Risk and Rates of Return

1. Risk exists when two or more outcomes are possible.

2. Risk can be defined as variability; more variability suggests more risk.

3. Probability distribution:
   a. Shows all of the possible outcomes along with the probability of each outcome occurring.
   b. A probability distribution with a wider (narrower) scatter of outcomes is considered to have more (less) risk than a probability distribution with a narrower (wider) scatter of outcomes.
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4. Expected return = weighted average of the possible outcomes from a probability distribution:

\[ \hat{r} = Pr_1 r_1 + Pr_2 r_2 + \ldots + Pr_n r_n \]

5. Standard deviation = total risk = stand alone risk = \( \sigma \)

\[ \sigma = \sqrt{(r_1 - \hat{r})^2 Pr_1 + (r_2 - \hat{r})^2 Pr_2 + \ldots + (r_n - \hat{r})^2 Pr_n} \]

a. Measures the scatter, or dispersion, of a probability distribution; measures variability.

b. \( \sigma \) must be greater than or equal to zero (0); that is, \( \sigma \geq 0 \)
   i. If \( \sigma > 0 \), risk exists.
   ii. If \( \sigma = 0 \), there is no variability, thus there is no risk.
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6. Coefficient of variation (CV)—amount of risk relative to the return; a lower CV is preferred to a higher CV:

\[
\text{Coefficient of variation} = \text{CV} = \frac{\sigma}{\hat{r}} = \frac{\text{Risk}}{\text{Return}}
\]

7. Portfolio—combination of investments

8. Portfolio return—weighted average of the returns on the individual investments

\[
\text{Portfolio return} = \hat{r}_P = w_1\hat{r}_1 + w_2\hat{r}_2 + \ldots + w_N\hat{r}_N
\]

\[w_j = \text{proportion (weight) of Investment } j \text{ contained in the portfolio}\]
9. Portfolio risk:
   a. Purchasing multiple investments achieves diversification.
   b. Diversification—risk reduction
   c. The risk of a portfolio of investments generally is less than the average of the risks of the individual investments

10. Total risk = Firm-specific risk + Market risk
    = Diversifiable risk + Nondiversifiable risk
    = Unsystematic risk + Systematic risk

11. Market risk = relevant risk; it cannot be reduced through diversification

12. Firm-specific risk = irrelevant risk; it can be reduced or eliminated through diversification
13. Beta ($\beta$)

a. A measure of systematic, or **relevant**, risk.

b. A measure of the relationship between an individual investment and a well-diversified portfolio of investments (the market portfolio).
   
i. $\beta = 1.0$ indicates the investment has similar relevant (systematic) risk as the entire market, which means the investment should earn the same return as the market.

   ii. $\beta > 1.0$ indicates the investment has more relevant (systematic) risk than the entire market, which means the investment should earn a higher return than the market.

   iii. $\beta < 1.0$ indicates the investment has less relevant (systematic) risk than the entire market, which means the investment should earn a lower return than the market.
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14. Portfolio beta ($\beta_p$)—weighted average of the betas of the individual investments

$$\beta_p = w_1\beta_1 + w_2\beta_2 + \ldots + w_N\beta_N$$

$w_j$ = proportion (weight) of Investment $j$ contained in the portfolio

15. Required rate of return for an investment—ONLY the relevant (market) risk should be rewarded; use investment’s $\beta$ to determine its required rate of return.

Required rate of return $= r_j = \text{Risk-free rate} + \text{Risk premium}$

$$= r_{RF} + (RP_M)\beta_j$$

$$= r_{RF} + (r_M - r_{RF})\beta_j$$
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16. Market equilibrium—required rate of return ($r$) versus expected rate of return ($\hat{r}$):

- If $r = \hat{r}$, the market is in equilibrium
- If $r < \hat{r}$, investors require a lower return than they expect the investment to generate; investors will buy more of the investment until $r = \hat{r}$
- If $r > \hat{r}$, investors require a higher return than they expect the investment to generate; investors stay away from the investment or will sell what they own until $r = \hat{r}$