Trading, Performance Evaluation, and Manager Selection

CFA三级培训项目

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1. Algorithmic Trading

Algorithmic Trading

- **Algorithmic trading** is the computerized execution of the investment decision following a specified set of trading instructions.
- Trading algorithms are primarily used for **two purposes**—trade execution and profit generation.
  - **Execution algorithms**. An execution algorithm is tasked with transacting an investment decision made by the portfolio manager.
    - ✓ The manager determines what to buy or sell on the basis of his investment style and investment objective and then enters the order into the algorithm.
  - **Profit-seeking algorithms**. A profit-seeking algorithm will determine what to buy and sell and then implement those decisions in the market as efficiently as possible.
    - ✓ Profit-seeking algorithms are used by electronic market makers, quantitative funds, and high-frequency traders.

2. Implementation Shortfall

Implementation Shortfall

- The **implementation shortfall** measure is the standard for measuring the **total cost** of the trade. IS compares a portfolio's **actual return** with its **paper return** (where transactions are based on decision price).
  - The paper return shows the **hypothetical return** that the fund would have received if the manager were able to transact **all shares at the desired decision price** and **without any associated costs or fees** (with no friction).
  - **IS = Paper return – Actual return**

Implementation Shortfall

- **Paper return** $= (P_n - P_d)(S) = (S)(P_n) - (S)(P_d)$
  - S represents the total order shares
    - ✓ S > 0 indicates a buy order
    - ✓ S < 0 indicates a sell order
  - P_d represents the price at the time of the investment decision
  - P_n represents the current price
- **Actual return** $= (\sum s_j)(P_n) - \sum s_j p_j - Fees$
  - s_j and p_j represent the number of shares executed and the transaction price of the jth trade
  - $\sum s_j$ represents the total number of shares of the order that were executed in the market
  - "Fees" includes all costs paid by the fund to complete the order

Implementation Shortfall

- **IS** = $\underbrace{\sum s_j \, p_j - \sum s_j \, P_d}_{\text{Execution cost}} + \underbrace{(S - \sum s_j)(P_n - P_d)}_{\text{Opportunity cost}} + Fees$

- **Expanded IS** =

$$\underbrace{\underbrace{(\sum s_j)P_0 - (\sum s_j)\,P_d}_{\text{Delay cost}} + \underbrace{\sum s_j \, p_j - (\sum s_j)P_0}_{\text{Trading cost}}}_{\text{Execution cost}} + \underbrace{(S - \sum s_j)(P_n - P_d)}_{\text{Opportunity cost}} + Fees$$

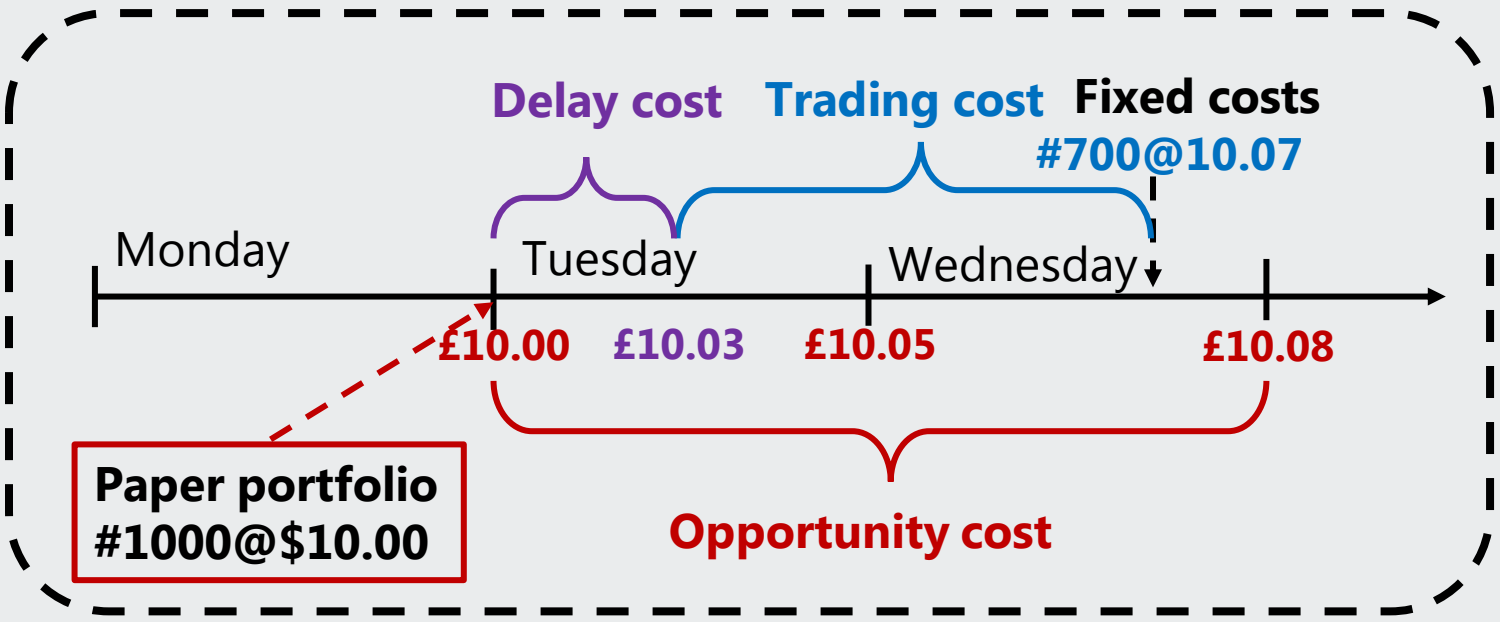
P_0 represents the arrival price

Example

- On Monday, the shares of Impulse Robotics close at £10.00 per share.
- On Tuesday, before trading begins, a portfolio manager decides to buy Impulse Robotics. An order goes to the trading desk to buy 1,000 shares of Impulse Robotics at £9.98 per share or better, good for one day. The **benchmark price** is Monday's close at £10.00 per share. No part of the limit order is filled on Tuesday, and the order expires. The closing price on Tuesday rises to £10.05.
  - Additional: The buy-side trading desk releases the order to the market 30 minutes after receiving it, when the price is £10.03.
- On Wednesday, the trading desk again tries to buy Impulse Robotics by entering a new limit order to buy 1,000 shares at £10.07 per share or better, good for one day. During the day, 700 shares are bought at £10.07 per share. Commissions and fees for this trade are £14. Shares for Impulse Robotics close at £10.08 per share on Wednesday.
- No further attempt to buy Impulse Robotics is made, and the remaining 300 shares of the 1,000 shares the portfolio manager initially specified are canceled.

Example

- **Solution:**
- We can break this IS down further, as follows:



- **Delay cost**, which reflects the adverse price movement associated with not submitting the order to the market in a timely manner and is based on the amount of shares executed in the order: (700 × £10.03) – (700 × £10.00) = £7,021 – £7,000 = £21.

Example

- **Trading cost**, which reflects the execution price paid on shares executed: (700 × £10.07) – (700 × £10.03) = £7,049 – £7,021 = £28.
- **Opportunity cost**, which is based on the amount of shares left unexecuted and reflects the cost associated with not being able to execute all shares at the decision price: (1,000 shares – 700 shares) × (£10.08 – £10.00) = £24.
- **Fixed fees**, which are equal to total explicit fees paid: £14.
- Therefore, expanded implementation shortfall (£) = £21 + £28 + £24 + £14 = £87.
- The expanded IS provides further insight into the causes of trade costs. The delay cost is £21, which accounts for 24.1% (£21/£87) of the total IS cost, whereas the opportunity cost of £24 accounts for 27.6% (£24/£87) of the total IS cost. Quite often, delay cost and opportunity cost account for the greatest quantity of cost during implementation. These costs can often be eliminated with proper transaction cost management techniques.

3. Evaluating Trade Execution

Evaluating Trade Execution

- **Cost in total dollars ($)**

$$Cost\ (\$) = Side \times (\overline{P} - P^*) \times Shares$$

- **Cost in dollars per share ($/share)**

$$Cost\ (\$/share) = Side \times (\overline{P} - P^*)$$

- **Cost in basis points (bps)**

$$Cost\ (bps) = Side \times \frac{(\overline{P} - P^*)}{P^*} \times 10{,}000\ bps$$

  - Side: +1 Buy order ; -1 Sell order
  - $\overline{P}$ = Average execution price of order
  - P^* = Reference price
  - Shares = Shares executed

Evaluating Trade Execution

VWAP

- Portfolio managers use the VWAP benchmark as a measure of whether they received **fair** and **reasonable prices** over the trading period.
- Since the VWAP comprises all market activity over the day, all buying and selling pressure of all other market participants, and market noise, it provides managers with a reasonable indication of the **fair cost** for market participants over the day.

$$\text{VWAP cost (bps)} = Side \times \frac{(\overline{P} - VWAP)}{VWAP} \times 10^4 \ bps$$

Evaluating Trade Execution

Market-Adjusted Cost

- The market-adjusted cost is a performance metric used by managers and traders to help **separate** the **trading cost** due to trading the order from the **general market movement** in the security price.
- The market-adjusted cost is calculated by subtracting the market cost due to market movement adjusted for order side from the total arrival cost of the trade.

Market-adjusted cost (bps)=Arrival cost (bps) – β × Index cost (bps)

Where,

β represents the stock's beta to the underlying index

$$\text{Index cost (bps)} = Side \times \frac{(Index\ VWAP - Index\ arrival\ price)}{Index\ arrival\ price} \times 10^4\ bps$$

Evaluating Trade Execution

- **Added Value**
  - Another methodology used by investors to evaluate trading performance is to compare the **arrival cost** of the order with the **estimated pre-trade cost**.
  - This metric helps fund managers understand the **value added** by their broker and/or execution algorithms during the execution of the order.
  - **Added value (bps) = Arrival cost (bps) – Est. pre-trade cost (bps)**

4. Performance Appraisal

Performance Appraisal

- The **Sharpe ratio** measures the additional return for bearing risk above the risk-free rate, stated per unit of return volatility. In performance appraisal, this additional return is often referred to as **excess return**.

$$S_A = \frac{\bar{R}_A - \bar{r}_f}{\hat{\sigma}_A}$$

  - One **weakness** of the Sharpe ratio is that the use of standard deviation as a measure of risk assumes investors are indifferent between upside and downside volatility.
- The **Treynor ratio** measures the **excess return per unit of systematic risk**.

$$T_A = \frac{\bar{R}_A - \bar{r}_f}{\hat{\beta}_A}$$

  - Because of its reliance on beta (only considers **systematic risk**), the Treynor ratio shows how a fund has performed in relation not to its own volatility but to the volatility it would bring to a well-diversified portfolio.

Performance Appraisal

- The **information ratio (IR)** is a simple measure that allows the evaluator to assess performance relative to the benchmark, scaled by risk.

$$IR = \frac{E(r_P) - E(r_B)}{\sigma(r_P - r_B)}$$

  - The implicit assumption is that the chosen benchmark is well matched to the risk of the investment strategy.
    - ✓ The information ratio (IR) is used to measure a portfolio's performance against the benchmark but accounting for differences in risk.

Performance Appraisal

- The **appraisal ratio (AR)** is a returns-based measure. It is the annualized alpha (**Jensen's alpha**) divided by the annualized residual risk (**unsystematic risk**). The appraisal ratio measures the reward of active management relative to the risk of active management.

$$\mathrm{AR} = \frac{\alpha}{\sigma_\varepsilon}$$

Where,

σ_ε equals the standard deviation of ε_t.

- The alpha and the residual risk are computed from a **factor regression**.
- The appraisal ratio is also referred to as the **Treynor–Black ratio** or the **Treynor–Black appraisal ratio**.

Performance Appraisal

- The **Sortino ratio** is a modification of the Sharpe ratio that penalizes only those returns that are lower than a user-specified return.

$$\mathrm{SR_D} = \frac{\mathrm{E}(r_p) - r_T}{\sigma_D} \qquad \widehat{\mathrm{SR}}_\mathrm{D} = \frac{\bar{r}_p - \bar{r}_T}{\hat{\sigma}_D} \qquad \sigma_\mathrm{D} = \left[\frac{\sum_{\mathrm{t}=1}^{\mathrm{N}} \min(r_t - r_T, 0)^2}{N}\right]^{1/2}$$

where r_T is the minimum acceptable return (MAR), which is sometimes referred to as a target rate of return.

- The Sortino ratio uses a measure of **downside risk** known as target semi-standard deviation or target semideviation.
- The Sortino ratio penalizes managers only for **"harmful" volatility** and is a measure of **return per unit of downside risk**.
- Sortino ratio offers the ability to accurately assess performance when return distributions are **not symmetrical**.
- Essentially, the Sortino ratio **penalizes** a manager when portfolio return is lower than the MAR; it is most relevant when one of the investor's primary objectives is capital preservation.
- **Cross-sectional comparisons** of Sortino ratios are difficult to make applicable to every investor, because the MAR is investor-specific.

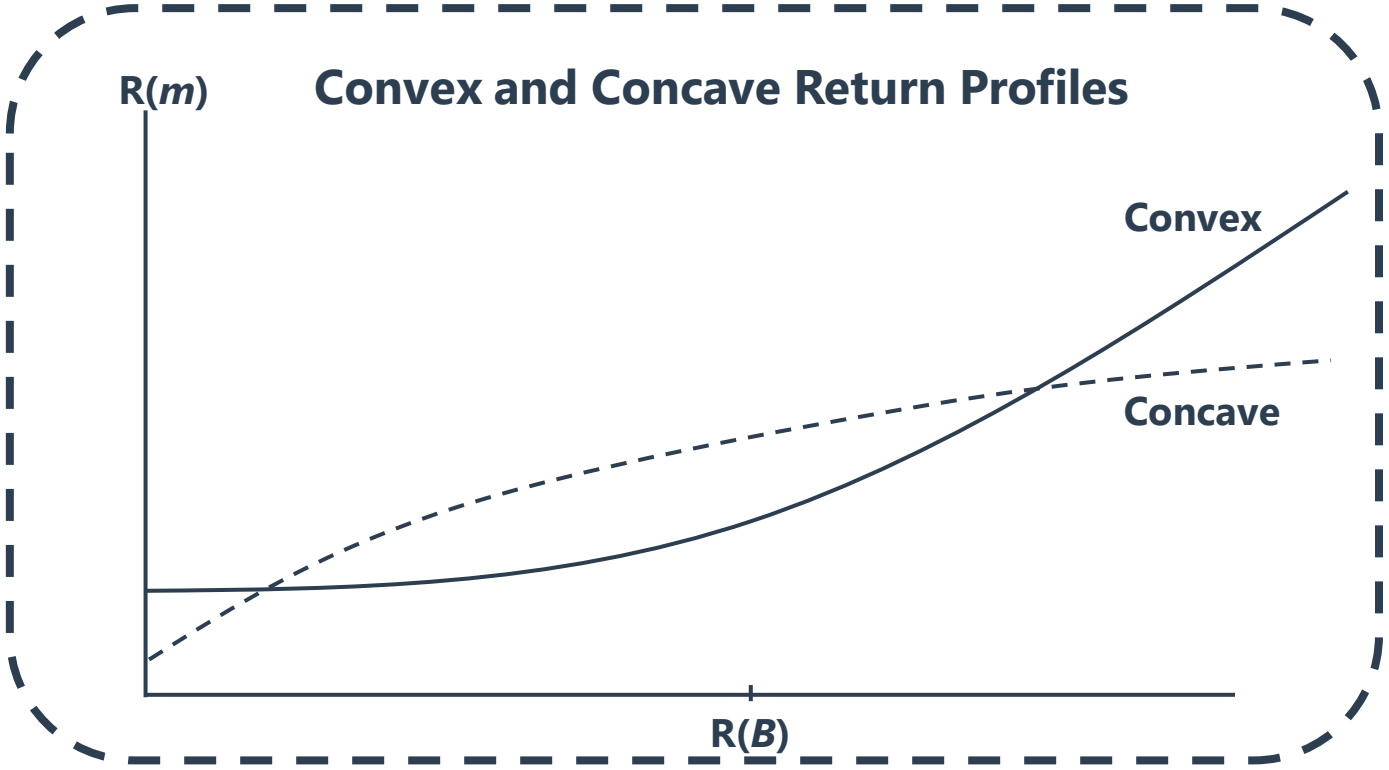
Performance Appraisal

- **Capture ratios**
  - The upside/downside capture, or simply the **capture ratio (CR)**,

    CR(mB,t) = UC(m,B,t)/DC(m,B,t)
  - The **upside capture ratio** UC(m,B,t) = R(m,t)/R(B,t) if R(B,t) ≥ 0
    - ✓ UC>100%, outperform the market.
  - The **downside capture ratio**(DC), DC(m,B,t) = R(m,t)/R(B,t) if R(B,t) < 0
    - ✓ DC<100%, outperform the market.

  where
    - ✓ R(m,t) = return of manager *m* for time *t*
    - ✓ R(B,t) = return of benchmark *B* for time *t*
  - It **measures the asymmetry of return** (e.g. convexity, gamma).
    - ✓ A **capture ratio greater than 1** indicates **positive asymmetry**, or a **convex** return profile;
    - ✓ A **capture ratio less than 1** indicates **negative asymmetry**, or a **concave** return profile.

Performance Appraisal



Performance Appraisal

- **Drawdown** is measured as the cumulative peak-to-trough loss during a continuous period.
- **Drawdown duration is** the total time from the start of the drawdown until the cumulative drawdown recovers to zero, which can be segmented into the drawdown phase (start to trough) and the recovery phase (trough-to-zero cumulative return).

$$Maximum\ DD(m,t) = \min\left(\frac{V(m,t) - V(m,t*)}{V(m,t*)}, 0\right)$$

where

V(m,t) = portfolio value of manager *m* at time *t*

V(m,t*) = peak portfolio value of manager *m*

$t > t^*$

5. Type I and Type II Errors in Manager Selection

Manager Selection Process

- **Hypothesis**
  - H_0: the manager adds no value.
  - H_a: the manager adds positive value.
- **Type I**: Hiring or retaining a manager who subsequently underperforms expectations. (worry more)
- **Type II**: Not hiring or firing a manager who subsequently outperforms, or performs in line with, expectations.

Type I and Type II Errors

		Realization	
		Below expectations (no skill)	At or above expectations (skill)
Decision	Hire/Retain	Type I	Correct
	Not Hire/Fire	Correct	Type II

Manager Selection Process

- The cost of errors is driven by the size, shape, mean, and dispersion of the return distributions of the skilled and unskilled managers within the universe.
  - The **smaller the difference** in sample size and distribution mean and the wider the dispersion of the distributions, the **smaller the expected cost** of the Type I or Type II error.
  - The extent to which markets are mean-reverting also has a bearing on the cost of Type I and Type II errors.
    - ✓ If performance is mean reverting, firing a poor performer (or hiring a strong performer) only to see a reversion in performance results is a Type I error.
    - ✓ A Type II error would be not trimming strong performers and avoiding hiring managers with weaker short-term track records, which can be costly.

It's not the end but just beginning.

By training your thoughts to concentrate on the bright side of things, you are more likely to have the incentive to follow through on your goals. You are less likely to be held back by negative ideas that might limit your performance.

试着训练自己的思想朝好的一面看，这样你就会汲取实现目标的动力，而不会因为消极沉沦停滞不前。

问题反馈

- 如果您认为金程**课程讲义/题库/视频**或其他资料中**存在错误，欢迎您告诉我们**，所有提交的内容我们会在最快时间内核查并给与答复。
- **如何告诉我们？**
  - 将您发现的问题通过电子邮件告知我们，具体的内容包含：
    - ✓ 您的姓名或网校账号
    - ✓ 所在班级（eg.202006CFA三级长线无忧班）
    - ✓ 问题所在科目（若未知科目，请提供章节、知识点）和页码
    - ✓ 您对问题的详细描述和您的见解
  - 请发送电子邮件至：academic.support@gfedu.net
- **非常感谢您对金程教育的支持，您的每一次反馈都是我们成长的动力**。后续我们也将开通其他问题反馈渠道（如微信等）。