CHAPTER

10

Risk and Return

Lessons from Market History

McGraw-Hill/Irwin

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

Chapter Outline

10.1 Returns (Self Study/Review)

10.2 Holding-Period Returns

10.3 Return Statistics (Self Study/Review)

10.4 Average Stock Returns and Risk-Free Returns

10.5 Risk Statistics (Self Study/Review)

10.6 More on Average Returns

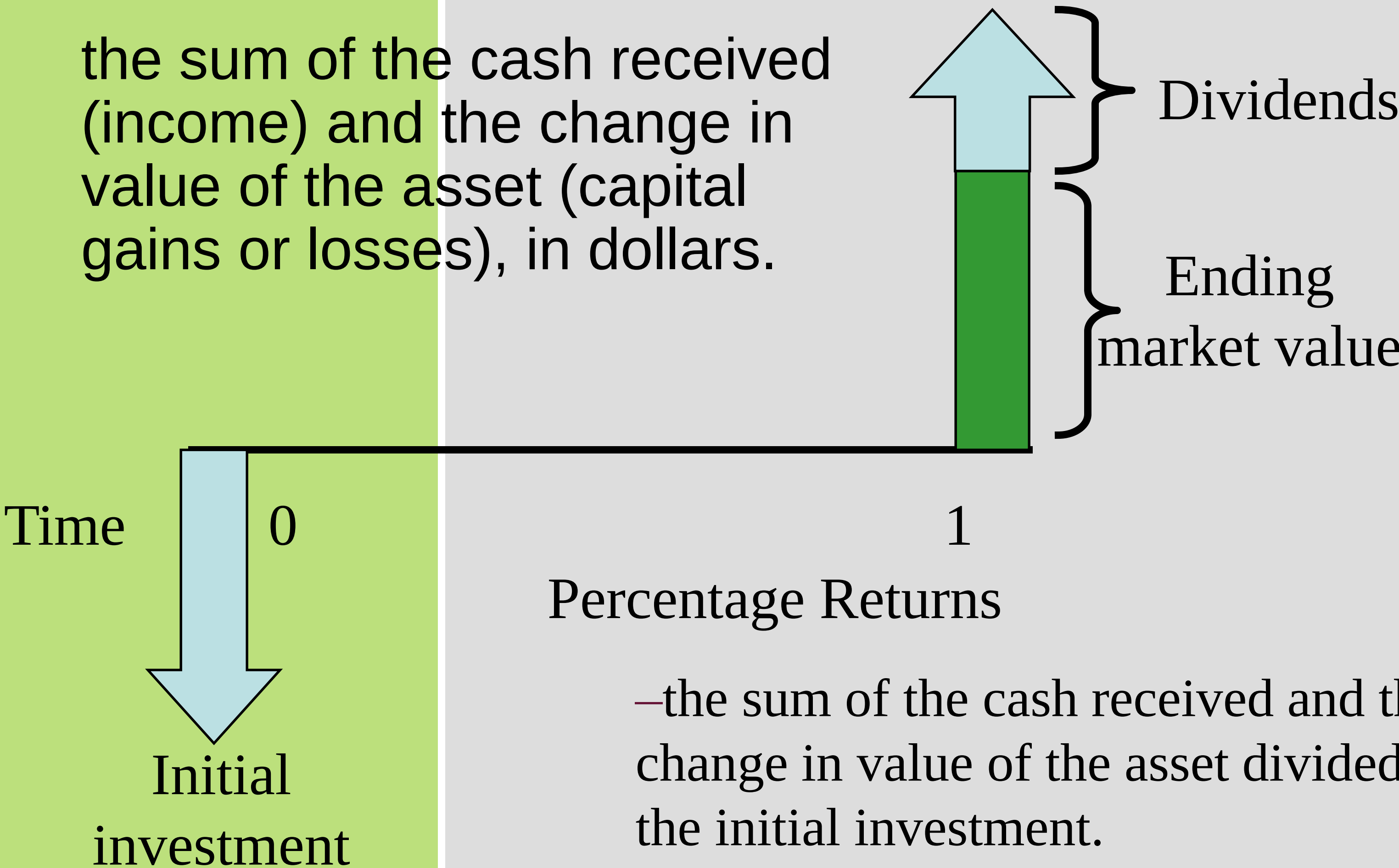
10.7 The U.S. Equity Risk Premium: (SS) Historical and International Perspectives

10.8 2008: A Year of Financial Crisis (SS)

10.1 Returns (Self Study/Review)

- Dollar Returns

  the sum of the cash received (income) and the change in value of the asset (capital gains or losses), in dollars.



Percentage Returns

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

Returns

Dollar Return = Dividend + Change in Market Value

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

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

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

Returns: Example

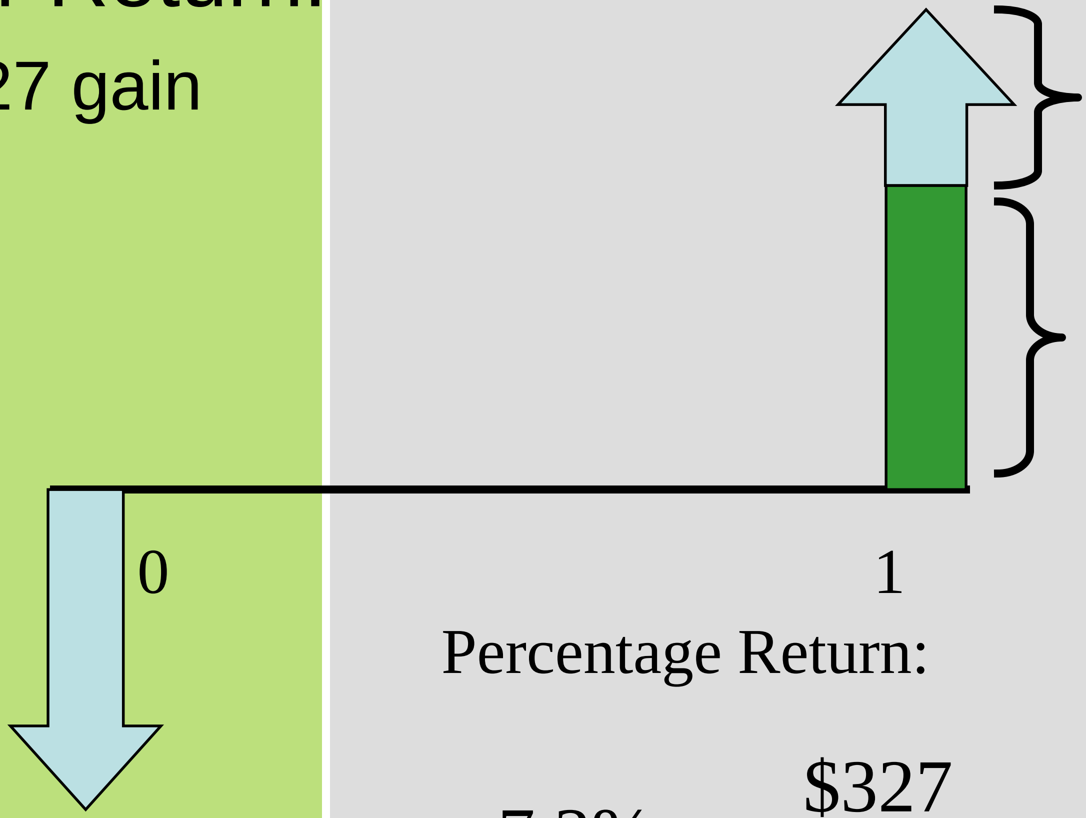
- Suppose you bought 100 shares of Wal-Mart (WMT) one year ago today at $45. Over the last year, you received $27 in dividends (27 cents per share $\times$ 100 shares). At the end of the year, the stock sells for $48. How did you do?
- Quite well. You invested $45 $\times$ 100 = $4,500. At the end of 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:

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

Returns: Example

Dollar Return:

$327 gain



Percentage Return:

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

10.2 Holding Period Returns

- The holding period return is the return that an investor would get when holding an investment over a period of *n* years, when the return during year *i* is given as r_i:

$$\text{holding period return} =$$
$$= (1+r_1)\times(1+r_2)\times\cdots\times(1+r_n)-1$$

Holding Period Return: Example

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

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

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 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

10.3 Return Statistics
(Self Study/Review)

- The history of capital market returns can be summarized by describing the:
  - average return (or sample mean)

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

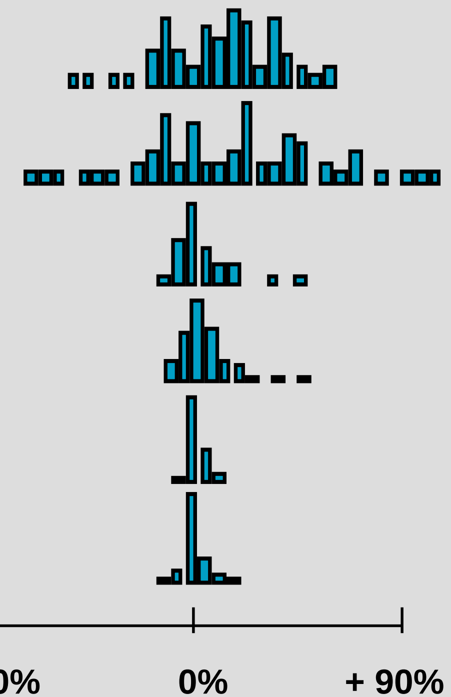
  - the (sample) standard deviation of those returns

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

  - the frequency distribution of the returns

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	



SourceGlobal Financial Data (www.globalfinddata.com)

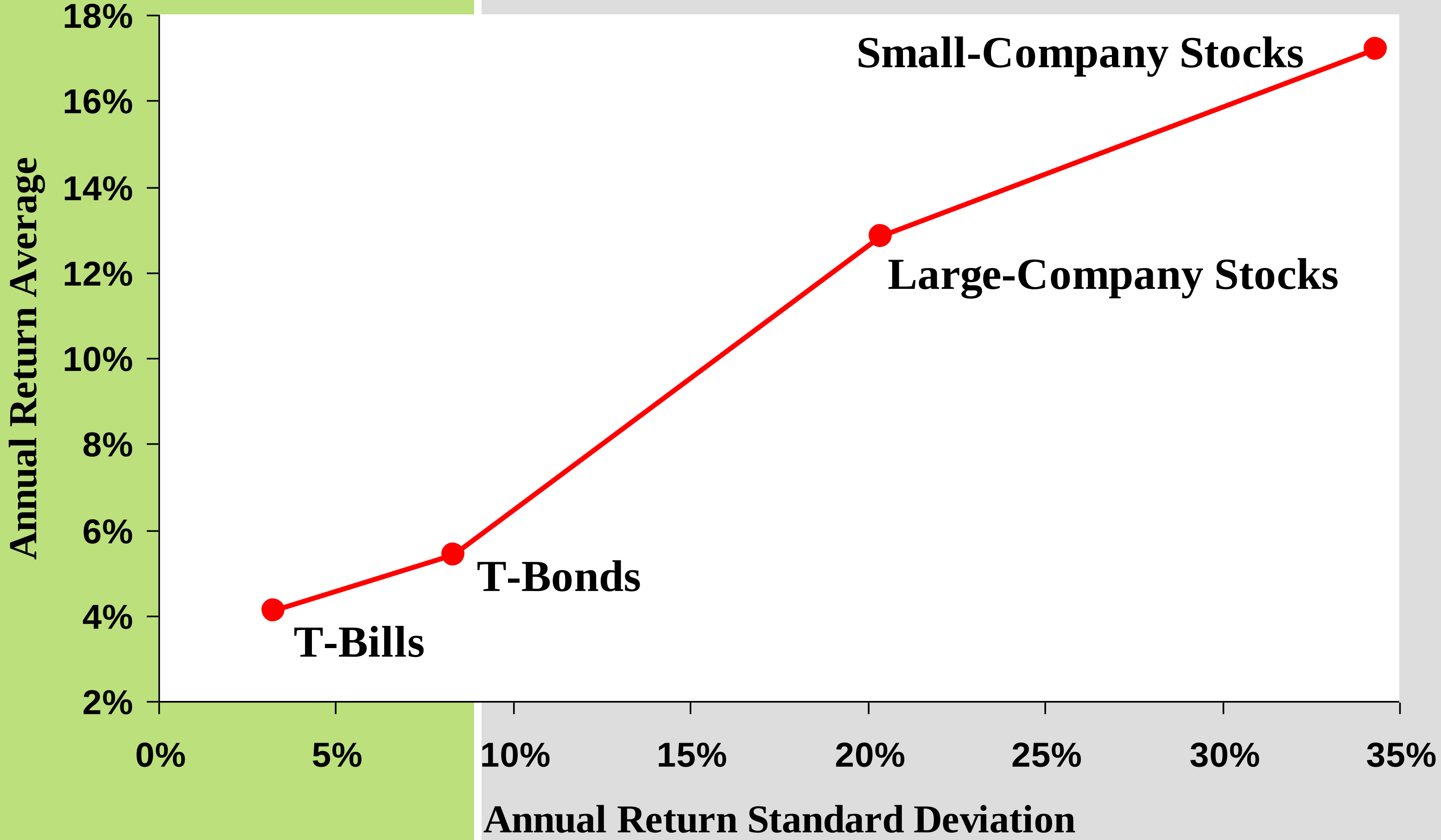
10.4 Average Stock Returns and Risk-Free Returns

- The *Risk Premium* is the added return (over and above the risk-free rate) resulting from bearing risk.
- One of the most significant observations of stock market data is the long-run excess of stock return over the risk-free return.
  - The average excess return from large company common stocks for the period 1926 through 2011 was:
    8.2% = 11.8% – 3.6%
  - The average excess return from small company common stocks for the period 1926 through 2011 was:
    12.9% = 16.5% – 3.6%
  - The average excess return from long-term corporate bonds for the period 1926 through 2011 was:
    2.8% = 6.4% – 3.6%

Risk Premia

- Suppose that *The Wall Street Journal* announced that the current rate for one-year Treasury bills is 2%.
- What is the expected return on the market of small-company stocks?
- Recall that the average excess return on small company common stocks for the period 1926 through 2011 was 12.9%.
- Given a risk-free rate of 2%, we have an expected return on the market of small-company stocks of 14.9% = 12.9% + 2%

The Risk-Return Tradeoff



Risk Premia

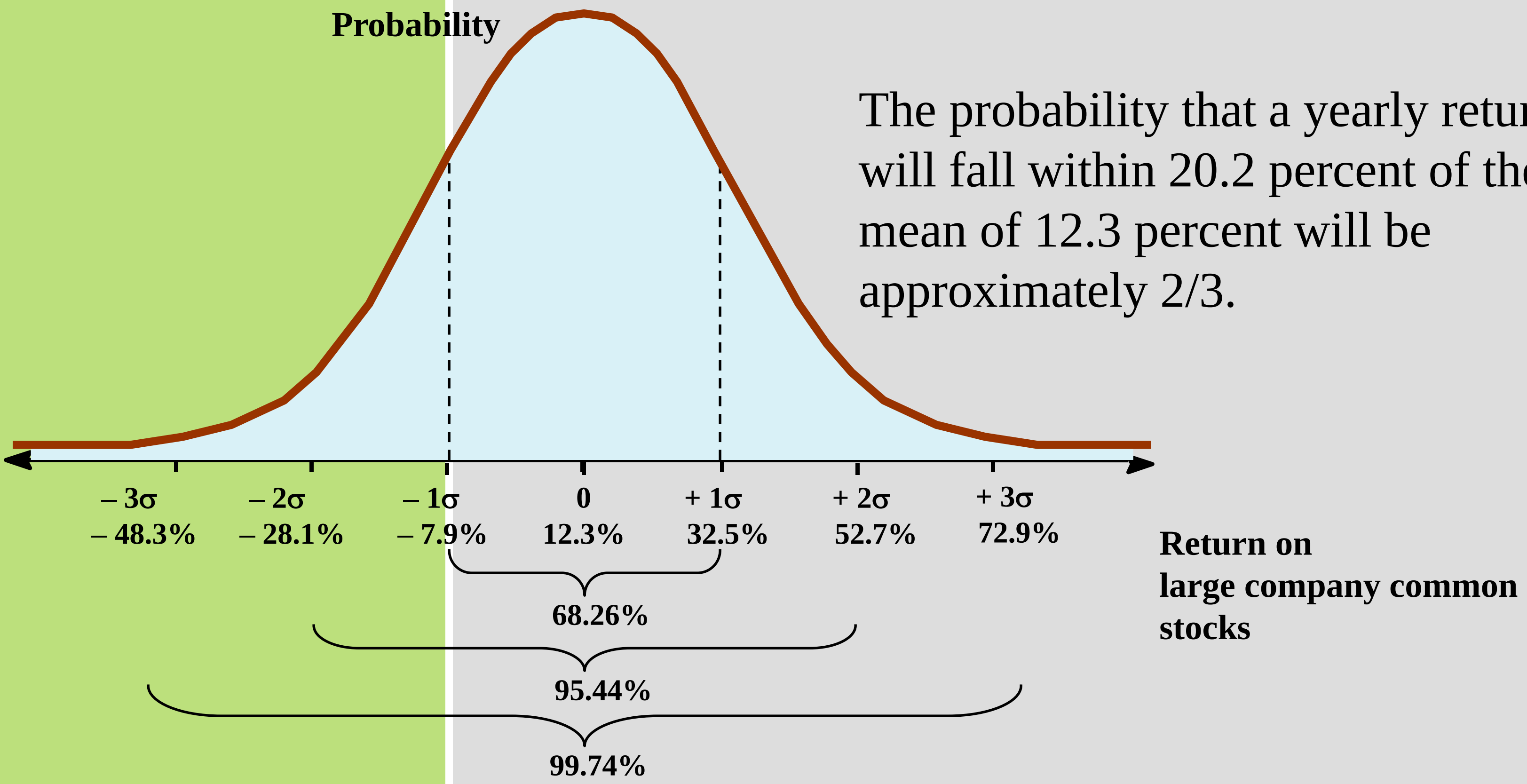
- Rate of return on T-bills is essentially risk-free.
- Investing in stocks is risky, but there are compensations.
- The difference between the return on T-bills and stocks is the risk premium for investing in stocks.
- An old saying on Wall Street is “You can either sleep well or eat well.”

10.5 Risk Statistics (Self Study)

- 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.

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 20.2 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.

Example – Return and Variance

Year	Actual Return	Average Return	Deviation from the Mean	Squared Deviation
1	.15	.105	.045	.002025
2	.09	.105	-.015	.000225
3	.06	.105	-.045	.002025
4	.12	.105	.015	.000225
Totals			.00	.0045

Variance = .0045 / (4-1) = .0015 Standard Deviation = .03873

10.6 More on Average Returns

- Arithmetic average – return earned in an average period over multiple periods
- Geometric average – average compound return per period over multiple periods
- The geometric average will be less than the arithmetic average unless all the returns are equal.
- Which is better?
  - The arithmetic average is overly optimistic for long horizons.
  - The geometric average is overly pessimistic for short horizons.

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%.

$$1.4421 = (1.095844)^4$$

Arithmetic 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%

$$\text{Arithmetic average return} = \frac{r_1 + r_2 + r_3 + r_4}{4}$$

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

» In general, the geometric average is lower than the arithmetic average. Furthermore, the larger the variation in the returns, the larger the discrepancy between the geometric average and the arithmetic average.

Forecasting Return

- To address the time relation in forecasting returns, use Blume's formula:

$$R(T) = \left(\frac{T-1}{N-1} \right) \times GeometricAverage + \left(\frac{N-T}{N-1} \right) \times ArithmeticAverage$$

where, T is the forecast horizon and N is the number of years of historical data we are working with. T must be less than N.

10.7 Perspectives on the Equity Risk Premium (Self Study)

- Over 1926-2011, the U.S. equity risk premium has been quite large:
  - Earlier years (beginning in 1802) provide a smaller estimate at 5.4%
  - Comparable data for 1900 to 2010 put the international equity risk premium at an average of 6.7%, versus 7.2% in the U.S.
- Going forward, an estimate of 7% seems reasonable, although somewhat higher or lower numbers could also be considered rational

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?