund charges .60 percent in expenses.

1. What advantages do the mutual funds offer compared to the company stock?
2. Assume that you invest 5 percent of your salary and receive the full 5 percent match from East Coast Yachts. What EAR do you earn from the match? What conclusions do you draw about matching plans?
3. Assume you decide you should invest at least part of your money in large-capitalization stocks of companies based in the United States. What are the advantages and disadvantages of choosing the Bledsoe Large-Company Stock Fund compared to the Bledsoe S&P 500 Index Fund?
4. The returns on the Bledsoe Small-Cap Fund are the most volatile of all the mutual funds offered in the 401(k) plan. Why would you ever want to invest in this fund? When you examine the expenses of the mutual funds, you will notice that this fund also has the highest expenses. Does this affect your decision to invest in this fund?
5. A measure of risk-adjusted performance that is often used is the Sharpe ratio. The Sharpe ratio is calculated as the risk premium of an asset divided by its standard deviation. The standard deviation and return of the funds over the past 10 years are listed here. Calculate the Sharpe ratio for each of these funds. Assume that the expected return and standard deviation of the company stock will be 18 percent and 70 percent, respectively. Calculate the Sharpe ratio for the company stock. How appropriate is the Sharpe ratio for these assets? When would you use the Sharpe ratio?

	10-Year Annual Return	Standard Deviation
Bledsoe S&P 500 Index Fund	11.48%	15.82%
Bledsoe Small-Cap Fund	16.68	19.64
Bledsoe Large-Company Stock Fund	11.85	15.41
Bledsoe Bond Fund	9.67	10.83

6. What portfolio allocation would you choose? Why? Explain your thinking carefully.

Appendix 9A The Historical Market Risk Premium: The Very Long Run

To access Appendix 9A, please go to www.mhhe.com/rwj.

Appendix 9A The Historical Market Risk Premium: The Very Long Run

The data in Chapter 9 indicate that the returns on common stock have historically been much higher than the returns on short-term government securities. This phenomenon has bothered economists: It is difficult to justify why large numbers of rational investors purchase the lower-yielding bills and bonds.

In 1985, Mehra and Prescott published a very influential paper that showed that the historical returns for common stocks are far too high when compared to the rates of return on short-term government securities.[1] They pointed out that the difference in returns (frequently called the *equity premium*) implies a very high degree of risk aversion on the part of investors. Since the publication of the Mehra and Prescott research, financial economists have tried to explain the so-called equity risk premium puzzle. The high historical equity risk premium is especially intriguing compared to the very low historical rate of return on Treasury securities. This seems to imply behavior that has not actually happened. For example, if people have been very risk-averse and historical borrowing rates have been low, it suggests that people should have been willing to borrow in periods of economic uncertainty and downturn to avoid the possibility of a reduced standard of living. However, we do not observe increased borrowing during recessions.

The equity risk premium puzzle of Mehra and Prescott has been generally viewed as an unexplained paradox. However, recently, Jeremy Seigel has shown that the historical risk premium may be substantially lower than previously realized (see Table 9A.1). He shows that although the risk premium averaged 8.4 percent from 1926 to 2002, it averaged only 2.9 percent from 1802 to 1870, and 4.6 percent from 1871 to 1925.[2] It is puzzling that the trend has been rising over the last 200 years. It has been especially high since 1926. However, the key point is that historically the risk premium has been lower than in more recent times, and we should be somewhat cautious about assumptions we make concerning the current risk premium.

Table 9A.1

	1802–1870	1871–1925	1926–2002	Overall 1802–2002
Common stock	8.1	8.4	12.2	9.7
Treasury bills	5.2	3.8	3.8	4.3
Risk premium	2.9	4.6	8.4	5.4

[1] Rajnish Mehra and Edward C. Prescott, "The Equity Premium: A Puzzle," *Journal of Monetary Economics* 15 (1985), pp. 145–61.

[2] Jeremy J. Seigel, *Stocks for the Long Run,* 3rd ed. (New York: McGraw-Hill, 2002).