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# RISK MANAGEMENT AND INVESTMENT MANAGEMENT

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## THE CAPITAL ASSET PRICING MODEL AND ITS APPLICATION TO PERFORMANCE MEASUREMENT

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### AIM 72.1: List the CAPM's underlying assumptions.

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The capital asset pricing model (CAPM) says that in equilibrium all investors hold a portfolio of risky assets that has the same weights as the market portfolio.

The CAPM's assumptions:

- Investors seek to maximize the expected utility of their wealth at the end of the period, and all investors have the same investment horizon.
  - Investors are risk averse.
  - Investors only consider the mean and standard deviation of returns (which implicitly assumes the asset returns are normally distributed).
  - Investors can borrow and lend at the same risk-free rate.
  - Investors have the same expectations concerning returns.
  - There are neither taxes nor transactions costs, and assets are infinitely divisible. This is often referred to as "perfect markets."
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### AIM 72.2: Explain the price of risk, the quantity of risk (beta), and equilibrium theory.

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The **risk premium** of an asset is  $[E(R_M) - R_F]\beta$ , the **quantity of risk** is  $\beta$ , and the **price of risk** is the market risk premium  $[E(R_M) - R_F]$ .

Equilibrium theory says that given all investors have the same expectations, which implies that the market efficiently reflects all available information, the best portfolio to hold is the market portfolio. In equilibrium, there is no reward for asset-specific risk because it can be diversified away, and that is why the market risk premium and beta determine the expected return.

### AIM 72.3: Define market efficiency, identify the three forms of market efficiency, and discuss the link between efficiency and the CAPM.

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The CAPM depends on the assumption of market efficiency, which states that market prices reflect available information.

- **Weak efficiency** means that the information in past price patterns is incorporated into the current prices.
- **Semistrong efficiency** means that all public information, including that in past price patterns, is incorporated into the current prices.
- **Strong efficiency** means that all information, including private and public, is incorporated into the current prices.

The most popular belief is that markets are close to being semistrong efficient. The CAPM assumes that they are strong efficient, however, because it is assumed that all investors have the same expectations. The possibility of different levels of information means that the CAPM and its proposed results may not be valid.

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### AIM 72.4: Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.

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$$\text{Treynor measure of a portfolio} = \left[ \frac{E(R_P) - R_F}{\beta_P} \right]$$

$$\text{Sharpe measure of a portfolio} = \left[ \frac{E(R_P) - R_F}{\sigma_P} \right]$$

$$\text{Jensen measure of a portfolio} = \alpha_P = E(R_P) - R_F - [E(R_M) - R_F]\beta_P$$

In all three cases, for a given portfolio, the higher, the better. The two that are most similar are the Treynor and Sharpe measures. They both normalize the risk premium by dividing by a measure of risk. Investors can apply the Sharpe measure to all portfolios because it uses total risk, and it is more widely used than the other two measures. The Treynor measure is more appropriate for comparing well-diversified portfolios. Jensen's alpha is the most appropriate for comparing portfolios that have the same beta.

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### AIM 72.5: Discuss extensions to Jensen's alpha.

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Since Jensen's measure is simply a raw return in excess of some reference (i.e., that implied by the CAPM in the case of the standard Jensen's measure) we can simply replace that reference with a value that we feel is more appropriate. One reference would be the required return based on the CML.

**AIM 72.6: Compute and interpret tracking error, the information ratio, and the Sortino ratio.**

**Tracking error** is the term used to describe the standard deviation of the difference between the portfolio return and the benchmark return. This source of variability is another source of risk to use in assessing the manager's success.

The **information ratio** is essentially the alpha of the managed portfolio relative to its benchmark divided by the tracking error. If we let  $R_B$  denote the return of the benchmark we can write:

$$e_p = R_p - R_B$$

$$\text{tracking error} = \sigma_{e_p}$$

$$\text{information ratio} = \left[ \frac{E(R_p) - E(R_B)}{\sigma_{e_p}} \right] = \frac{\alpha_p}{\sigma_{e_p}}$$

The **Sortino ratio** is similar to the Sharpe ratio except for two changes. We replace the risk-free rate with a minimum acceptable return, denoted  $R_{\min}$ , and we replace the standard deviation with a type of semi-variance. A semi-variance measures the variability of only those returns that fall below the minimum acceptable return.

$$\text{Sortino ratio} = \frac{E(R_p) - R_{\min}}{\sqrt{\text{MSD}_{\min}}}$$

The Sortino ratio can be interpreted as a variation of the Sharpe ratio that is more appropriate for a case where returns are not symmetric.

### PERFORMANCE ANALYSIS

**AIM 73.1: List and explain the shortcomings of cross-sectional analysis of performance data.**

Cross-sectional performance analysis classifies performance over a period of time. It offers an easy and quick way to rank performance data; however, it is subject to numerous shortcomings.

1. *There is no adjustment for non-survivorship.*
2. *There is no adjustment for size.*
3. *There is no adjustment for risk.* A high performing fund manager may be taking less risk while a low performing fund manager may be taking high risk.