

Specific applications of multifactor model	1. Passive management : construct a <u>tracking portfolio</u> → match same set of factor with a predetermined benchmark 2. Active management : make a specific bet on desired factors while hedging on other factors - Factor portfolio : sensitivity of a specific risk factor = 1 ; sensitivities of remaining factors = 0 3. Ruled-based or algorithmic active management (alternative indices) : use rules to change factor exposures when constructing portfolios → introduce biases in the portfolio relative to value-weighted benchmark indices
Carhart model	$E(R) = R_f + \beta_1 \times RMRF + \beta_2 \times SMB + \beta_3 \times HML + \beta_4 \times WML$ RMRF = Return on value weighted equity index - Risk-free rate SMB = Avg. return on small cap stocks - Avg. return on large cap stocks HML = Avg. return on high book-to-market stocks - Avg. return on low book-to-market stocks WML = Avg. return on past winners - Avg. return on past losers
Potential benefits of multifactor model	- Enable investors to zero on risks that they have comparative advantage in bearing , and avoid risk that they are incapable of absorbing - If the actual asset returns are better described by multifactor models → help investors to select more efficient portfolios

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Concepts	Description
Algorithmic Trading and High-Frequency Trading	
Algorithmic trading	Algorithmic trading : trading strategy automated through the use of computer - thousand times faster than human trader - make same kinds of decisions that human trader makes
Primary categories of algorithmic trading	1. Execution algorithms : execute large orders with minimal price impact and without notice from other market participants (by breaking large order into smaller pieces) 2. High-frequency trading algorithms : analyse real-time market data to search for patterns that can be profitably traded - Identify and execute trade in milliseconds - Securities are held for short time (less than a second to less than a day)
Types of execution algorithms	1. Volume-weighted average price (VWAP) - Algorithms : - Consider a security's historical trading patterns over a typical day - Split large order into pieces sized proportionally to this historical distribution → larger pieces are executed during times of the day when there are more trading 2. Implementation Shortfall Algorithms : - Adjust the trade schedule in reaction to market condition → balance between minimising potential market drift that may happen if an order takes long time to execute, and minimizing the negative price impact that will result when an order is executed too quickly. 3. Market Participation Algorithms : - Cut large orders into pieces that vary proportionally with actual trading volume
Types of High-frequency trading algorithms	1. Statistical arbitrage : identify securities that historically move together but have diverged recently → buy 1 security + sell the other to realise profit when they eventually converge a. Pairs trading : price of 2 securities diverge from their historically correlated movements → short outperforming security + long underperforming security → earn profit when the relative price of these securities converge b. Index arbitrage : seek temporary price performance differences between securities and their sector c. Basket trading : similar to pairs trading, but with groups of securities d. Spread trading : take long and short position in 2 closely-related futures contracts e.g.: - Intra-market spread : long 1 contract month + short another contract month for the same futures (long nearer futures + short later futures) - Inter-market spread : Long futures in 1 market + Short same futures on another market - Inter-exchange spread : Long futures in 1 exchange + Short same futures on another exchange - Multilegged inter-exchange spreads : + Crack spread : crude oil vs petroleum products + Spark spread : electricity from gas-fired power plant vs. fuel prices + Crush spread : soybean futures vs. soybean oil futures vs. soybean meal futures e. Mean reversion : when price of a security drift away from its recently historical mean → price will likely to move toward that mean f. Delta neutral strategies : combine securities (e.g.: stocks+ options) → total delta = 0 → small profit regardless whether market goes up or down 2. Liquidity aggregation and smart order routing : - <u>Market fragmentation</u> → different price and liquidity of an individual security across market - <u>Liquidity aggregation</u> → gain full picture of liquidity over multiple trading venues → direct orders to the market that has the best price and liquidity 3. Real-time pricing of securities : price securities in real time by using live price and liquidity info from the market 4. Trading on the news : trade, near-instantaneously and without human intervention, based on reaction to breaking news 5. Genetic tuning : self-evolving system that test performance of different strategies using live market data → deploy profitable strategies only
Market fragmentation / Liquidity aggregator / Smart ordering routing	Market fragmentation : same security is traded in multiple financial markets Disadvantages of market fragmentation : - <u>Inter-market difference in price and liquidity</u> arises - Liquidity of a security in any market may represent only a fraction of its total liquidity across all market Liquidity aggregators : tool that adds up the liquidity available for an individual instrument across multiple markets Smart orderin routing : direct orders to market with best combination of liquidity and price For this algorithmic method to be effective, liquidity information needs to be <u>timely updated</u> + <u>low latency</u> <u>Latency</u> : time lag between market data being released and corresponding trade being placed
Use of technology in risk management	1. Real-time pre-trade risk firewall - Continuously calculate risk exposures on trading positions being taken → block trades that would exceed the risk limits - Block erroneous trades (e.g.: fat finger trades - trade @ irrational price / quantity) - Protect brokers that offers clients "sponsored access" to broker's exchange membership 2. Back testing and market simulation - Test algorithms for performance under various offline scenarios
Use of technology in regulatory oversight	Technology allow regulators to detect and respond to market issues more quickly and effectively Real-time market monitoring and surveillance : monitor markets continuously to identify abnormal movements (unusual and dramatic changes in volume or price). E.g.: 1. Insider trading 2. Front running : trader has advance knowledge of a large buy order → trades slightly earlier than that order to profit from the price movement created by that large transaction 3. Painting the tape : trader who wants to sell a large quantity of a security first buys small quantities of same security in order to drive up the market price 4. Fictitious orders : submit fictitious orders to move market price / force other algorithms to make unwise trades - <u>Quote stuffing</u> : submit a large number of orders into the market and immediately cancels them → distract other market participants → give the originating algorithm opportunity to trade ahead of others + take advantage of mispricing from the false order - <u>Layering</u> : algorithm places genuine orders on one side of the market and layers of fake orders on the other side of the market → induce market participants to trade with the genuine order - <u>Spoofing</u> : place orders between the bid and ask price and cancel these trades before they execute → create fake pessimism / optimism about the security 5. Wash trading : buy + sell the same security repeatedly → create false trading volume → increase buyer interest in a security that trader wishes to sell 6. Trader collusion : multiple traders work together to sway markets in a favorable direction to them