CHAPTER 9
Risk and Return
Lessons from Market History

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
9.1 Returns
9.2 Holding-Period Returns
9.3 Return Statistics
9.4 Average Stock Returns and Risk-Free Returns
9.5 Risk Statistics
9.6 More on Average Returns

Returns
Dollar Return = \frac{\text{Dividend} + \text{Change in Market Value}}{\text{Beginning Market Value}}

Percentage Return = \frac{\text{Dollar Return}}{\text{Beginning Market Value}}

Returns: Example
• Suppose you bought 100 shares of Wal-Mart (WMT) one year ago today at $25. Over the
  last year, you received $20 in dividends (20 cents per share \times 100 shares). At the end of
  the year, the stock sells for $30. How did you do?
• Quite well. You invested $25 \times 100 = $2,500. At the end of the year, you have
  stock worth $3,000 and cash dividends of $20. Your dollar gain was $520 = $20 + ($3,000 – $2,500).
• Your percentage gain for the year is: 20.8% = \frac{520}{2,500}
9.2 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 \( r_i \):

\[
\text{holding period return} = \left(1 + r_1\right) \times \left(1 + r_2\right) \times \ldots \times \left(1 + r_n\right) - 1
\]

9.3 Return Statistics

- The history of capital market returns can be summarized by describing the:
  - average return
    \[
    \bar{R} = \frac{\sum R_i}{T}
    \]
  - the standard deviation of those returns
    \[
    SD = \sqrt{\frac{\sum (R_i - \bar{R})^2}{T-1}}
    \]
  - the frequency distribution of the returns
9.4 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 2005 was: $8.5\% = 12.3\% - 3.8\%$
  - The average excess return from small company common stocks for the period 1926 through 2005 was: $13.6\% = 17.4\% - 3.8\%$
  - The average excess return from long-term corporate bonds for the period 1926 through 2005 was: $2.4\% = 6.2\% - 3.8\%$

9.5 Risk Statistics

- 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.

The 20.2% standard deviation we found for large stock returns from 1926 through 2005 can now be interpreted in the following way: if stock returns are approximately normally distributed, the probability that a yearly return will fall within 20.2 percent of the mean of 12.3% will be approximately 2/3.
### Example – Return and Variance

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Return</th>
<th>Average Return</th>
<th>Deviation from the Mean</th>
<th>Squared Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.15</td>
<td>-1.05</td>
<td>.045</td>
<td>.002025</td>
</tr>
<tr>
<td>2</td>
<td>.09</td>
<td>-1.05</td>
<td>-.015</td>
<td>.000225</td>
</tr>
<tr>
<td>3</td>
<td>.06</td>
<td>-1.05</td>
<td>-.045</td>
<td>.002025</td>
</tr>
<tr>
<td>4</td>
<td>.12</td>
<td>-1.05</td>
<td>.015</td>
<td>.000225</td>
</tr>
</tbody>
</table>

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

### Geometric Return: Example

- Recall our earlier example:

<table>
<thead>
<tr>
<th>Year</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>-5%</td>
</tr>
<tr>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>4</td>
<td>15%</td>
</tr>
</tbody>
</table>

Geometric average return = \((1 + r_1)(1 + r_2)(1 + r_3)(1 + r_4)\)^{1/4} = .095844 = 9.58%

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

### Forecasting Return

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

\[
R(T) = \left( \frac{T - 1}{N - 1} \right) \times \text{Geometric Average} + \left( \frac{N - T}{N - 1} \right) \times \text{Arithmetic Average}
\]

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 \(N\).

### 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?
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