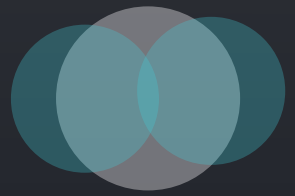
寻找穿越牛熊的资产配置:

-A Fundamental and Quantitative Approach.



Presented by ETC Academy

- 宏观前沿：Pessimism and Opportunities
- 行业研究：Industry Insights
- Equity Analysis
- Technical Analysis
- 量化原则：Principle of Alpha Design
- 算法交易：Asset portfolio optimization using SVM and real-coded genetic algorithm

Outline

宏观前沿:

悲观与机遇

Pessimism and Opportunities

Policy Rate 政策利率（季度）

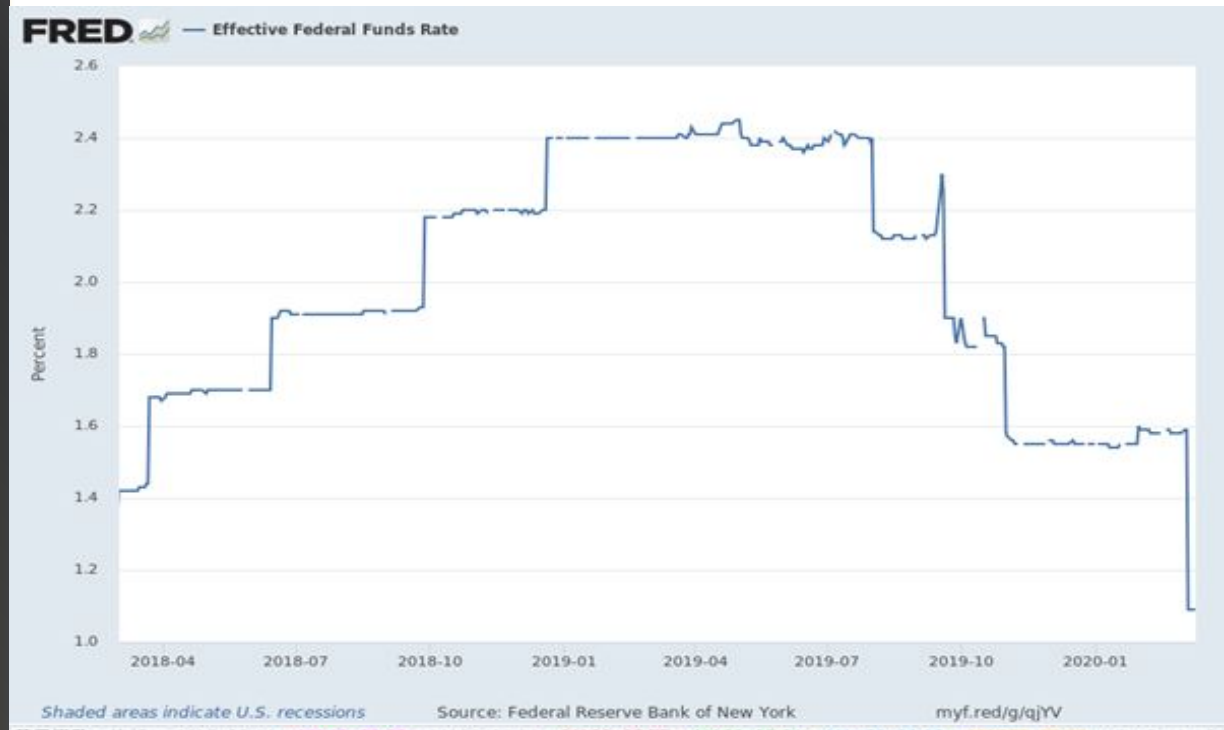
锚定利率（政策利率）

Signal:

- 美联储大幅度降息
- 对抗经济下行压力
- 美元贬值

Model Prediction:

- 理论上通货膨胀温和上涨，刺激经济复苏，稳定市场
- 美元有进一步贬值空间
- 长期来看，美元贬值释放新的股票市场流动性



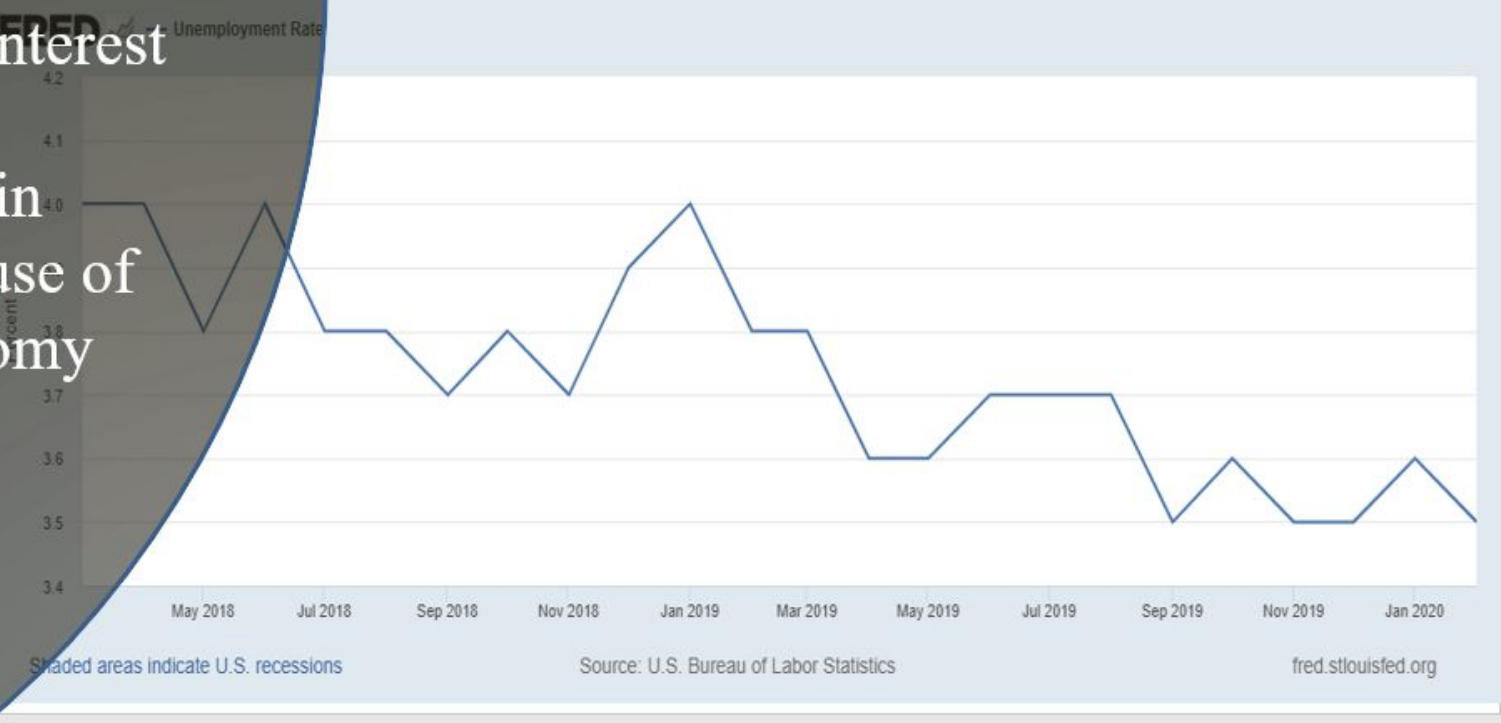
预期通货膨胀率与失业率 (Quarter)

Signal:

- 预期通货膨胀率下降迅速
- 失业率低位波动

Model Prediction：

- Fearness of recession in the market
- Potential liquidity trap (negative real interest rate)
- Discourage labour force not involved in unemployment rate, may increase because of the pessimetic expectation for the economy
- Unemployment is lagging behind



大宗商品：原油价格与黄金价格

Signal:

- 原油价格下降
- 黄金价格持续上升

Model Prediction：

-沙特和俄罗斯价格站加剧市场不确定性，造成进一步市场悲观预期

- 黄金等避险资产价格持续走高
- 预期黄金价格在悲观市场氛围下继续增长

美国国债收益率曲线

Signal:

- 2019 年一年期国债与十年期国债出现倒挂

Model Prediction：

-市场自2019年起就出现悲观情绪

- 2019年起存在潜在衰退危机

- Fixed Income等固定收益类金融资产价格可能将在未来持续走高

- 股市未来不确定性高

  1. 流动性陷阱
  2. 固定收益类与避险资产走高

美国1年期国债收益率

美国10年期国债收益率

股市行情与市场恐慌指数

Signal:

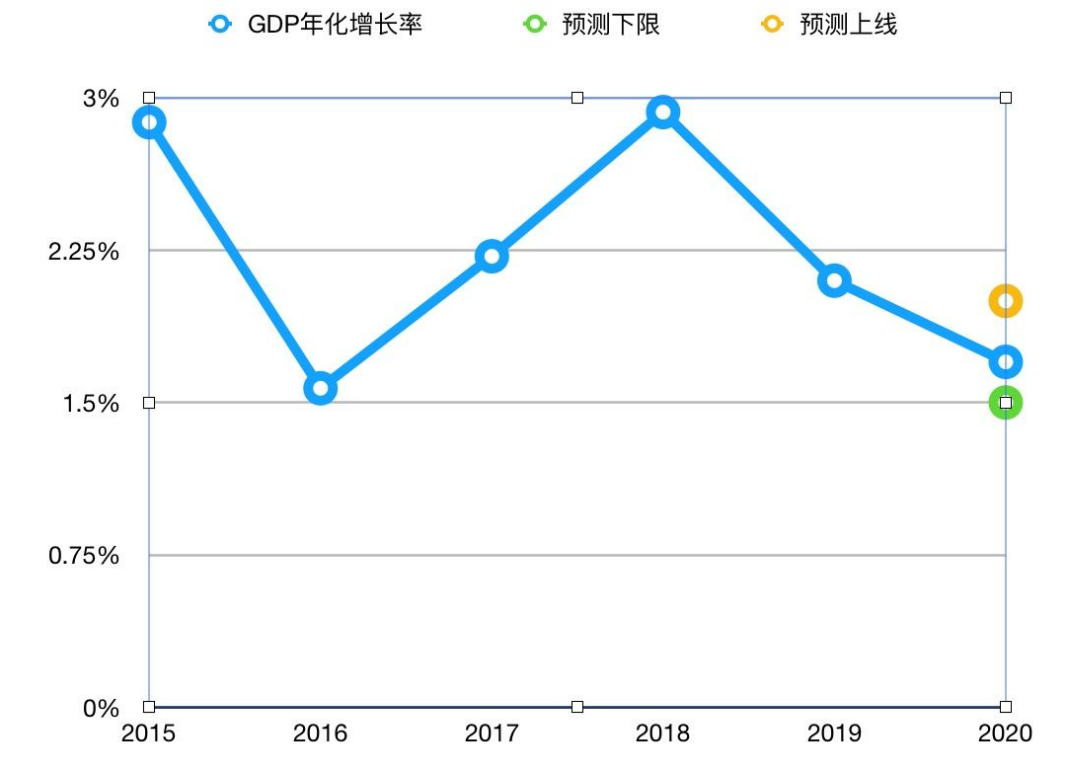
- 三大指数暴跌，恐慌指数暴涨

Model Prediction：

- 市场恐慌情绪高涨
- 美联储降息政策陷入流动性陷阱
- “动物精神”之悲观情绪
- 上涨动能不足，短期恐慌纠正行情涨幅不大，空间有限。
- 但长期空间较大，未来可期

本次冠状病毒疫情对宏观经济影响较大，2020年GDP涨幅在2%以下基本已成定局

受疫情影响，2020年GDP涨幅大概率在2%以下　　三种可能场景对经济带来不同程度影响



乐观预测

- 测试中的抗病毒疗法被证明高度有效
- 各洲疾控措施执行得力，传播被有效遏制
- 疫情在6月底得到有效控制

基线预测

- 测试中的抗病毒疗法被证明有效
- 带来一定程度和范围的传播
- 疫情在8月底得到有效控制

悲观预测

- 短期内仍缺乏有效治疗手段
- 扩散感染范围，形成新疫区
- 病毒存在潜在变异增强感染率
- 疫情在12月前后得到有效控制

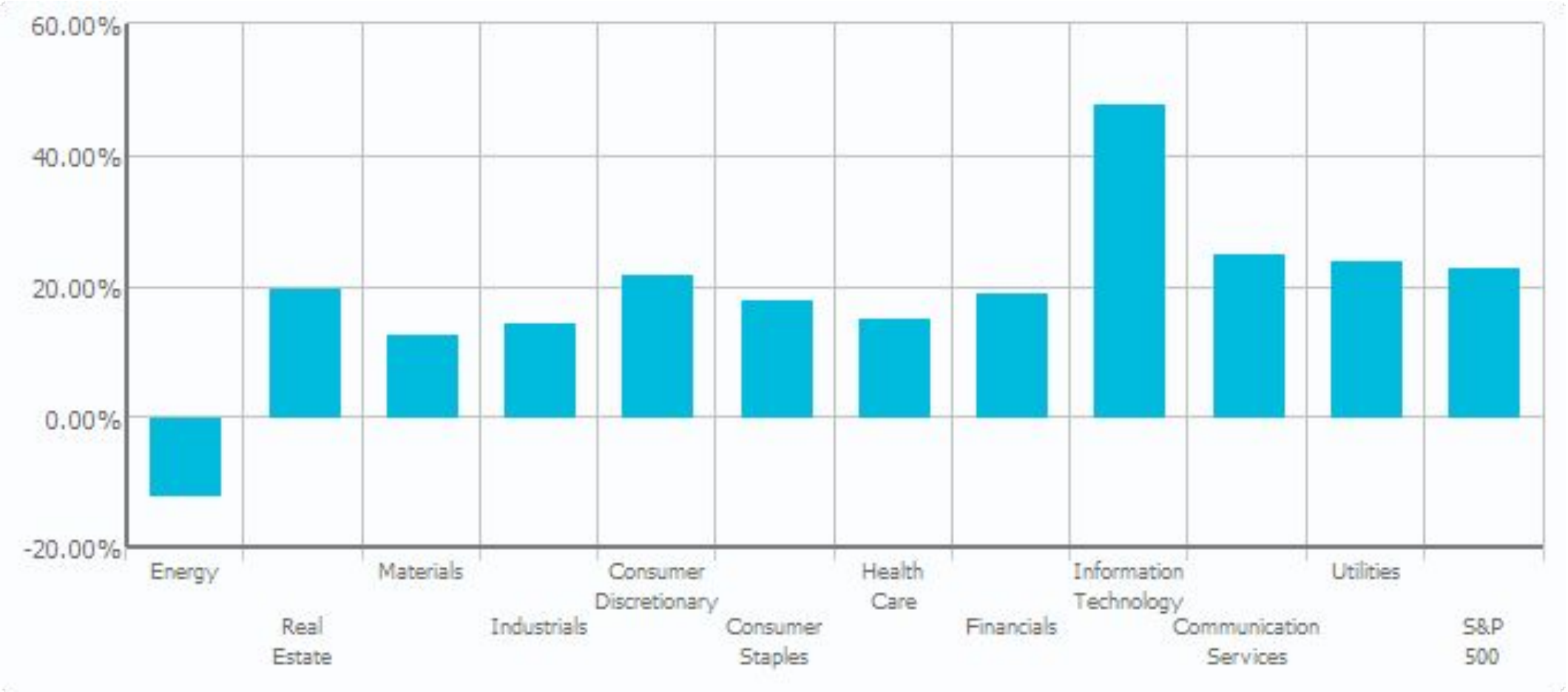
Industry Research

Chun Zhou, ETC Academy

Project Logic

- Manual:
  - Use Industry Research to pick profitable industry and stock
  - Fully understand supply side, demand side and their business model
  - Apply technical analysis and stock picking method to select stock
  - Update the portfolio according to market research
- Algorithmic:
  - Construct the portfolio using previously selected stock
  - Optimize the portfolio and trade according to algorithmic strategies
- Profitability:
  - Compare with Industry ETF

Sector Performance Chart



Data From S&P 500

Things to consider for Industry Research

- Key players, core products and their business model
- Competitors
- Supply Chain（上下游企业）
- Historical and predicted growth
- New trends and cycles
- Factors infecting the industry

Key Players: Forbes Global 2000(Real Estate)

- Brookfield Asset Management(largest assets of $256 billion, highest revenues of $57.6 billion, second highest profits $3.5 billion, fourth highest market cap $46 billion)
- Link REIT($5.7 billion profit)资产信托基金
- American Tower Corporation (cell tower giant)
- Simon Property Group(mall operator)
- Prologis(warehouse owner)
- Blackstone(PE giant with massive property portfolio)

Competitors(Information Technology)

- Amazon(largest e-commerce company by revenue)
- Amazon breaks down its revenue into five major categories for competitors

1. Online stores: JD.com,Vipshop, Overstock.com,Etsy
2. Physical stores: Target, Walmart, BestBuy, Costco
3. Third party seller service: eBay
4. Subscription service: Netflix, Apple, Google
5. Amazon web service(AWS):Oracle, Microsoft, IBM

Supply Chain(Healthcare)

- Drug and medical machine manufacturers
- Insurance companies
- Hospitals
- Group Purchasing organizations
- Cold chain supply
- Regulators
- Research companies

Factors Affecting the Industry(Real Estate)

- Rental vacancy rates: as vacancy declines, supply of rental units become tight to charge higher rents
- Value of residential construction: value of all new work performed and construction equipment rentals and materials
- Homeownership rate: represents the share of households that own their own home, which weakens demand from the rental market
- Per capita disposable income: represent affordability
- Yield on 10-year treasury note: represent the federal government's cost of borrowing, increase the cost on mortgages and lease will push up sector revenue if increases do not stifle demand

Trend and Cycles

- Predict future stock price movements based on recently observed trend data
- Three main types of trend: short, intermediate and long term
- Analyze how the sector was affected by internal and external forces
- Changes in a similar industry
- Creation of a new governmental regulation

Trend and Cycles(Coronavirus)

- Coronavirus made investors struggled to quantify the effect
- Panic began in the oil market: many small oil companies responsible 15% of American oil production face bankruptcy
- 10 worst performing stocks in S&P500 drops 30% from oil industry
- S&P500 fell more than 7% in one day, Dow Jones industry average fell 2000 points
- Banks were hit on March 9, JPMorgan fell 13%, BOA fell 14%
- Yields on government bonds dropped low
- Clorox(disinfecting cleaners and wipes) and retail stocks rose

Method

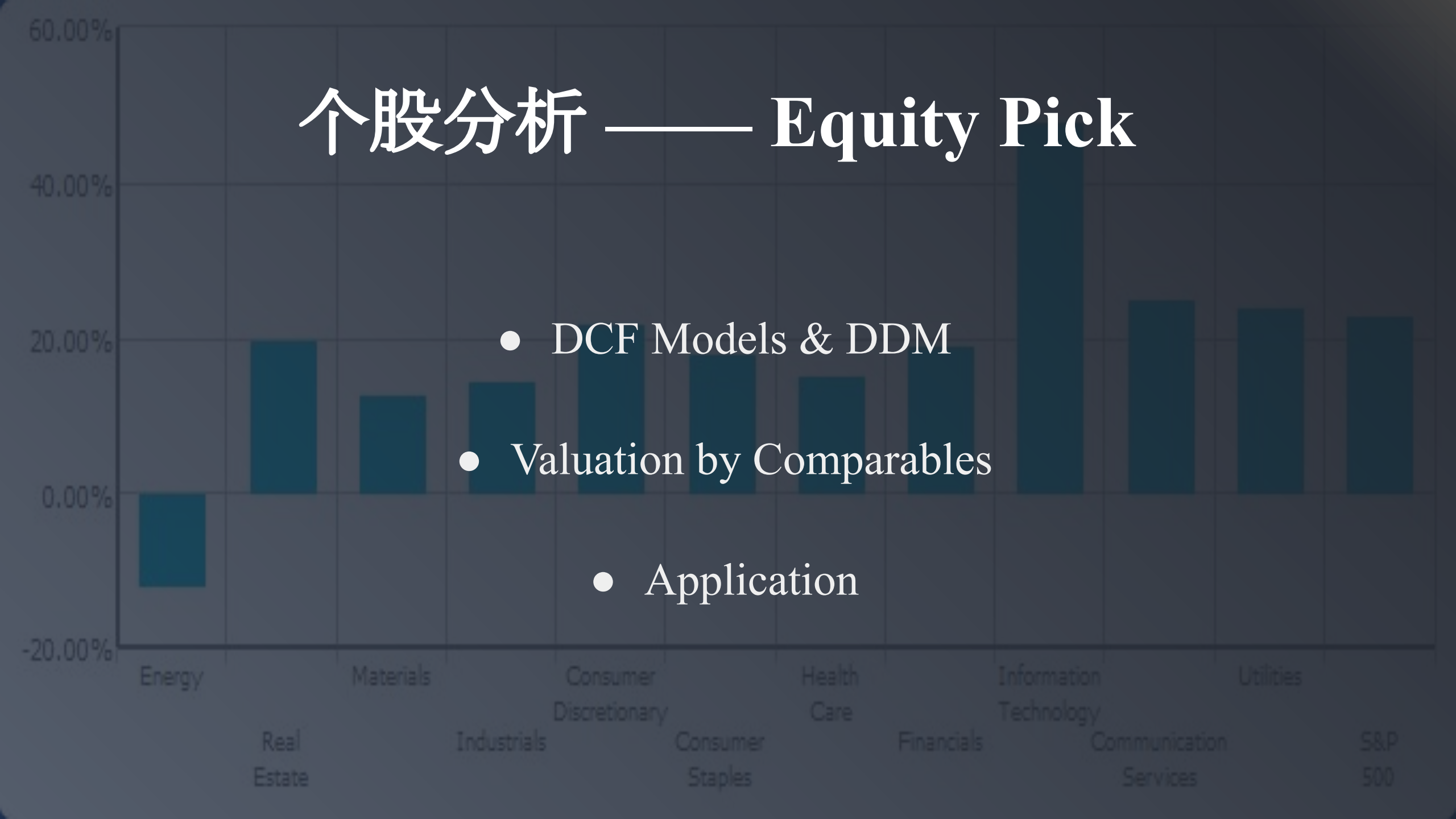
- Top-bottom approach
- Bottom-up approach
- Market cap
- Market share
- Growth rate
- Profit and revenue
- Asset

Where to find Industry Info

- List of Industry Association
- Trade Show Calendar
- United States Census Bureau(Industry Statistics Portal)
- IBIS world
- NY Times
- Forbes

个股分析 —— Equity Pick

- DCF Models & DDM
- Valuation by Comparables
- Application



DCF Model

Value the firm by discounting its free cash flows

Free cash flow to the firm, FCFF, equals:

- After tax EBIT
- Plus depreciation
- Minus capital expenditures
- Minus increase in net working capital

Value of the Firm:

$$Firm\ Value = \sum_{t=1}^{T} \frac{FCFF_t}{(1+WACC)^t} + \frac{V_t}{(1+WACC)^T}$$

PV of FCFF to time T

PV of terminal Value, based on forecast long term growth rate)

Where

$$V_t = \frac{FCFF_{T+1}}{WACC - g}$$

FCFF

$$= EBIT \times (1 - t_c) + Depreciation - Cap.\,Exp. - \Delta NWC$$

DDM

If future dividends are at a constant rate g

If T increases to infinity

$$Value = \frac{D_1}{1+r} + \frac{D_1(1+g)}{(1+r)^2} + \ldots\ldots + \frac{D_1(1+g)^{T-1}}{(1+r)^T} + \frac{P^T}{(1+r)^T}$$

$$Value = \frac{D_0(1+g)}{r-g}$$

Discount rate & Growth rate

•The discount rate r can be Weighted Average Cost of Capital (WACC) when a firm is evaluating a potential project. The WACC is the average cost the company pays for capital from borrowing or selling equity.

计算税后WACC的基本公式如下:

$$WACC=(Ke * We) + (Kd [1-t] * Wd)$$

WACC:加权平均资本成本;

Ke:公司普通权益资本成本;

Kd:公司债务资本成本;

We:权益资本在资本结构中的百分比 i.e. Ke/(Ke+Kd);

Wd:债务资本在资本结构中的百分比 i.e. Kd/(Ke+Kd);

T:公司有效的所得税税率。

•The growth rate of a company's earnings depends on:

1.The proportion of earnings it retains

2.The rate of return it can earn on these new assets

•Without external financing, a company cannot exceed its Sustainable Growth Rate of Earnings

g = Retention rate of earnings (RR) x Return on Equity (ROE)

Valuation by comparables

1. P/E ratio
    - Compare PE ratio with its industry average PE ratio.
2. ROE = Profit Margin X Total Asset Turnover X Financial Leverage
    - Profit Margin: Impacted by the business cycle for some companies;Declines as competition increases or products become mature
    - Total Asset Turnover: Reflects operating efficiency–industry & company specific factors
    - Financial Leverage:How has the firm financed its business
3. PEG Ratio
    - P/E Ratio divided by the growth rate (This is key valuation metric for valuing growth stocks)
    - Pick a growth stock with a low PEG
4. Price/book ratio (P/B ratio)
    - Market value of a company's common stock divided by its book (accounting) value of equity. A ratio bigger than 1.0 indicates that the firm is creating value for its stockholders.
5. Capitalization

Technical Analysis Section

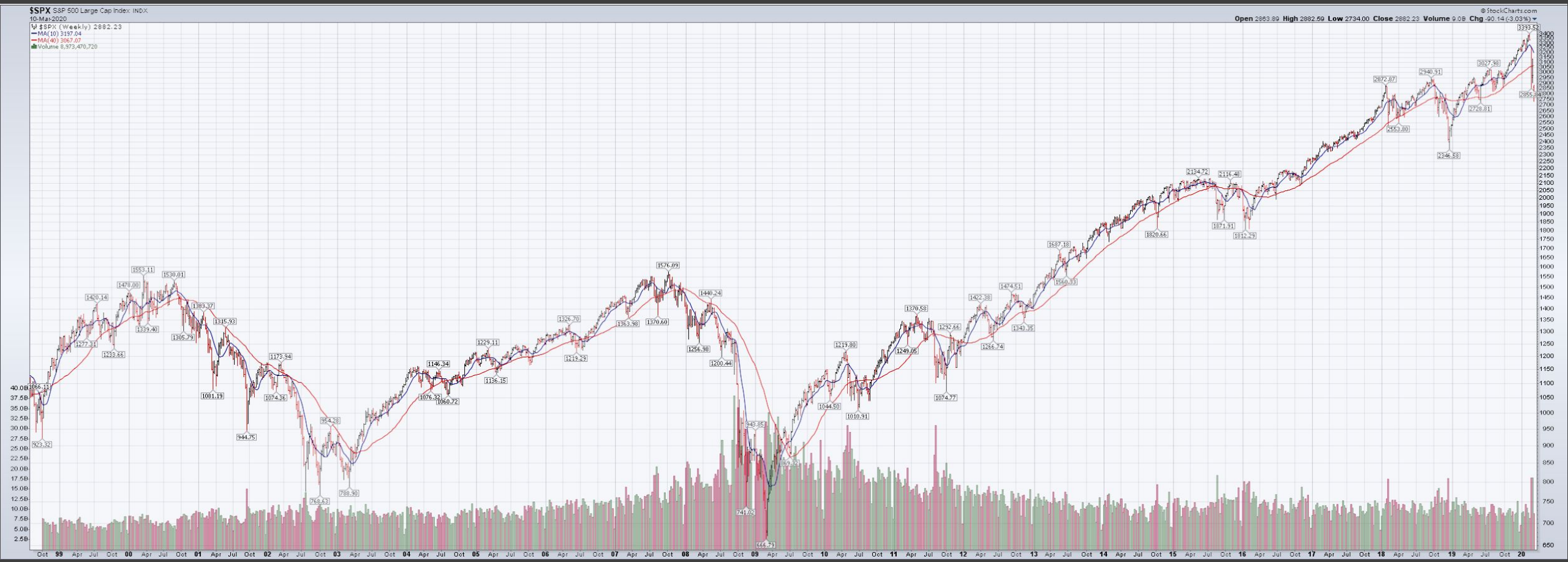
1. Technical Analysis overview, history and philosophy
2. Simple ways of trend analysis - for both investors and beginners
3. Warning of a recent top before crash: Divergences and sell signals; how we can manage risk
4. Use breath as the ultimate signal to pinpoint bull/bear environment

Kevin Deng

历史&主流的理论

- 18世纪日本的蜡烛图
- 20世纪初Charles Dow - Dow Theory (He also founded Dow Jones & Company and Wall Street Journal)
- Elliott Wave theory - 数浪的部分在技术分析界争议比较大，有太主观的问题（千人千浪）。Fibonacci Ratios的部分更加广为接受。对理论体系（人类作为一个群体的心理活动&预期）也有很大贡献。
- 20世纪晚期 - 21世纪初
  - Quantitative Indicators:
    - Momentum, Trend, Breath, Sentiment, Volume-based indicators
    - Intermarket Analysis: all markets are connected。John Murphy & Martin Pring
- Others: Seasonality, Cycles, Leading Economic Indicators (ECRI, Recession Watch, OECD LEI), Contrarian

Trend Analysis with moving Average



- very easy to learn
- good for both trader & investor

https://stockcharts.com/h-sc/ui?s=%24SPX&p=W&st=1998-08-03&id=p13293705407
http://schrts.co/NBtKXrAW

Topics on recent crash

1. Negative Divergence & Sell Signals

   a) Trend & Momentum: http://schrts.co/ZgHjIRqS
   b) Breadth: SPXA200R: http://schrts.co/MkjSsxqS ;
      SPXA50R: http://schrts.co/mPZMBfWY
   c) Intermarket Analysis - SOX:NDX: http://schrts.co/pBanXGGm;
      US vs World ex-US

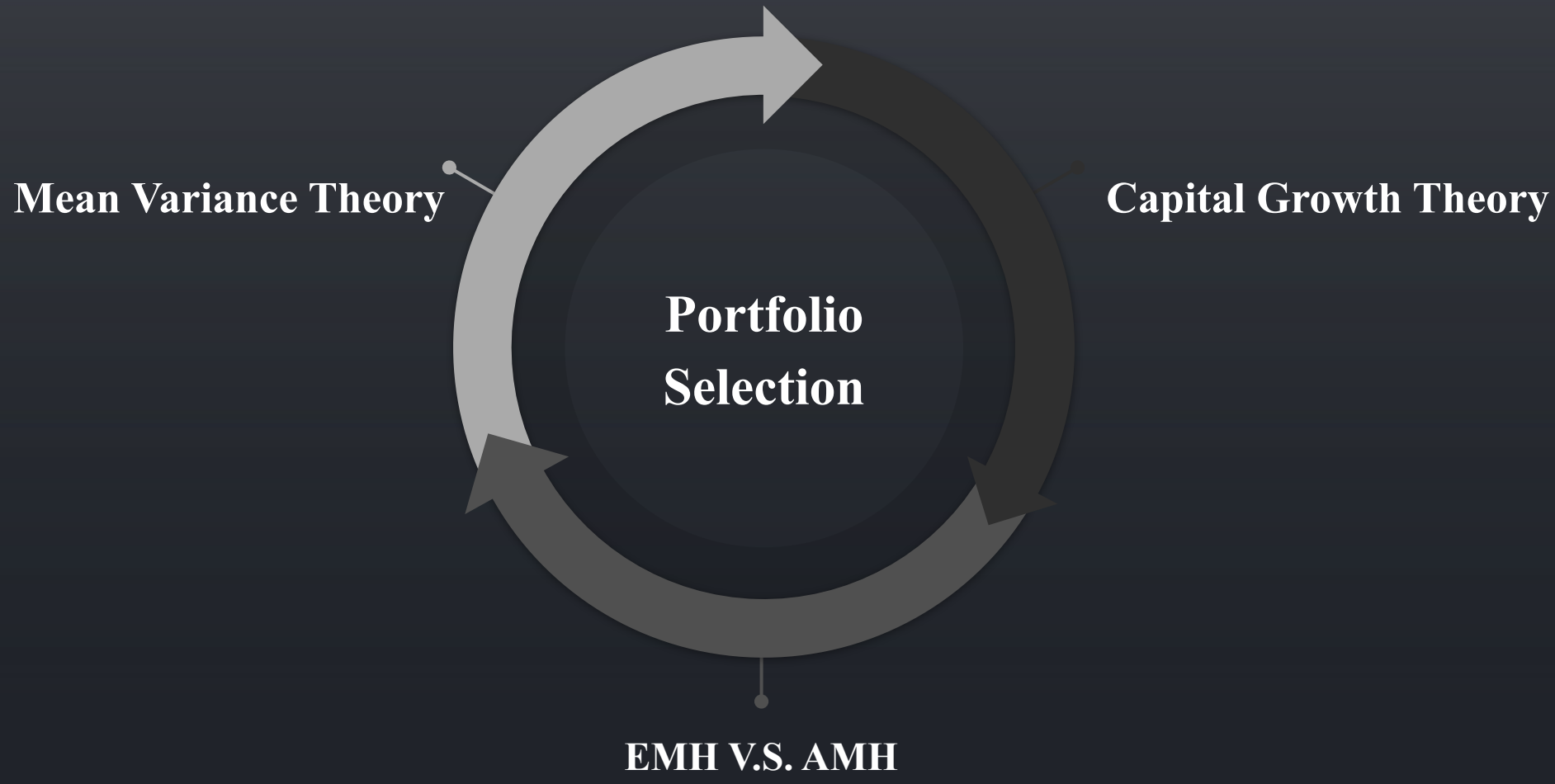
2. Using breath signals to tell bull/bear market environment
   – what will be the all clear sign?

量化设计原则：

随机漫步与规则套利

-A Fundamental and Quantitative Approach.

Victor，ETC Academy



Quantitative Approach

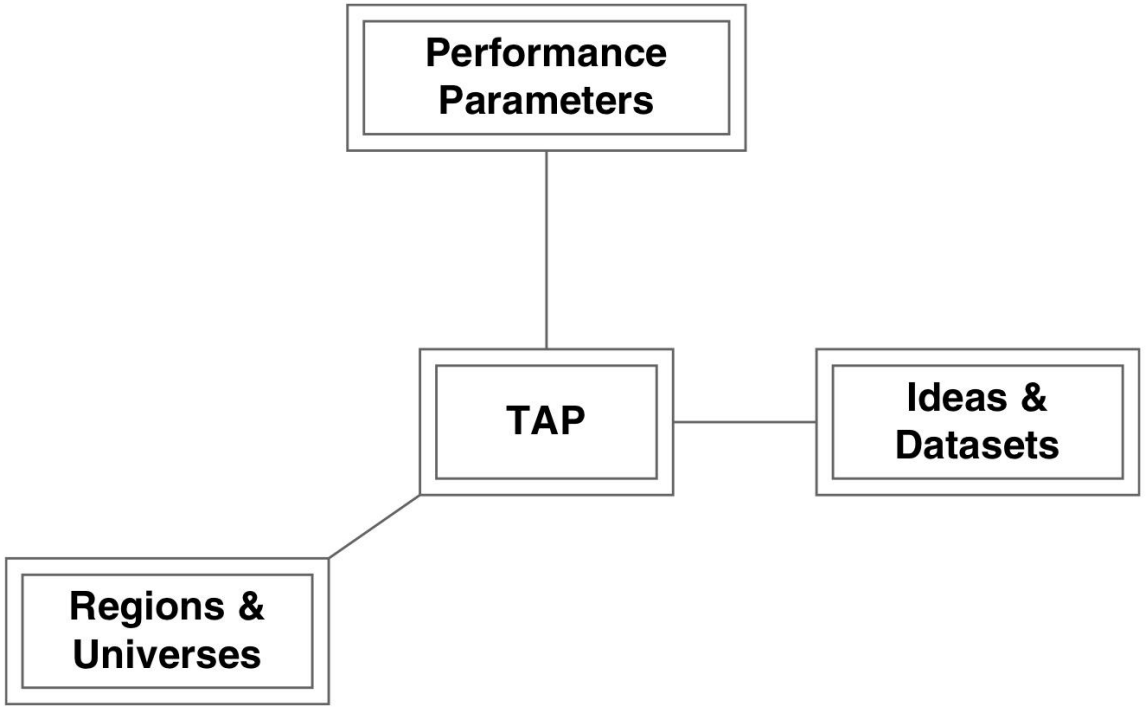
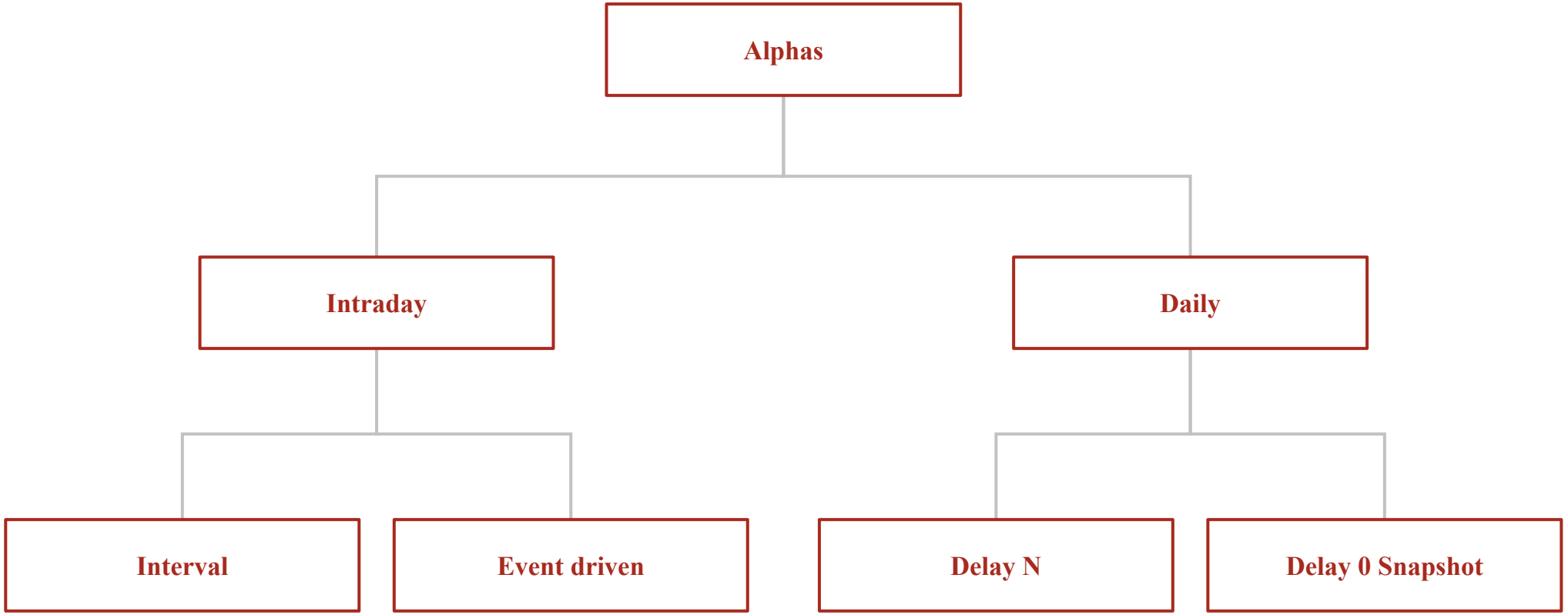


Figure 11.1 The three axes of the Triple-Axis Plan

Basic Framework

- Ideas and Datasets
- Regions and Universes
- Performance Parameters



Categories of Alpha

- Intraday Alphas
- Daily Alphas
- Weekly/Monethly Alphas

Selection Algorithms

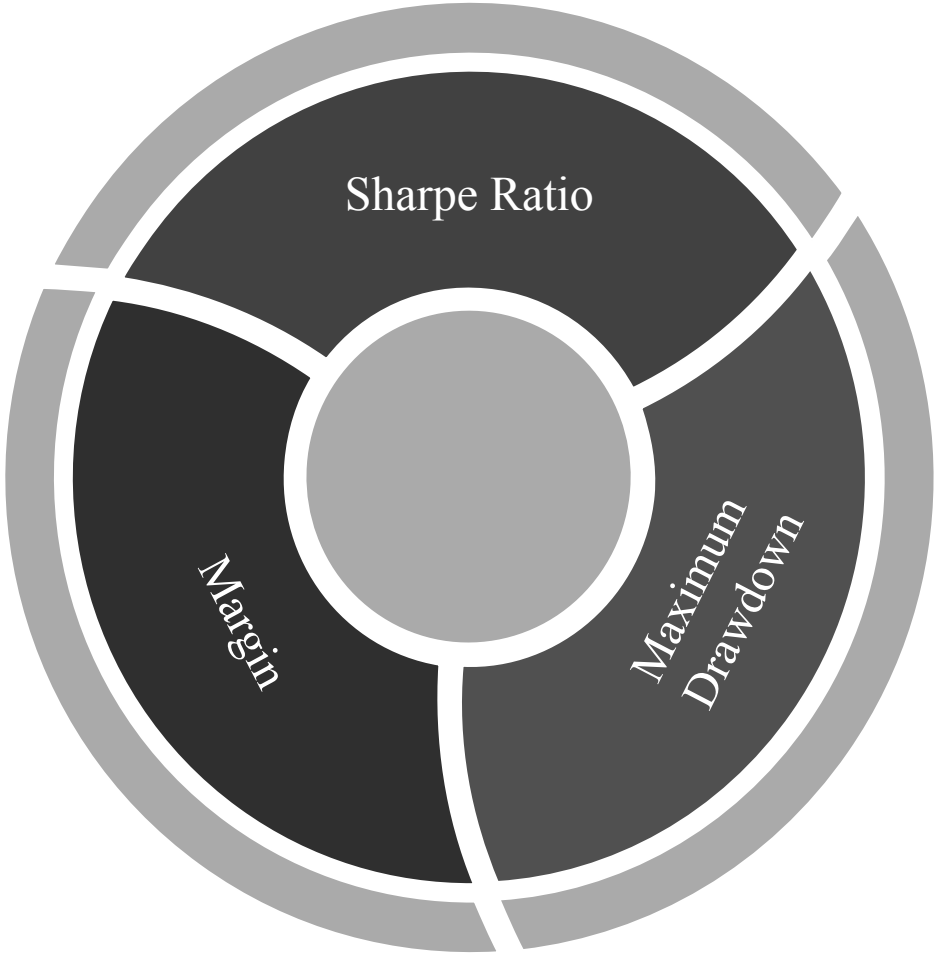
- Benchmark Strategy
- Follow the Winner
- Follow the Loser
- Pattern Arbitrage
- Meta-Learning

Table I. General classification for the state-of-the-art online portfolio selection algorithms.

Classifications	Algorithms	Representative References
Benchmarks	Buy And Hold	
	Best Stock	
	Constant Rebalanced Portfolios	Kelly [1956]; Cover [1991]
Follow-the-Winner	Universal Portfolios	Cover [1991]; Cover and Ordentlich [1996]
	Exponential Gradient	Helmbold et al.[1996; 1998]
	Follow the Leader	Gaivoronski and Stella [2000]
	Follow the Regularized Leader	Agarwal et al. [2006]
	Aggregating-type Algorithms	Vovk and Watkins [1998]
Follow-the-Loser	Anti Correlation	Borodin et al.[2003; 2004]
	Passive Aggressive Mean Reversion	Li et al. [2012]
	Confidence Weighted Mean Reversion	Li et al.[2011b; 2013]
	Online Moving Average Reversion	Li and Hoi [2012]
	Robust Median Reversion	Huang et al. [2013]
Pattern-Matching Approaches	Nonparametric Histogram Log-optimal Strategy	Györfi et al. [2006]
	Nonparametric Kernel-based Log-optimal Strategy	Györfi et al. [2006]
	Nonparametric Nearest Neighbor Log-optimal Strategy	Györfi et al. [2008]
	Correlation-driven Nonparametric Learning Strategy	Li et al. [2011a]
	Nonparametric Kernel-based Semi-log-optimal Strategy	Györfi et al. [2007]
	Nonparametric Kernel-based Markowitz-type Strategy	Ottucsák and Vajda [2007]
	Nonparametric Kernel-based GV-type Strategy	Györfi and Vajda [2008]
Meta-Learning Algorithms	Aggregating Algorithm	Vovk [1990][1998]
	Fast Universalization Algorithm	Akcoglu et al.[2002; 2004]
	Online Gradient Updates	Das and Banerjee [2011]
	Online Newton Updates	Das and Banerjee [2011]
	Follow the Leading History	Hazan and Seshadhri [2009]

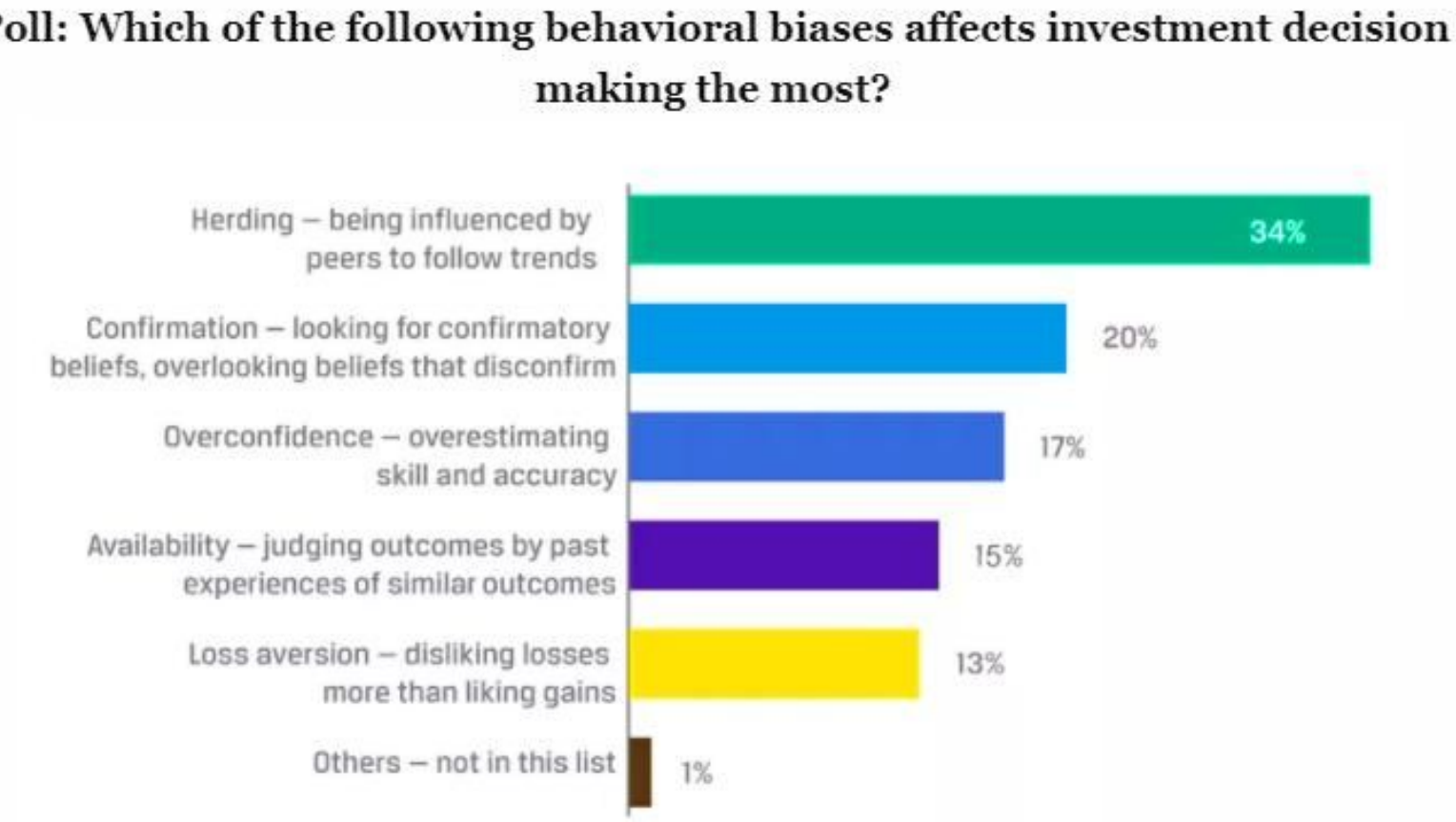
Alpha Evaluation

- Holding/Rebalancing: always clear/adjust position at predetermined point or time-stamp to realize PnL w.r.t term.
- Diversify when possible
- Balance Risk with Return
- Leave a set proportion for statistical arbitrage



Controlling Bias

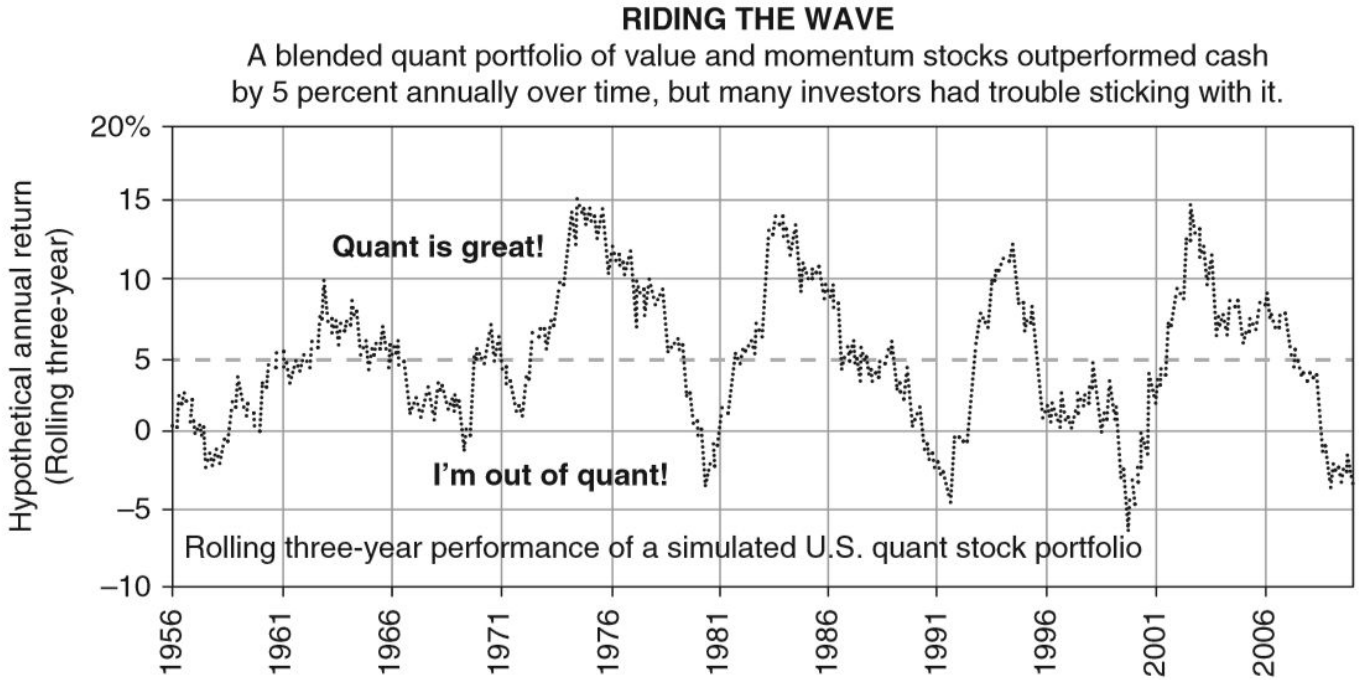
- Familiarity Bias
- Confirmatory Bias
- Narrow Framing
- Availability Bias
- Herding Bias



Source: CFA Institute

Cutting Loss

- Drawdown exceeds typical drawdown from backtesting
- Sharpe Ratio falls significantly
- Implement a circuit breaker
- Holding/Rebalancing: clear/adjust position to realize PnL w.r.t term.
- Diversify when possible
- Balance Risk with Return



Source: AQR Capital Management.

Reference

AGARWAL, A., HAZAN, E., KALE, S., AND SCHAPIRE, R. E. 2006. Algorithms for portfolio management based on the newton method. In Proceedings of International Conference on Machine Learning. 9–16.

BORODIN, A., EL-YANIV, R., AND GOGAN, V. 2004. Can we learn to beat the best stock. Journal of Artificial Intelligence Research 21, 579–594.

Dochow, Robert. “Portfolio Selection Problems.” Online Algorithms for the Portfolio Selection Problem, 2016, pp. 9–43., doi:10.1007/978-3-658-13528-7_2.

Main idea:

Applying SVM and RCGA to generate an optimal fitness function.

Including the classification of asset and the MOP model.

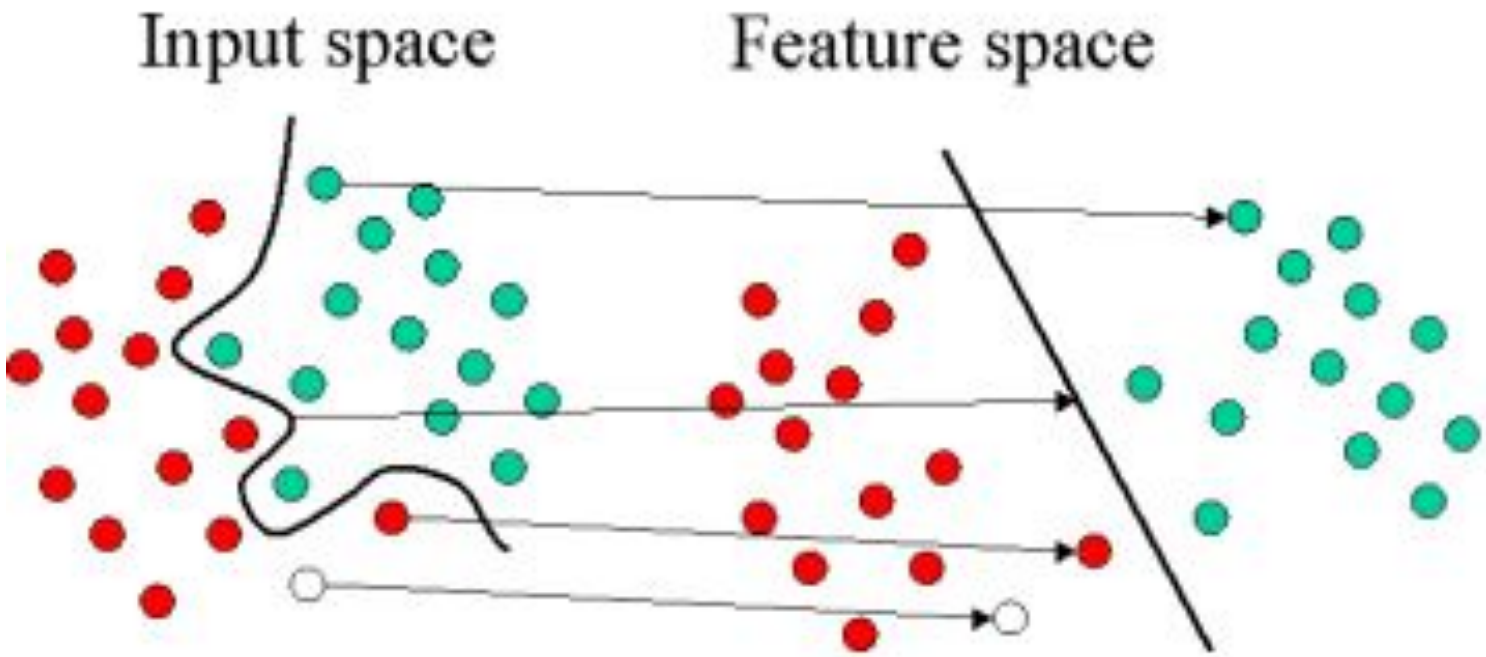
Introduction

- Data pre-processing
  - Classification of assets
    - SVM - by LIBSVM
- Algorithm application
  - Parameter settings for model
  - Modeling fitness function by MOP
  - RCGA solving MOP
- Performance & Critic

Outline

Data Preparation

- The assets are classified by SVM into 3 different groups.
  - High-yield
  - Low-risky
  - Liquidity



$$\max_{\alpha} L_D(\alpha) = \sum_{i=1}^{m} \alpha_i - \frac{1}{2} \sum_{i,j=1}^{m} \alpha_i \alpha_j y_i y_j K(x_i, x_j)$$

$$\text{subject to} \quad 0 \le \alpha_i \le C, \quad i = 1, \ldots, m,$$

$$\sum_{i=1}^{m} \alpha_i y_i = 0.$$

Algorithm

MOP models

$$\text{(MOP)}\quad \max f_1(x) = \sum_{i=1}^{n} r_i^{12} x_i \quad \text{(Short term return)}$$

$$\max f_2(x) = \sum_{i=1}^{n} r_i^{36} x_i \quad \text{(Long term return)}$$

$$\min f_3(x) = \sum_{t=1}^{T} \frac{\left|\sum_{i=1}^{n}(r_{it} - r_i)x_i\right| + \sum_{i=1}^{n}(r_i - r_{it})x_i}{2T} \quad \text{(Risk)}$$

$$\max f_4(x) = \sum_{i=1}^{n} L_i x_i \quad \text{(Liquidity)}$$

$$\text{subject to} \quad \sum_{i=1}^{n} x_i = 1, \quad \text{(Capital budget constraint)}$$

$$\sum_{i=1}^{n} y_i = h, \quad \text{(Number of assets held in the portfolio)}$$

$$x_i \le u_i y_i, i = 1, 2, \ldots, n, \quad \text{(Maximal fraction invested in single asset)}$$

$$x_i \ge l_i y_i, i = 1, 2, \ldots, n, \quad \text{(Minimal fraction invested in single asset)}$$

$$x_i \ge 0, i = 1, 2, \ldots, n, \quad \text{(No short selling of assets)}$$

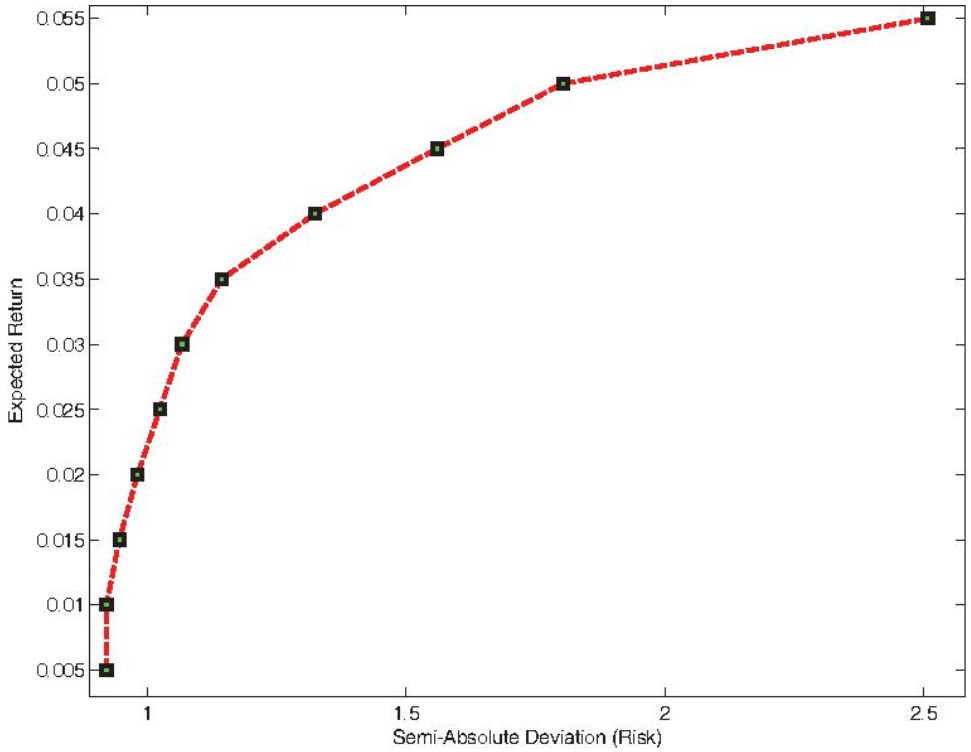
$$y_i \in \{0, 1\}, i = 1, 2, \ldots, n.$$

Developed by Gupta et al.

Algorithm

Goal:
Find the optimized fitness function to qualify the assets

- Returns
  - Short-term returns (12-month)
  - Long-term returns (36-month)
- Liquidity
- Risk
  - Expected semi-absolute deviation of return of the portfolio below the expected return



Algorithm

Modelling fitness function by MOP

Fitness evaluation

The way to trade off from maximizing the return/ minimum risk/ maximum liquidity.

The fitness function is the sum up of short term return$(f_1(x))$ + long term return$(f_2(x))$ - risk$(f_3(x))$ + liquidity$(f_4(x))$ but with 4 different coefficients. A penalty will be applied if the sum of the fraction of assets is 0.001 from 1 which means not all capital is used efficiently with penalty coefficient P. $f_5(x) = |\sum_{i=1} x_i - 1|$

$$Fitness = w_1 f_1(x) + w_2 f_2(x) - w_3 f_3(x) + w_4 f_4(x) - P f_5(x)$$

Algorithm

Using RCGA to solve MOP

- We use Real coded Genetic Algorithm to solve the MOP problem
- The Main idea for RCGA is
  - by generating chromosome, we set up a fixed length(n) of each chromosome
  - where n represents the number of assets in the respective class (High-yield, Low Risky and Liquidity).
  - For initialization, a random mask is generated with the format restricted and a fixed number of 1’s contained.

Algorithm

Using RCGA to solve MOP

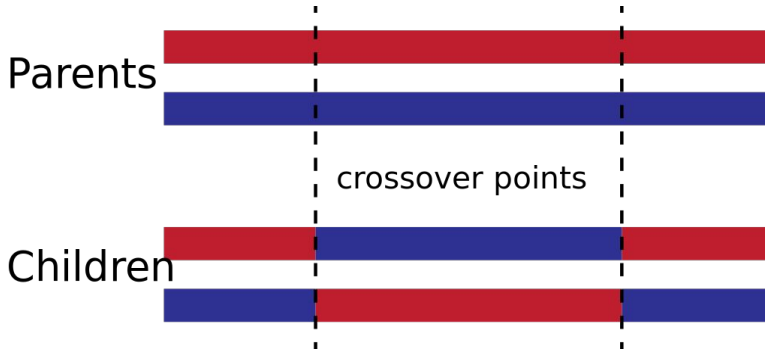
- The weight of the gene corresponding to the selected asset(xi):
  - The Maximal & minimal fraction of the capital could be invested.

- Gene is characterized by the value it takes (allele) and the position it is placed(locus).
  - Each bit indicates the selection(1) or rejection(0) of the corresponding asset.

Algorithm

Using RCGA to solve MOP

- To implement the RCGA, we need to clarify the crossover and mutation operation
  - We use Two-point crossover
    - Pick two random cutting point on chromosomes then swap the bit value of two chromosomes in between.



Algorithm

Using RCGA to solve MOP

- Pseudo code for crossover-point operator:

```
procedure SX(C1, C2)
    select two crossover points s & t
  until(C1 & C2 have equal number of 1's between
    t = t-1
  enduntil
  for(i = s to t)
    temp = C1[i]
    C1[i] = C2[i]
    C2[i] = temp
  endfor
endprocedure
```

Algorithm

Using RCGA to solve MOP

- Mutation operation:
  - If the chromosome is mutated by itself where mask bit value of the cutting points are ‘0’ and ‘1’, then a new gene will be generated by the same way of the weight generation
  - where $l_(r)y_(r) \leq x_(r) \leq u_(r)y_(r)$

Performance

Experimental Results

- Class 1（Liquidity Assets)

Corresponding to
$\omega_(1) = 0.2, \omega_(2) = 0.25, \omega_(3) = 0.2, \omega_(4) = 0.35$
we obtained the desired portfolio by solving the model (MOP).
As the assets are classified by high liquidity, a higher weight is set on the fitness function

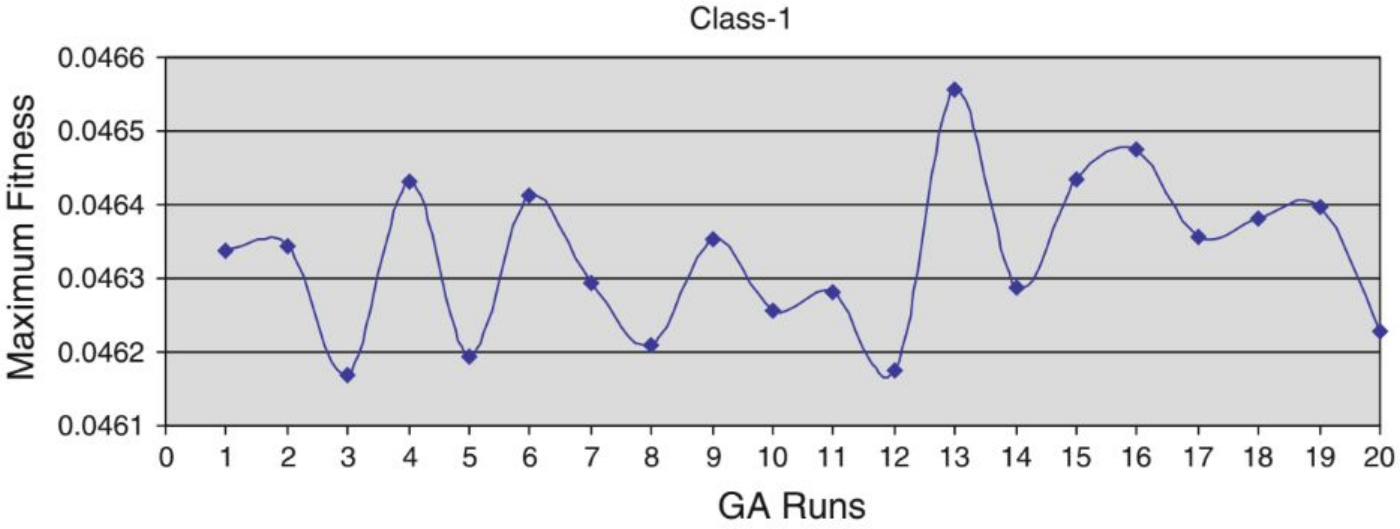


Fig. 4 Maximum fitness vs. GA runs for Class 1

Performance

Experimental Results

- Class 2 (High-yield Assets)
- Corresponding to $\omega(1) = 0.3, \omega(2) = 0.35, \omega(3) = 0.2, \omega(4) = 0.15$, we obtain the desired portfolio by solving the model (MOP).
- As the assets are classified by high yield (short-term & long-term), the priority is given to the returns.($\omega(1), \omega(2)$)

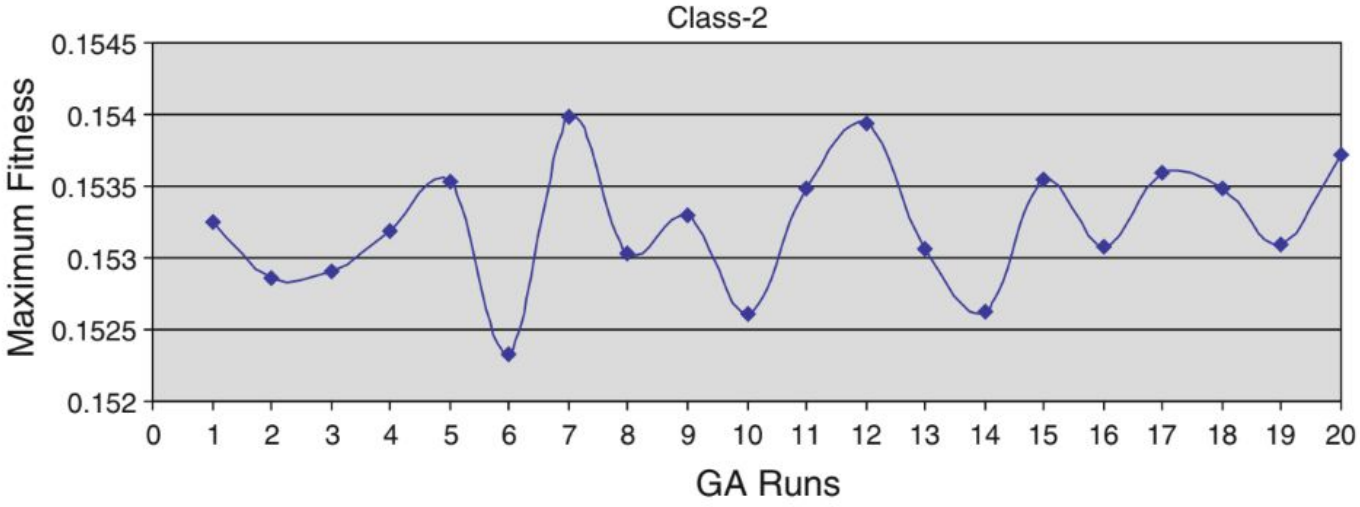


Fig. 5 Maximum fitness vs. GA runs for Class 2

Performance

Experimental Results

- Class 3 (Less-risky Assets)
- Corresponding to $\omega_(1) = 0.17, \omega_(2) = 0.23, \omega_(3) = 0.45, \omega_(4) = 0.15$
- we obtain the desired portfolio by solving the model (MOP). It may be noted that class 3 is of less-risky assets, therefore, the highest weightage (w3) is given to risk objective.

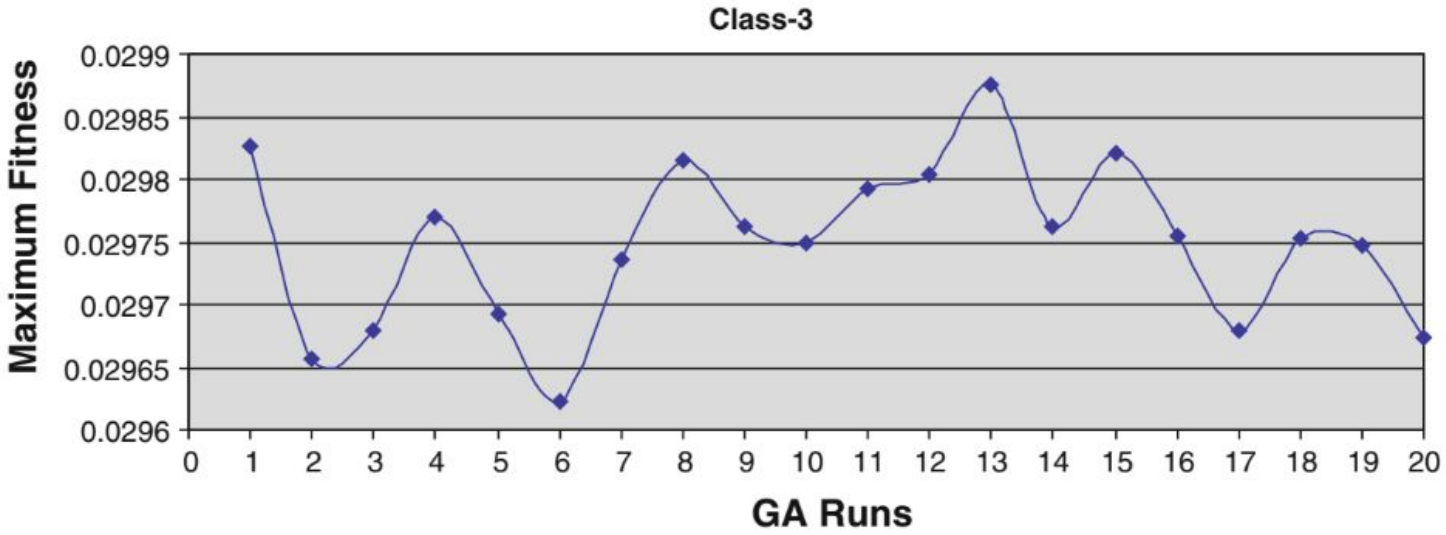


Fig. 6 Maximum fitness vs. GA runs for Class 3

Performance

Experimental Results

- It may be noted that various multicriteria decision making techniques can be used to determine the weights of the different objective functions.

- Based upon investor-preferences, Analytical hierarchy process (AHP) is a good technique to determine the weights.

Performance

Experimental Results

Table 5 Solution statistics for 20 GA runs for the various classes

	Class		
	Class 1	Class 2	Class 3
Best fitness	0.046555	0.153982	0.029875
Average fitness	0.0463282	0.1532298	0.0297486
Standard deviation	0.000105604	0.000439727	6.52028E-05
Coefficient of variation (%)	0.227947185	0.286972182	0.219179529

Table 6 Attainment values of the various objectives

Objective	Class		
	Class 1	Class 2	Class 3
Short term return	0.165134	**0.269611**	0.152307
Long term return	0.181297	**0.340519**	0.202851
Risk	0.190471	0.232001	**0.158369**
Liquidity	**0.017995**	0.002114	0.006025

in comparison to class 1 and class 2, but that supposes accepting medium level of expected returns.

Conclusion

The
Main Idea

- This design of fitness function relies on GA to solve how the weight is distributed.
- First use SVM to filter and try to mutate for the best asset groups.
- After classification of assets, different groups has its own way to decide how to prior all parameters.
- Very basic algorithm with relatively high error rate
- May be used as a example for future design.

Reference

- Gupta, P., Mehlawat, K, M. & Mittal, G.: Asset portfolio optimization using support vector machines and real-coded genetic algorithm, © Springer Science+Business Media, LLC. 2011, doi: 10.1007/s10898-011-9692-3