

Quantitative Investment Handbook

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Contents

I	Financial Market and Investment Tools	1
1	Economics and Econometrics	2
1.1	Macroeconomics	2
2	Basic Financial Concepts	4
2.1	Asset Management	4
2.2	Accounting, Corporate Finance and Fundamental Analysis . .	4
3	Major Asset Classes and Asset Valuation Theories	8
3.1	Money Market	8
3.2	FX	9
3.3	Equity	9
3.4	Currency/Foreign Exchange	10
3.5	Fixed-Income	10
3.6	Commodities	11

<i>CONTENTS</i>	3
II Quantitative Portfolio Management	12
4 Portfolio Optimization Study	13
4.1 Estimating Return and Co-variance Matrix	15
4.2 Transaction Cost	15
4.3 Tax	15
4.4 Dynamic Portfolio Choice	15
4.5 Covariance Matrix	15
4.6 Easy	15
4.7 Medium	16
4.8 Hard	16
5 Statistical Arbitrage	17
5.1 mean-reversion	17
6 Factor Investing	18
6.1 Smart beta and Smart Alpha	18
6.2 Key things to Notice in Index Making	18
6.3 factor analysis and risk premia	18
6.4 Market Anomalies	19
6.4.1 Behavioral Finance	19
7 Single (Asset Class) Trading Strategies	21
7.1 Equity	21
7.2 Volatility and Dispersion Trades	21

7.2.1	Volatility Models and Time-Series Models	21
7.3	fixed income + macro	21
7.4	fixed income derivatives	21
7.5	credit	22
7.6	commodities	22
8	Strategies Implementation/Platform Building	23
8.1	Trading System	24
8.2	Strategy Development Pipeline(Single/Linear Strategy) . . .	24
8.2.1	Basic Architecture/System	24
8.2.2	Data	27
8.2.3	Backtester/Simulator	27
8.2.4	Trade Record and Money Management	28
8.2.5	Analytics	28
8.2.6	Research Team	28
8.3	Backtesting	34
9	Portfolio Risk Management	35
9.1	Derivatives and Hedging Strategies	35
9.2	FX risk management	36
10	Monitoring and Performance Evaluation	37
10.1	Monitoring	37
10.2	Performance Evaluation	37
10.2.1	Equity	37

<i>CONTENTS</i>	5
-----------------	---

10.2.2 Fixed Income	37
-------------------------------	----

11 Alternative Data and General Machine Learning	38
---	-----------

Part I

Financial Market and Investment Tools

Chapter 1

Economics and Econometrics

1.1 Macroeconomics

GDP, Inflation and Unemployment:

- $GDP = C + I + G + X$
- CPI, RPI, PPI, Core CPI, Nonfarm Payroll, HICP (Europe)
- Philips Curve(Inflation and Unemployment)
- Unemployment Rate(labor force), Participation Rate(total population), Quit Rate
- Unemployment: Frictional, Cyclical, Structural, Seasonal, Voluntary

Economic Indicators:

Leading Indicators:

- PMI, Tanken Survey(Japan)
- Capacity Utilisation
- Retail Sales
- Consumer Sentiment/Confidence

Market Data Release Time Schedule:

Time	Market Data
Week 1	Employment Situation (First Friday), ISM
Week 2	Retail Sales, Consumer Sentiment
Week 3	CPI, IP
Week 4	Durable Goods, GDP, Consumer Sentiment(UoM final & Conference Board)

- PMI
- Capacity Utilisation
- Retail Sales
- Consumer Sentiment/Confidence

Fiscal Policy and Monetary Policy:

- General Economic Goals: Full Employment, Economic Growth, Low Inflation
- Fiscal Policy: Government Spending and Tax Policy
- Monetary Policy: Open Market Operations, Discount Rate, Reserve Requirement, Federal Fund Rate(Upper Limit for Repo Rate) (In other countries: Overnight discount rate, Refi Rate, Deposit Rate, Main Lending Rate)
- Interaction: Crowding Out: Higher Interest Rates may cause investment and consumption
- Central bank, Taylor rule

Keynesian Theory

stagflation and non zero inflation

Chapter 2

Basic Financial Concepts

This chapter summarizes some basic financial concepts you should know about.

2.1 Asset Management

Asset Owners(Real Money): From conservative to active: Banks, Insurance Company, Defined Contribution Plan, Pension, Endowment/Foundations

Hedge Funds(Fast Money)

Investment Purpose Statement(IPS): Consider Return, Risk, Time Horizon, Tax, Liquidity, Legal and Unique.

2.2 Accounting, Corporate Finance and Fundamental Analysis

Accounting:

- Balance Sheet, Income Statement, Cash flow Statement Basics
- $EBIT = \text{operating profit} + \text{non recurring expense} - \text{non-recurring}$

2.2. ACCOUNTING, CORPORATE FINANCE AND FUNDAMENTAL ANALYSIS 5

income, EBITDA, Operating profit, normalized net income = NI + non recurring items

- Gross Profit, Operating profit, profit before tax, net income
- Gross Margin, EBIT Margin, EBIT Margin, Net Operating Margin, Net Profit Margin
- Cash flow from Operations = NI + DA +/- change in inventory/accounts payable, receivable, operating items
- CF from investing = Capital Expenditure -/+ Disposal/Purchase of Assets
- CF from financing = -Dividend - Share buybacks + issuance of stock/bond
- Equity: Preferred shares, authorized shares (maximum shares the board can issue), Treasury stock, buy back book value, Free float
Market capitalization = share price * (shares outstanding - shares not traded), Small free float: little share holder control, volatile share price, high premium in M&A

Capital Structure:

- Operating items vs financing items (cash, financial asset/liability, equity)
- Working Capital = Current Assets - Current Liabilities, Operating Working Capital = Operating Assets - Operating Liabilities(exclude cash)
- Inventory COGS LIFO FIFO inventory turnover
- Payable days, receivable days, working capital cycle (payable days - inventory days + receivable days)
- Leverage ratios: Debt/Equity, Total Debt/EBITDA, EBITDA/inst expense

Credit Scoring/Credit Analysis

- Credit Risk = Business Risk(Country, Economic Cycle, Industry Cycle, Currencies, Commodities, trends) + Financial Risk(Cash Risk)
- Creditor Cashflow Statement Net Income + D/A/non-cash items = FFO(Funds from Operations), FFO +/- Decrease/Increase in OWC = Operating Cash Flow, Operating Cash Flow - Capex = Free Operating Cash Flow(FOCF)
FOCF + Dividends = Discretionary Cash Flow, DCF +/- Acquisition, Asset Disposals, Net other sources/uses of cash = pre-financing cashflow +/- Increase(Decrease) in Debt, +/- Net Sale/Repurchase of Shares = Inc/(Dec) in Cash/Securities
- Profitability & Efficiency Ratios: EBIT/EBITDA margin, Return on Assets, Return on Invested Capital
- Coverage Ratios: EBITDA/interest(net interest), EBITDA/(interest + Principal Amortization), EBIT/interest or net interest
- Leverage Ratios: Debt/Equity, Debt/Capital, Debt/EBITDA
- Cash flow adequacy Ratios: FFO/Debt, FOCF/Debt, Free Cash flow/Debt, Retained Cash Flow/Debt
- Liquidity Ratios: maturing debt principal this year/FFO or discretionary cash flow, Quick Ratio = (Cash + Marketable Securities + Committed un-used bank credit lines)/maturing debt principal this year.

Tax: Effective Tax Rate, Loss Harvesting and Tax-Aware investment

Valutaion fundamentals:

- Intrinsic Value and two approaches - absolute valuation and relative valuation
- Enterprise Value = Debt + Equity Value - Cash/Cash Equivalent
- Equity Value (affected by performance (operating), investing and financing (leverage)) = Price x Shares Outstanding
- Asset = Enterprise Value + Non-core assets(not valued by Multiples/DCF models, like cash)

2.2. ACCOUNTING, CORPORATE FINANCE AND FUNDAMENTAL ANALYSIS7

- Free Cash Flow Calculation: $EBIT - \text{tax on EBIT (LT tax rate} \times EBIT) = NOPAT$ (net operating profit after tax)/EBIAT, Free Cash flow = $NOPAT + D\&A - \text{capex} - \text{increase in OWC} + \text{decrease in OWC} - \text{Increase in Other net operating assets} + \text{Decrease in other net operating assets}$
- FCFF, FCFE
- Discount Rate- Weighted Average Cost of Capital (WACC) - CAPM / required rate of return, $WACC = D/(D+E) \text{ cost of net debt} \times (1-t) + (rf + (rm - rf) \times beta) \times E/(D + E)$, D is net debt
- Gordon Growth Model

Chapter 3

Major Asset Classes and Asset Valuation Theories

3.1 Money Market

- Overnight (O/N) reference ratesL SONIA(Sterling Overnight Index Average), EONIA, SOFR - All has different day count convention
- LIBOR Rate, STIR Futures (Cash Settlement by 100 - expected interest) , IMM Dates(Exchange for interest rate and currency futures)
- T-bill(1,3,6,12 Month) , T-note, T-bond
- Commercial Paper(Issued by best quality companies)
- Day Count Conventions
- Repo Market: Repo(seller, needs cash), Reverse Repo(buyer, owns collateral for a while)
- Fed Funds Rate:
 - The Upper Bound: Interest on Excess Reserves: interest rate paid by the Fed on Excess reserves held by banks at the Fed. (many money market participants are not reserve account holders so they do not have access to the IOER).

- Lower Bound: Overnight RRP: Non-reserve account holder can earn interest by entering into an overnight reserve repo(overnight RRP)- offer each day.

3.2 FX

Basic Concepts:

- FX Market is Extremely liquid (smaller bid ask spread on equity)
- Market Size High to Low: USD, EUR, Cheap Currencies: JPY(safe currency), CHF, GBP, Rich(high rate) currencies: ZAR, MXN, AUD
- Uncovered Interest Rate Parity and Covered IRP
- Interest Rate Forward/Futures, Non-deliverable forwards(NDF)
- FX Drivers: Interest rate differential, inflation rate differential, Global M&A/Capital Flows, Technical Drivers(Indicators), Central Bank Policies, Risk Appetite
- Purchasing Power Parity

3.3 Equity

Sell Side Services

- Traditionally, Sales and Trading Service build around research (content stream)
- New Model -automation: Algo-trading, Dark pools, MiFID

3.4 Currency/Foreign Exchange

3.5 Fixed-Income

Basic Concepts:

- Day Count Convention, Dirty Price
- Macaulay Duration, Modified Duration, DV01, Dollar Duration, Effective Duration
- Maturity Effect, Coupon Effect, Yield Effect, Coupon Frequency Effect on Duration
- Term Structure of Yield Curve, Expectation Theory, Liquidity Preference Hypothesis, Segmented Markets/Preferred Habitat Theory. Bond Markets: \downarrow 1 y (money market) 1-3, 3-10 (bellwehther of market movements, the major contributor for beta in the fixed-income portfolio) 10(long end, relatively illiquid and sensitive)
- long end risks: liquidity, credit(sovereign credit), inflation, growth
- Carry and Roll Down(no yield curve shift)
- yield curve trading/fly trading, steepner, flatener, positive/negative butterfly, Barbell and Bullet
- Inflation Linked bonds(Linkers) UK Index-Linked Gilts, French OATi, US TIPS, JGBi. Breakeven Inflation: The difference in linker yields and nominal bond yields (linker coupon is always lower under positive inflation)
- Treasury Strips, UK Gilt Strips

Calculations

- Spot yield, par yield, forward rate, Bootstrapping

3.6 Commodities

- Much more volatile than other major asset classes.(volatility from both supply/demand side)
- Low correlation with traditional asset classes
- Market drivers
 - Fear: Reduced risk appetite/ fight to real assets. Geopolitics shuts down supply chains
 - Currencies; Gold-USD, Oil-USD
 - OPEC, Freak weather, earthquake
- Commodity Currencies: IMF found 22 commodity currencies (CHF-copper, AUD-Iron Ore,uranium)
- Stocks-to-Use Ratio, Reverse-to-Production Ratio
- Oil: Brent
- Physical Trade vs Derivatives(liquidity and leverage, low cost, less exotic)
- BSCOM, GSCI
- Commodity Futures, Convenience Yield, Contango(normal), Backwardation(Reversed)

Calculations

- $\text{Yield} = \text{Collateral Yield} + \text{Roll Yield/Cost} + \text{Spot Return}$
1. NPV and IRR
 2. Discounted Cash Flow Model
 - Free Cashflow
 - Required Rate of Return = Cost of Capital = Risk-adjusted discount rate : Usually from the CAPM
 3. Valuation using Multiples - P/E, P/B

Part II

Quantitative Portfolio Management

Chapter 4

Portfolio Optimization Study

1. Efficient Market Hypothesis (Weak, Semi-strong, Strong forms)
2. Markowitz Portfolio Optimization
 - Minimum Variance Portfolio / Tangency Portfolio
 - Jensen's alpha
3. Capital Asset Pricing Model(CAPM) Model

$$r = \beta(r_m - r_f) + r_f$$

$$\beta = \frac{cov(r, r_M)}{var(r_M)}$$

4. APT(Arbitrage-Free-Pricing) Model
5. No-arbitrage(weak, strong) and Law-of-one-price
6. Metrics
 - Sharpe Ratio
 - Jensen's alpha
 - Required Rate of Return = Cost of Capital = Risk-adjusted discount rate : Usually from the CAPM
7. Valuation using Multiples - P/E, P/B

Mainframe Portfolio Optimization Models Include

1. portfolio optimization - mean-variance short-comings and 1. Monte-Carlo simulation 2. reverse optimization and black-litterman (less sensitive to inputs) 3. resampled mean-variance optimization 4. add additional constraints (other than budget) - concentrated position 5. resampled mean-variance 6. non-normal optimization approach 7. allocating to less liquid asset class - (no investable benchmark) 8. risk budgeting vs factor based asset allocation (risk parity)

1. liability-relative 1. surplus optimization 2. hedging/risk-seeking portfolio 3. integrated asset-liability (non-linear correlation) 2. goal-based approach 1. describing goals, constructing sub-portfolios (selecting a module) One-fund theorem, two fund theorem

convex reformulation of maximizing Sharpe ratio problem (normalizing)

Multi-factor Risk Model

$$r = \mathbf{B}f + u \quad V = \mathbf{B}cov(f)\mathbf{B}^T + cov(u)$$

Mixed Integer Optimization

Stochastic and Dynamic Optimization

Issue

Active Holding Optimization optimize alpha holdings and tracking error

Improvements on MVO estimation error Shrinkage estimators Jason-Stein Estimator Black-Litterman Model Robust Estimators

optimization issue add constraints resampled efficiency use other diversification approach risk-parity maximize diversification

Mixed Integer Optimization

Heuristic forward backward selection clustering

Stochastic Optimization scenario optimization approach Var cVar

Kellys Criterion

Multi-period optimization room

Excel solver CVX matlab CVXOPT python optimization toolbox matlab
Gorubi

4.1 Estimating Return and Co-variance Matrix

4.2 Transaction Cost

4.3 Tax

4.4 Dynamic Portfolio Choice

4.5 Covariance Matrix

Table 5.4

Covariance estimators

Equally weighted	Exponentially weighted
$\sigma_{12}^2 = \frac{1}{T} \sum_{t=1}^T (r_{1t} - \bar{r}_1) (r_{1t} - \bar{r}_2)$	$\sigma_{12}^2 = (1-\lambda) \sum_{j=1}^T \lambda^{j-1} (r_{1t} - \bar{r}_1) (r_{1t} - \bar{r}_2)$

4.6 Easy

- Two coins, one is double tail, you see one
 - three pancakes: golden-golden, golden-brunt, brunt-brunt, see one golden, probability that the other side is golden two
 -
- Two coins - one toss n+1, one toss n, probability that n+1 gets more tail than n man?

4.7 Medium

1. Use coins to create probabilities : fair coin to create $1/3$ probability - toss twice, one result is retoss unfair coin to create $1/3$ probability - combine two toss as one

4.8 Hard

Chapter 5

Statistical Arbitrage

5.1 mean-reversion

intraday mean-reversion

Volatility Clustering and Leverage Effect

Chapter 6

Factor Investing

6.1 Smart beta and Smart Alpha

long-short STS strategy short extension(120/20) Strategy alpha and beta separation portable alpha

long short equities (factor) convertible arbitrage

6.2 Key things to Notice in Index Making

6.3 factor analysis and risk premia

value, momementum, quality, volatility, betaRM-RF The return spread between the capitalization weighted stock market and cash.

QQuality Minus Junk (quanlity)

SMB The return spread of small minus large stocks (i.e., the size effect).

HML The return spread of cheap minus expensive stocks (i.e., the value effect).

RMW The return spread of the most profitable firms minus the least

profitable.

CMA The return spread of firms that invest conservatively minus aggressively.

UMD (momentum/trend) UMD is long winners and short losers and also from Ken French's website)

Carry Vol Carry

Special: liquidity premia

Market Inefficiency Analysis: funding constraint of financial institutions, grand move of large funds constraints

6.4 Market Anomalies

6.4.1 Behavioral Finance

Behavioral Finance Theories Includes Prospect Theory(People suffice rather than optimize, the utility curve is concave at the gain part and convex at the loss part(loss aversion). Bounded Rationality and Behavioral Market Anomalies/bias

1. loss aversion(herding)
2. illusion of control(TAA)
3. Mental accounting(goal),
4. availability bias(familiarity, home-bias)
5. recency bias(tactical shifts)
6. framing(risk-return presented in a different way)

other: liquidity risk premia

1. Risk Management and Hedging

2. Leverage
3. Correlation
4. Strategy replacements, leverage rebalancing and rebalancing frequency, leverage reset

other: liquidity risk premia

1. Risk Management and Hedging
2. Leverage
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Chapter 7

Single (Asset Class) Trading Strategies

7.1 Equity

7.2 Volatility and Dispersion Trades

7.2.1 Volatility Models and Time-Series Models

7.3 fixed income + macro

7.4 fixed income derivatives

MBS Convexity Trade

1. real estate-direct vs indirect environment
2. benchmarks of real estate
3. other alternative, commodity to hedge

7.5 credit

7.6 commodities

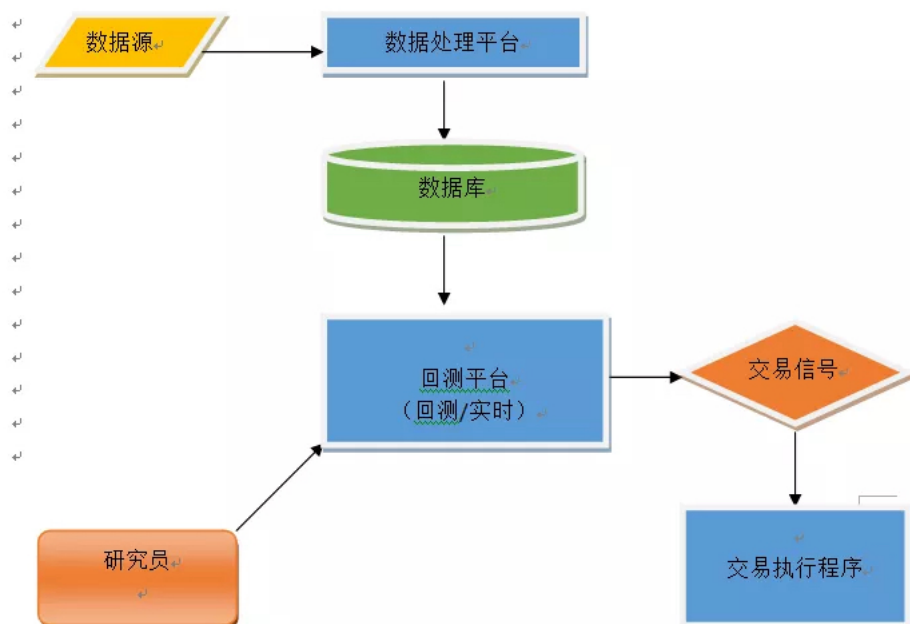
Chapter 8

Strategies Implementation/Platform Building

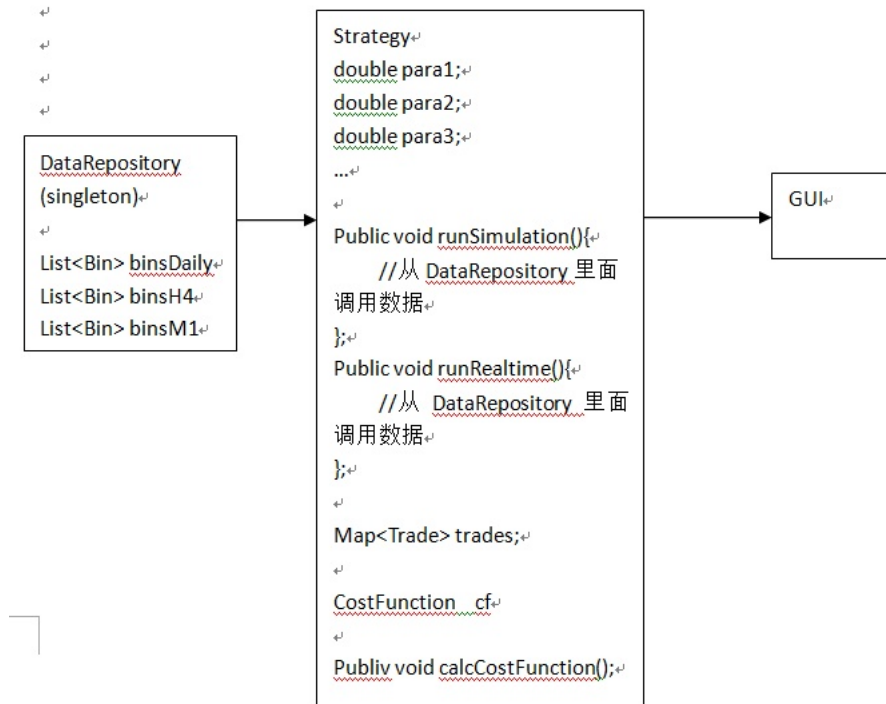
8.1 Trading System

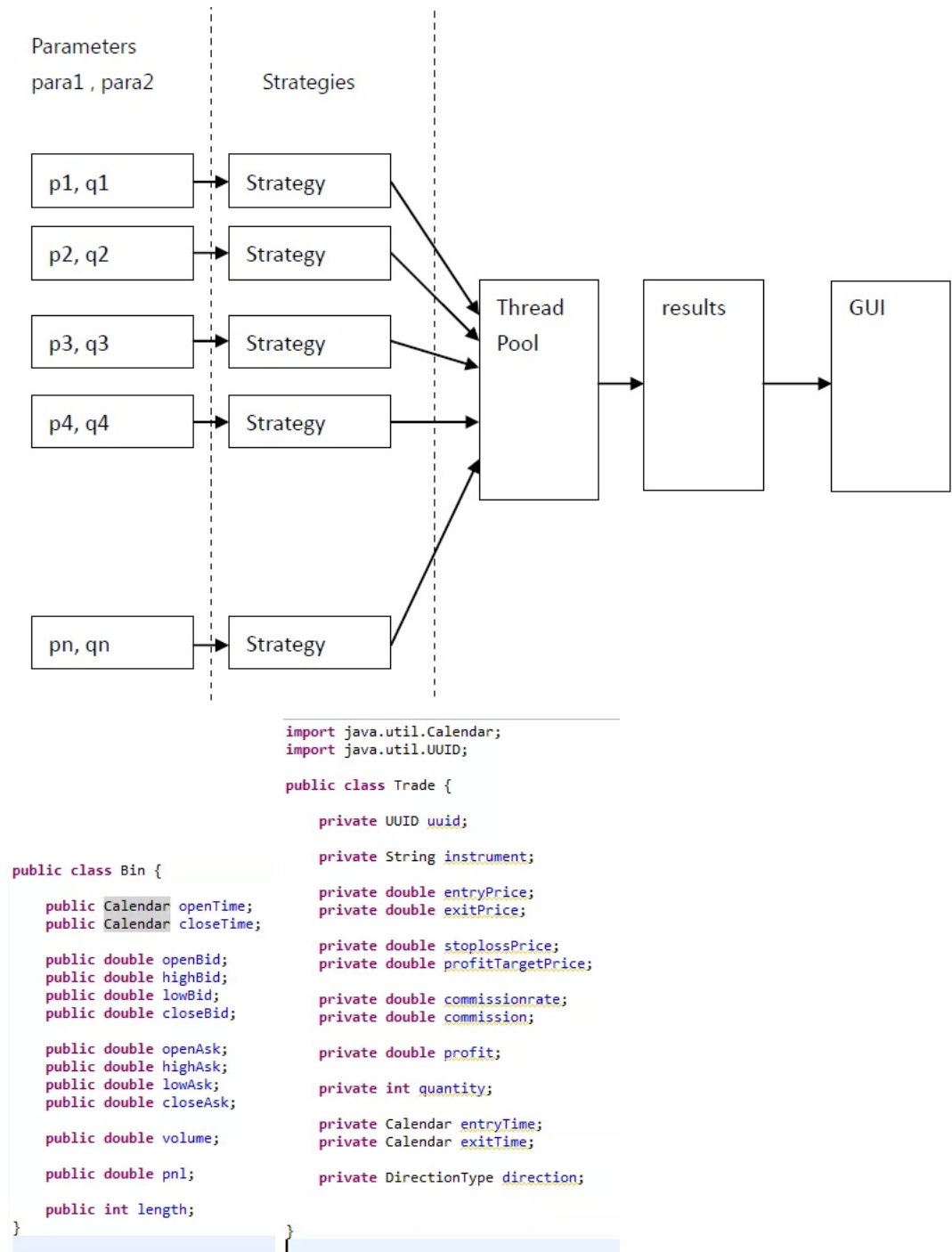
8.2 Strategy Development Pipeline(Single/Linear Strategy)

8.2.1 Basic Architecture/System



8.2. STRATEGY DEVELOPMENT PIPELINE(SINGLE/LINEAR STRATEGY) 25





8.2. STRATEGY DEVELOPMENT PIPELINE(SINGLE/LINEAR STRATEGY) 27

```
for binsDaily {  
  for (Bin bin:binsM1) {  
    if(达到入场价){  
      //入场一单  
      Trade trade = new Trade()  
      Trades.put(trade);  
    }  
    For (trades){  
      If(打止损/打止损){  
        Trade.close()  
      }  
    }  
  }  
}
```

Historical Data is a singleton. All Market Data (eg. a candle stick) should be organized to feed the researcher to program strategies on the backtester (eg. like quantopian). All back-testing should be parallized (ideally on GPU) to display parameter-profit relationship. (heatmap, stock charts, etc) Ideally the optimization process could be visualized (like Tensorflow)

All like a research facility feedback cycle.

Key Details: API Design, Module Separation etc.

8.2.2 Data

Key is a real-time listener. Technical Considerations: KDB, Hadoop and HDFI(?), SQL Like, Mongo Db to store Archive Data. Market Data Providers consideration buying from Wind, BBG, Reuters, Etc.
teams: platform operation engineer, analytics builder, strategy control/management and risk management, data team, execution team, researcher team (3 x tech)
data licensing and data quality insurance
data base, text file archive, big data issue
cheap data: brokerage: interative brokers.

8.2.3 Backtester/Simulator

Key Components

*Send Singal to Quoting/Trading/Exection Tool(Real Time) *Market

Data Objects (eg. loop for every time bins) *stop loss/risk control system integration *parameter-backtest profit/statistics result: optimization and loss function set function to tune the parameters *multi-thread: Java backter (Java thread pool*) *human selection of parameters: parameter table and visualization

8.2.4 Trade Record and Money Management

record every trade, summarize execution shortfall, statistical trends and information (shortcomings of strategy executions) and market information (learning material) build statistics and storage

More: order book and trade book level data handling

8.2.5 Analytics

Strategy Management

, Sharpe Anslysis, Holding Period, Slippage visualization to better assistant strategic allocation

Execution Analysis and Cost

quantitative trading/systematic trading strategies: * equity long/short

8.2.6 Research Team

Key problems: * Optimization and Combination of Sub-Strategies (Eg. factors) * Market Regime Change Detection(problem not solved): Distinguish between trend and oscillation market * market supply/demand imbalance analysis (risk-premia) * volatility trading, dispersion trading - 2nd and 3rd degree trading, (vol model, vol clustering effect, vol leverage effect) * hedging/overlay strategy research: hedging cost and hedging risk management, how to adjust hedge according to market condition. * common ideas: market imbalance, mean-reversion, autocorrelation

8.2. STRATEGY DEVELOPMENT PIPELINE(SINGLE/LINEAR STRATEGY) 29

patterns etc (find patterns and trade) - based on statistics. Risk factors, implied arbitrage - based on math.

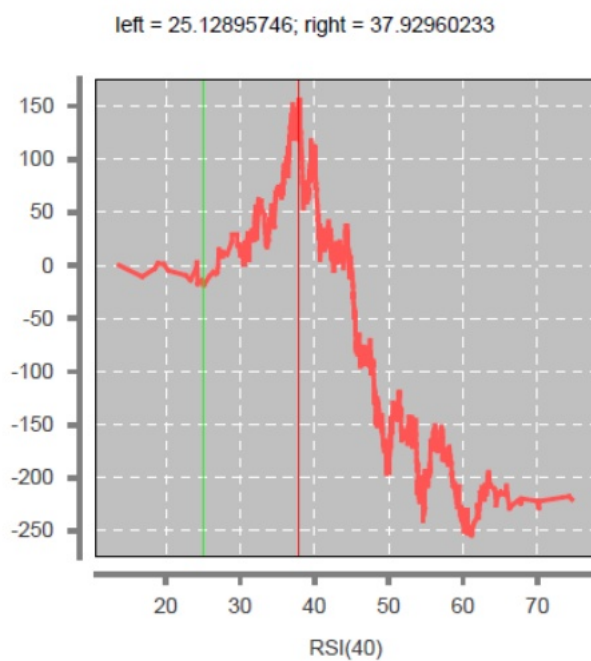
Parameter Optmization and Control

Rely on GUI - parameter distribution and selection optmization
methdologies from machine learning (see optimization chapter) robustness
anslysis and out-of sample test ** (random cut the universe of rolling
window on selection period)

Signal Indicator Design

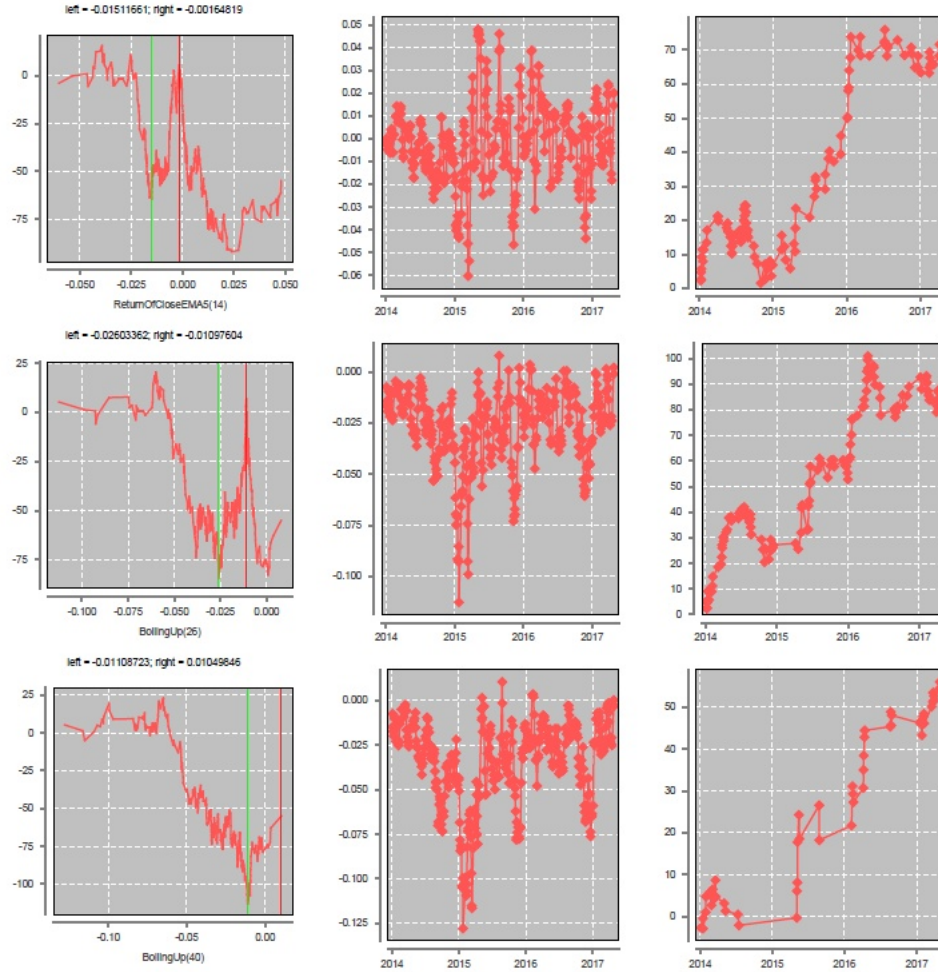
For example, based on fundamental ratio and technical indicators - design
a formula. And check the level of prediction power (if any)

1.seeking stationarity: find a stationary time series use difference,
integration, and normalize with volatility 2.find signal level, plot
cumulative back-test return against different signal level (use own quotes,
and use signal level to filter quotes)



3.Check stability of

customized indicators



4. check overfitting and type-II error in all settings, apply noise filtering if possible
5. design a interface to input indicator(math formula parser to read string) and visualize information using GUI.(HTML/XML Render)

8.2. STRATEGY DEVELOPMENT PIPELINE(SINGLE/LINEAR STRATEGY) 31

```
<?xml version="1.0"?>
<indicators>
  <section name="priceDivEMA">
    <indicator>
      <f>OpenDivEMA(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>CloseDivEMA(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>HighDivEMA(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>LowDivEMA(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
  </section>
  <section name="ReturnEMA">
    <indicator>
      <f>ReturnOfOpenEMA5(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>ReturnOfCloseEMA5(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>ReturnOfHighEMA5(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
    <indicator>
      <f>ReturnOfLowEMA5(\i)</f>
      <i>2,3,4,5,7,10,14,20,24,26,30,36,40,42,46,48,50</i>
    </indicator>
  </section>
</indicators>
```

```

public static HashMap<String, List<String>> parseXML(File fXmlFile) {

    HashMap<String, List<String>> map = new HashMap<String, List<String>>();

    DocumentBuilderFactory dbFactory = DocumentBuilderFactory.newInstance();
    DocumentBuilder dBuilder = null;
    try {
        dBuilder = dbFactory.newDocumentBuilder();
    } catch (ParserConfigurationException e) {
        e.printStackTrace();
    }
    Document doc = null;
    try {
        doc = dBuilder.parse(fXmlFile);
    } catch (SAXException | IOException e) {
        e.printStackTrace();
    }

    doc.getDocumentElement().normalize();

    NodeList nList = doc.getElementsByTagName("section");

    for (int i = 0; i < nList.getLength(); i++) {
        Node nNode = nList.item(i);
        if (nNode.getNodeType() == Node.ELEMENT_NODE) {
            Element element = (Element) nNode;
            String sectionName = element.getAttribute("name");
            map.put(sectionName, new ArrayList<String>());
            NodeList childList = element.getElementsByTagName("indicator");

            for (int j = 0; j < childList.getLength(); j++) {
                Node childNode = childList.item(j);
                Element cElement = (Element) childNode;
                String indicatorNameOrigin = cElement.getElementsByTagName("f").item(0).getChildNodes().item(0)
                    .getNodeValue();
                if (cElement.getElementsByTagName("i").getLength() > 0) {
                    String indicatorParaList = cElement.getElementsByTagName("i").item(0).getChildNodes().item(0)
                        .getNodeValue();
                    String[] indicatorParas = indicatorParaList.split(",");
                    for (String indicatorPara : indicatorParas) {
                        String indicatorName = indicatorNameOrigin.replace("\\i", indicatorPara);
                        map.get(sectionName).add(indicatorName);
                    }
                } else {
                    map.get(sectionName).add(indicatorNameOrigin);
                }
            }
        }
    }

    return map;
}

```

6. aggregate all indicators(eg. macd, ead). Aggregate all strategies using optimization framework or selection framework to gain statistical alpha
7. indicator effectiveness test
 1. test correlation - the correlation between indicator and profit vs. the correlation between correlation and white noise(hypothesis test) * use spearman correlation rather than pearson correlation*
 2. Use Monte Carlo Simulation to do permutation test of effectiveness of indicator
 3. Very very hard - detect sensensitivity to market regime change(osicallation and trend) and identify market regime change.

Integration of single indicators and portfolio theory

Form indicator as factors: standardization to mean-0, normal/t-distributed scores. Select powerful ones (ones that passed the permutation test). Optimize to maximize holdings exposure to factor with risk penalty. The key is still feature engineering.

$$h'f - ah'Vh$$

h :列向量, portfolio 里各个品种的持仓

f :列向量, expected return

a 常数: risk aversion

V : covariance matrix

‘ 意思是矩阵转秩

For Covariance, See section "covariance matrix".

Strategy Risk Management and Money management

small stop loss, big stop gain level on reversion strategies.bigger stop loss, smaller stop gains on volatile markets - based on experience, market analysis.

Choose symmetric/non-symmetric risk control based on market belief

Hedging and Market Exposure Management - Volatility Control and Automatic de-leveraging.

together with cost consideration.

8.3 Backtesting

1. Survivorship-bias
2. Look ahead-bias
3. In-sample bias

Chapter 9

Portfolio Risk Management

9.1 Derivatives and Hedging Strategies

2. risk management 1. Var - historical, analytical, MC good and bad 2. credit risk exposure (pv only swap has) 3. derivatives 1. futures, hedge, synthetic equity/cash, pre-investing 2. options 1. spread-bull bear, butterfly 2. straddle, collar, box spread(bull, bear spread- risk free rate) 3. interest rate swap - leveraged floating-rate notes, inverse floater; currency swap 4. swaption - payer, receiver - use receiver to add/remove callable bond features

1. fixed income 1. duration matching 1. requirements 2. vs cashflow matching(tenor offer), contingent immunization, horizon matching 2. index and challenges 1. index vs mutual fund,ETF, synthetic strategies(total return swap, less cash but counterparty risk) 3. yield curve strategies 1. laddered, bullet, barbell vs level slope curvature 2. barbell vs bullet, condor and butterfly long short at level change, slope change, curvature change, yield volatility change performance and strategy (wing and body) 4. high yield and credit spread 1. IGB HYB : credit risk, credit migration risk, interest rate risk, liquidity risk 2. access liquidity risk and tail risk 3. emerging market difference

9.2 FX risk management

1. currency management 1. forward price (long/short base currency) 2. options- risk reversal, put spread, seagull spread 2. index and benchmark
1. capitalization-weighted, price-weighted, equal-weighted index, fundamental-weighted indexes

Chapter 10

Monitoring and Performance Evaluation

10.1 Monitoring

1. rebalancing corridor width
2. CPPI/ swaption etc

10.2 Performance Evaluation

10.2.1 Equity

Factor Model (Axima, Barra)

10.2.2 Fixed Income

1. fixed income - no contribution-risk-free-asset categories-benchmark level(style)-manger-allocation effects(residual)

Chapter 11

Alternative Data and General Machine Learning