Chapter 10

Risk and Return: Lessons from Market History
风险与收益：历史的启示

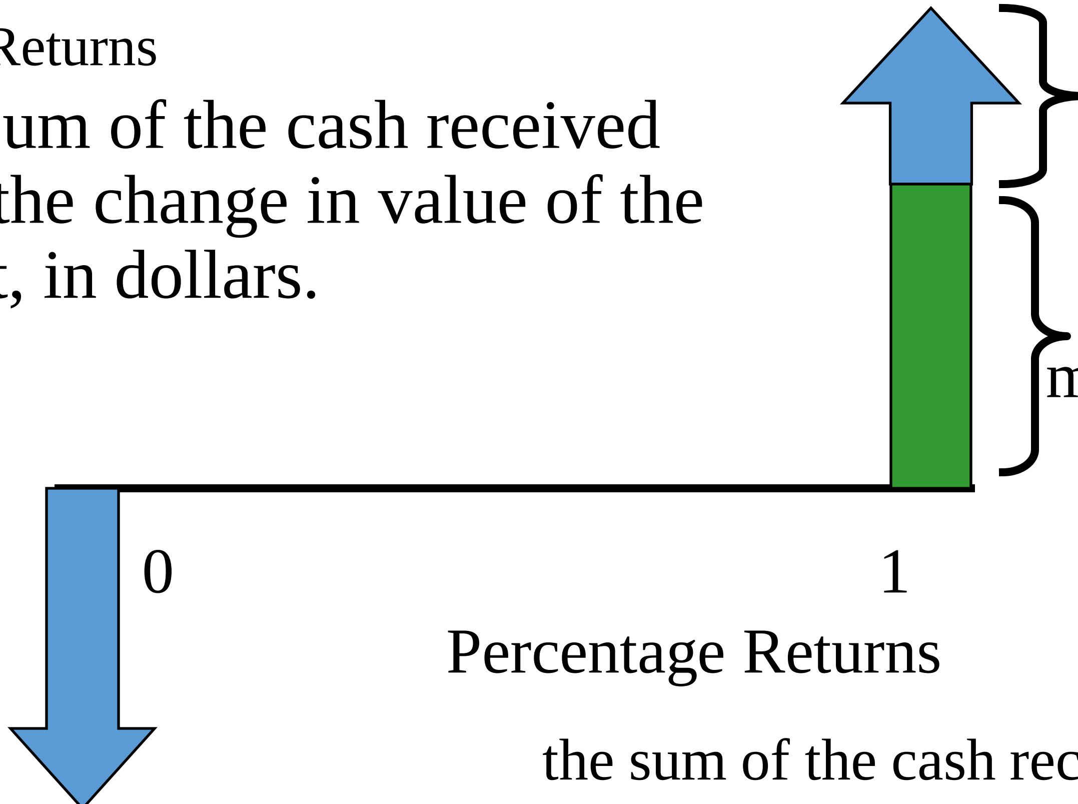
Key Concepts and Skills

- Know how to calculate the return on an investment
- Know how to calculate the standard deviation of an investment's returns
- Understand the historical returns and risks on various types of investments
- Understand the importance of the normal distribution
- Understand the difference between arithmetic and geometric average returns

10.1 Returns

- Dollar Returns

  the sum of the cash received and the change in value of the asset, in dollars.



Percentage Returns

the sum of the cash received and the change in value of the asset, divided by the initial investment.

Stock Return

Return = Dividend + Change in Market Value

$$\text{percentage return} = \frac{\text{return}}{\text{beginning market value}}$$

$$= \frac{\text{dividend} + \text{change in market value}}{\text{beginning market value}}$$

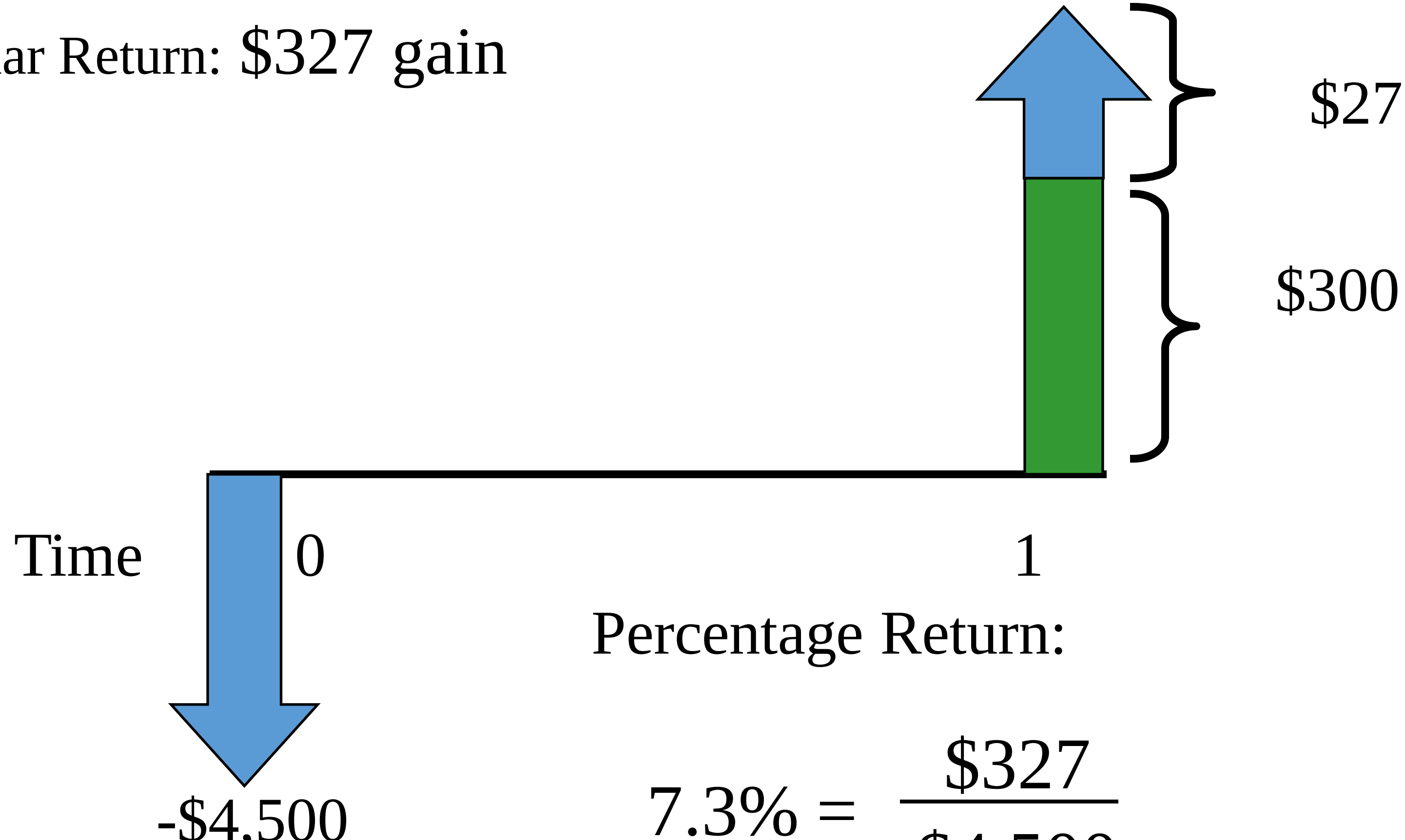
$$= \text{dividend yield} + \text{capital gains yield}$$

Returns: Example

- Suppose you bought 100 shares of Wal-Mart (WMT) one year ago today at \$45. Over the last year, you received \$27 in dividends (27 cents per share × 100 shares). At the end of the year, the stock sells for \$48. How did you do?
- You invested \$45 × 100 = \$4,500. At the end of the year, you have stock worth \$4,800 and cash dividends of \$27. Your dollar gain was \$327 = \$27 + (\$4,800 – \$4,500).
- Your percentage gain for the year is: $7.3\% = \dfrac{\$327}{\$4{,}500}$

Returns: Example

Dollar Return: $327 gain



Percentage Return:

$$7.3\% = \frac{\$327}{\$4,500}$$

Holding Period Return （持有期收益率）: Example

- Suppose your investment provides the following returns over a four-year period:

Year	*Return*
1	10%
2	-5%
3	20%
4	15%

$$\text{Your holding period return} =$$
$$= (1+r_1)\times(1+r_2)\times(1+r_3)\times(1+r_4)-1$$
$$= (1.10)\times(.95)\times(1.20)\times(1.15)-1$$
$$= .4421 = 44.21\%$$

Holding period return is the **total return** received from holding an asset or portfolio of assets over a period of time, known as the holding period, generally expressed as a percentage.

Historical Returns

- A famous set of studies dealing with rates of returns on common stocks, bonds, and Treasury bills was conducted by Roger Ibbotson and Rex Sinquefield.
- They present year-by-year historical rates of return starting in 1926 for the following five important types of financial instruments in the United States:
  - Large-company Common Stocks
  - Small-company Common Stocks
  - Long-term Corporate Bonds
  - Long-term U.S. Government Bonds
  - U.S. Treasury Bills

Return Statistics

- The history of capital market returns can be summarized by describing the
  - average return

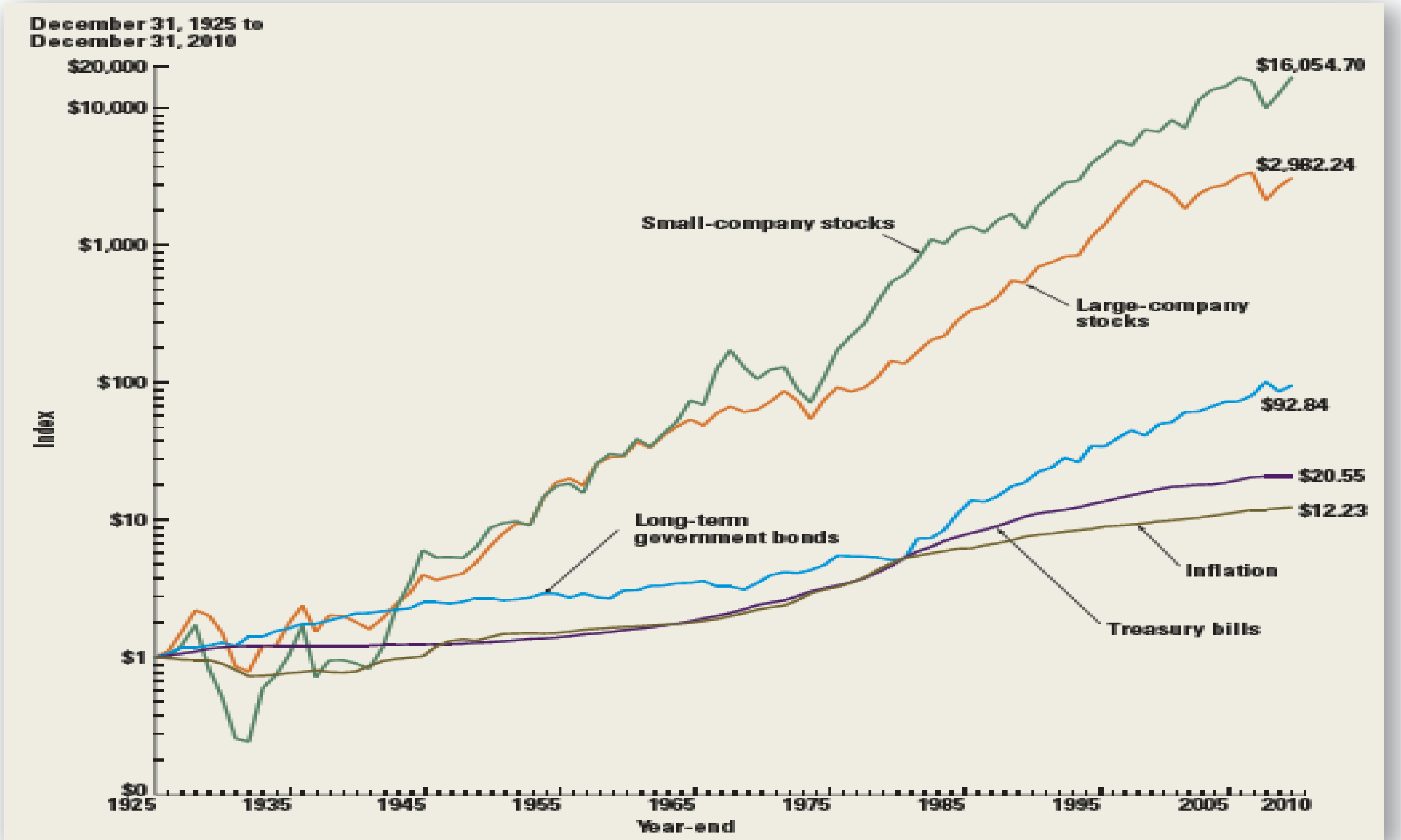
$$\overline{R} = \frac{(R_1 + \cdots + R_T)}{T}$$

  - the standard deviation of those returns

$$SD = \sqrt{VAR} = \sqrt{\frac{(R_1 - \overline{R})^2 + (R_2 - \overline{R})^2 + \cdots (R_T - \overline{R})^2}{T-1}}$$

  - the frequency distribution of the returns.

FIGURE 12.4 A $1 Investment in Different Types of Portfolios: 1925–2010 (Year-End 1925 = $1)



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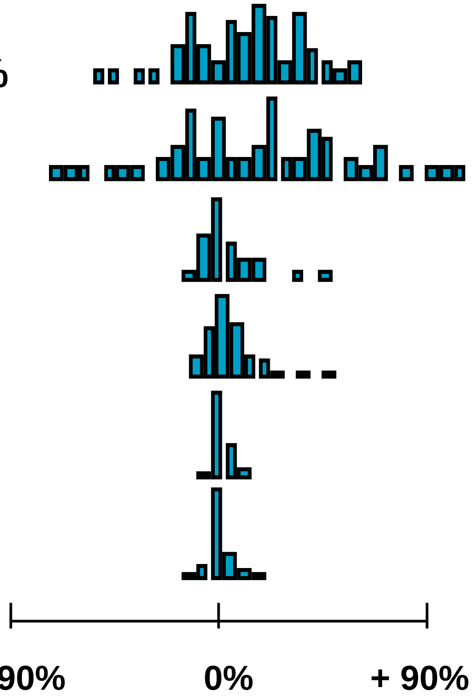
Small-company stock: 20% of companies listed on the NYSE, measured as market value of outstanding stock
Large-company stocks: S&P500 index stocks,
Long-term government bonds: US government bonds with 20 years to maturity
Treasury bills: Treasury bills with a one-month maturity

Historical Returns, 1926-2011

Series	Average Annual Return	Standard Deviation	Distribution
Large Company Stocks	11.8%	20.3%	
Small Company Stocks	16.5	32.5	
Long-Term Corporate Bonds	6.4	8.4	
Long-Term Government Bonds	6.1	9.8	
U.S. Treasury Bills	3.6	3.1	
Inflation	3.1	4.2	



Source: Global Financial Data (www.globalfinddata.com) copyright 2012.

Risk Premiums

- Risk-free rate:
  - The risk-free rate of return is the theoretical rate of return of an investment with zero risk. The risk-free rate represents the interest an investor would expect from an absolutely risk-free investment over a specified period of time.
  - Rate of return on a riskless investment
  - Treasury Bills are considered risk-free

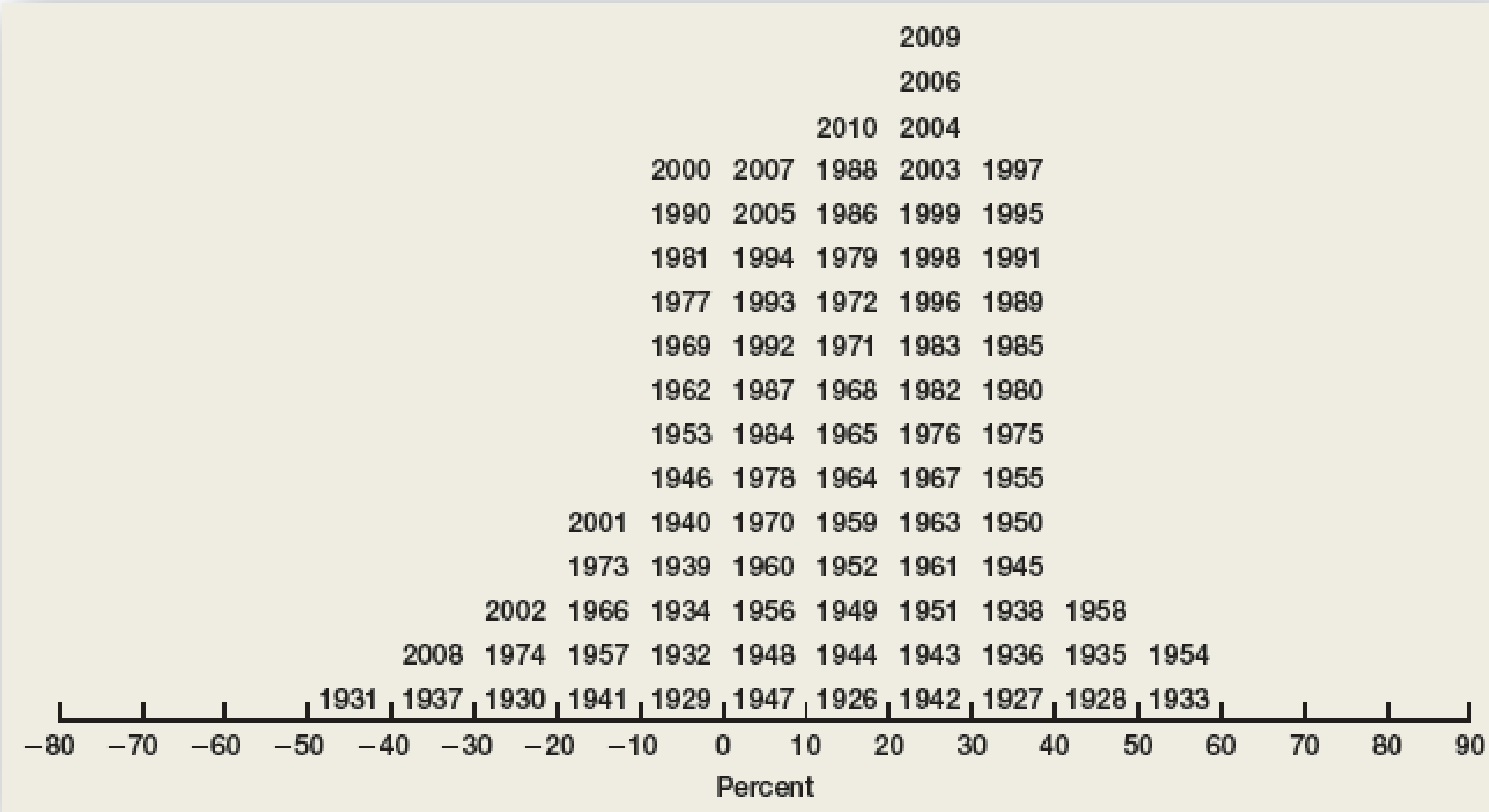
- Risk premium （风险溢价）:
  - Excess return on a risky asset over the risk-free rate
  - Reward for bearing risk

Historical Risk Premiums

- Large Stocks: 11.9 – 3.7 = 8.2%
- Small Stocks: 16.7 – 3.7 = 13.0%
- L/T Corporate Bonds: 6.2 – 3.7 = 2.5%
- L/T Government Bonds: 5.9 – 3.7 = 2.2 %
- U.S. Treasury Bills: 3.7 – 3.7 = 0*

* By definition!

FIGURE 12.9 Frequency Distribution of Returns on Large-Company Stocks: 1926–2010



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Risk Statistics 风险统计

- There is no universally agreed-upon definition of risk.
- The measures of risk that we discuss are variance and standard deviation.
  - The standard deviation is the standard statistical measure of the spread of a sample, and it will be the measure we use most of this time.
  - Its interpretation is facilitated by a discussion of the normal distribution.

Return Variability:

The Statistical Tools for Historical Returns

- Return variance: ("T" =number of returns)

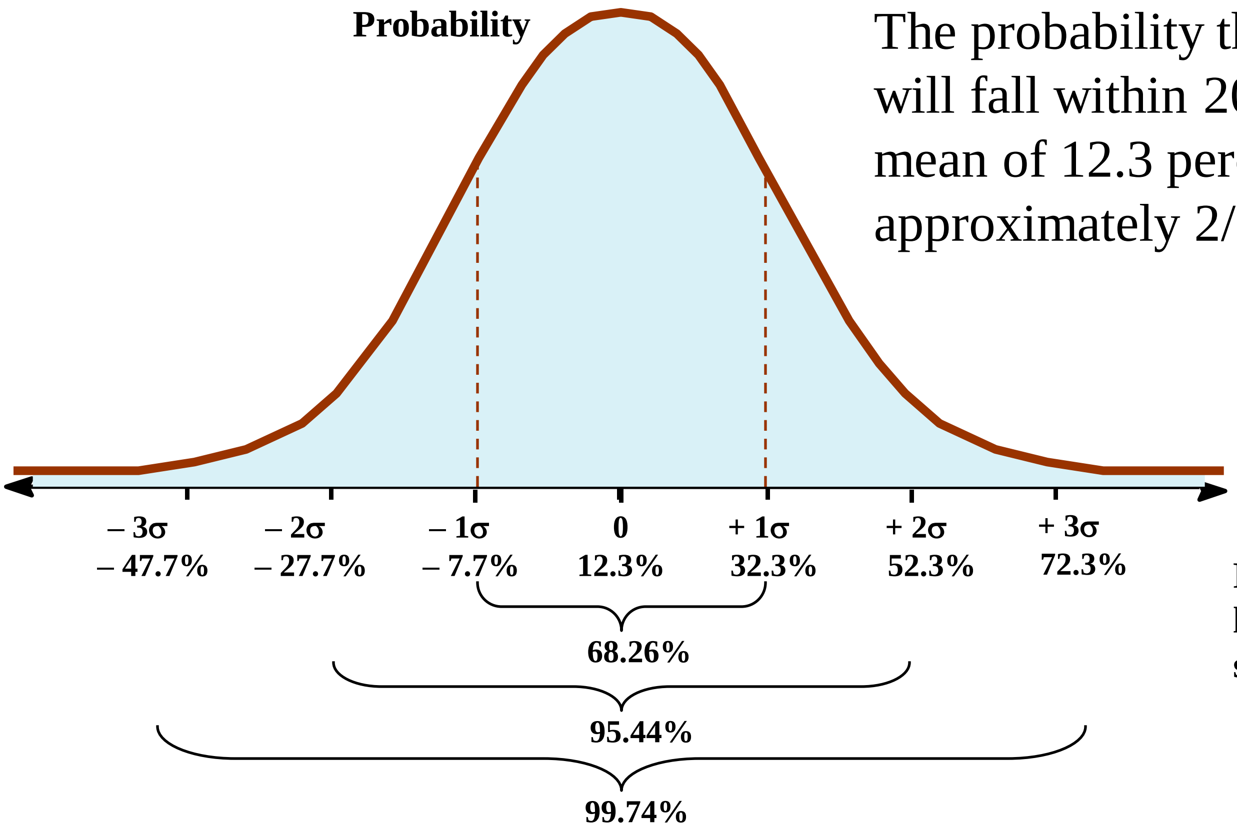
$$\mathbf{VAR(R)} = \sigma^2 = \frac{\sum_{i=1}^{T} \left(R_i - \overline{R}\right)^2}{T-1}$$

- Standard Deviation:

$$\mathbf{SD(R)} = \sigma = \sqrt{\mathbf{VAR(R)}}$$

Normal Distribution

- A large enough sample drawn from a normal distribution looks like a bell-shaped curve.



The probability that a yearly return will fall within 20.0 percent of the mean of 12.3 percent will be approximately 2/3.

Normal Distribution

- The 20.3% standard deviation we found for large stock returns from 1926 through 2011 can now be interpreted in the following way:
  - If stock returns are approximately normally distributed, the probability that a yearly return will fall within 20.3 percent of the mean of 11.8% will be approximately 2/3.

More on Average Returns

- Arithmetic average （算术平均）– return earned in an average period over multiple periods
- Geometric average （几何平均）– average compound return per period over multiple periods
- The geometric average will be less than the arithmetic average unless all the returns are equal

Geometric Average Return: Formula

$$GAR = \left[(1+R_1)\times(1+R_2)\times\ldots\times(1+R_N)\right]^{1/T} - 1$$

Where:

R_i = return in each period

T = number of periods

Geometric Return: Example

- Recall our earlier example:

Year	*Return*
1	10%
2	-5%
3	20%
4	15%

Geometric average return =

$$(1+R_g)^4 = (1+R_1)\times(1+R_2)\times(1+R_3)\times(1+R_4)$$

$$R_g = \sqrt[4]{(1.10)\times(.95)\times(1.20)\times(1.15)} - 1$$

$$= .095844 = 9.58\%$$

So, our investor made an average of 9.58% per year, realizing a holding period return of 44.21%.

$$1.4421 = (1.095844)^4$$

Geometric Return: Example

- Note that the geometric average is not the same as the arithmetic average:

Year	*Return*
1	10%
2	-5%
3	20%
4	15%

$$\text{Arithmetic average return} = \frac{R_1 + R_2 + R_3 + R_4}{4}$$

$$= \frac{10\% - 5\% + 20\% + 15\%}{4} = 10\%$$

Quick Quiz

- Which of the investments discussed has had the highest average return and risk premium?
- Which of the investments discussed has had the highest standard deviation?
- Why is the normal distribution informative?
- What is the difference between arithmetic and geometric averages?