

From Measurement to Mastery

Elevating Forecasting Performance in Investment Management

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February 13th, 2024

Agenda

Introduction – Two Foundational Thoughts

Design Principles for Forecasts Scoring Systems

Improving Forecasts

All managers* say they have an investment process.
Very few** also claim to have an improvement process

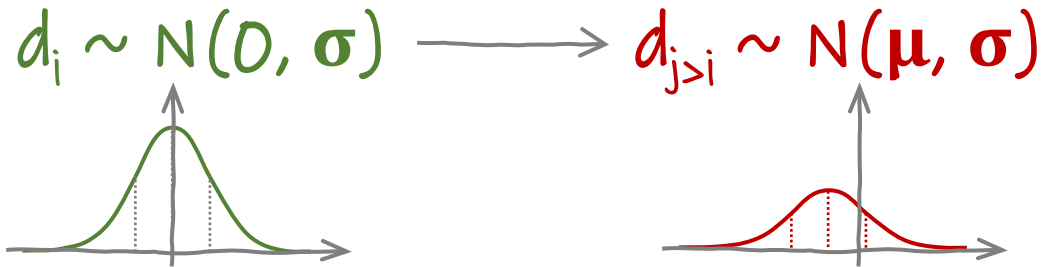


- Define project – team, charter, client value
 - Agree on how to measure improvement
 - Analyze what **improves client value**
 - Test and implement improvements
 - Control for lasting effect

*) all that I met

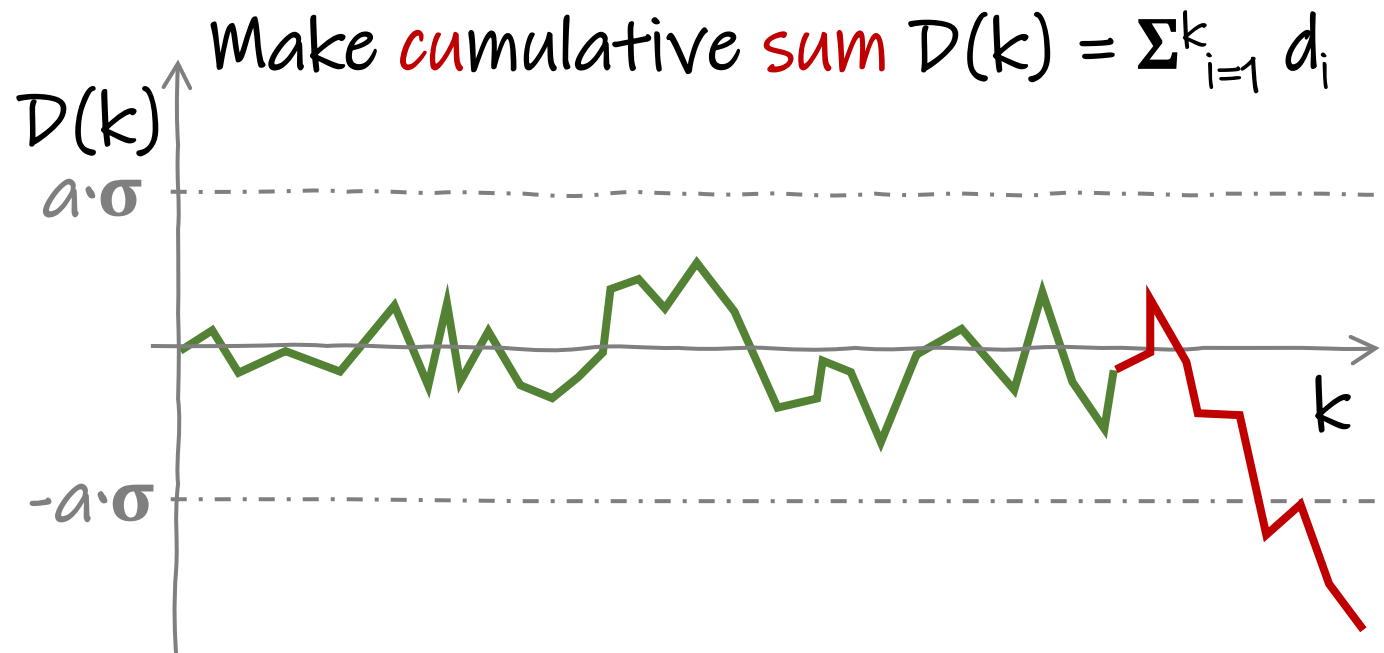
**) no fundamental manager that I know

The Cusum method* in process control is related to Change Point Analysis



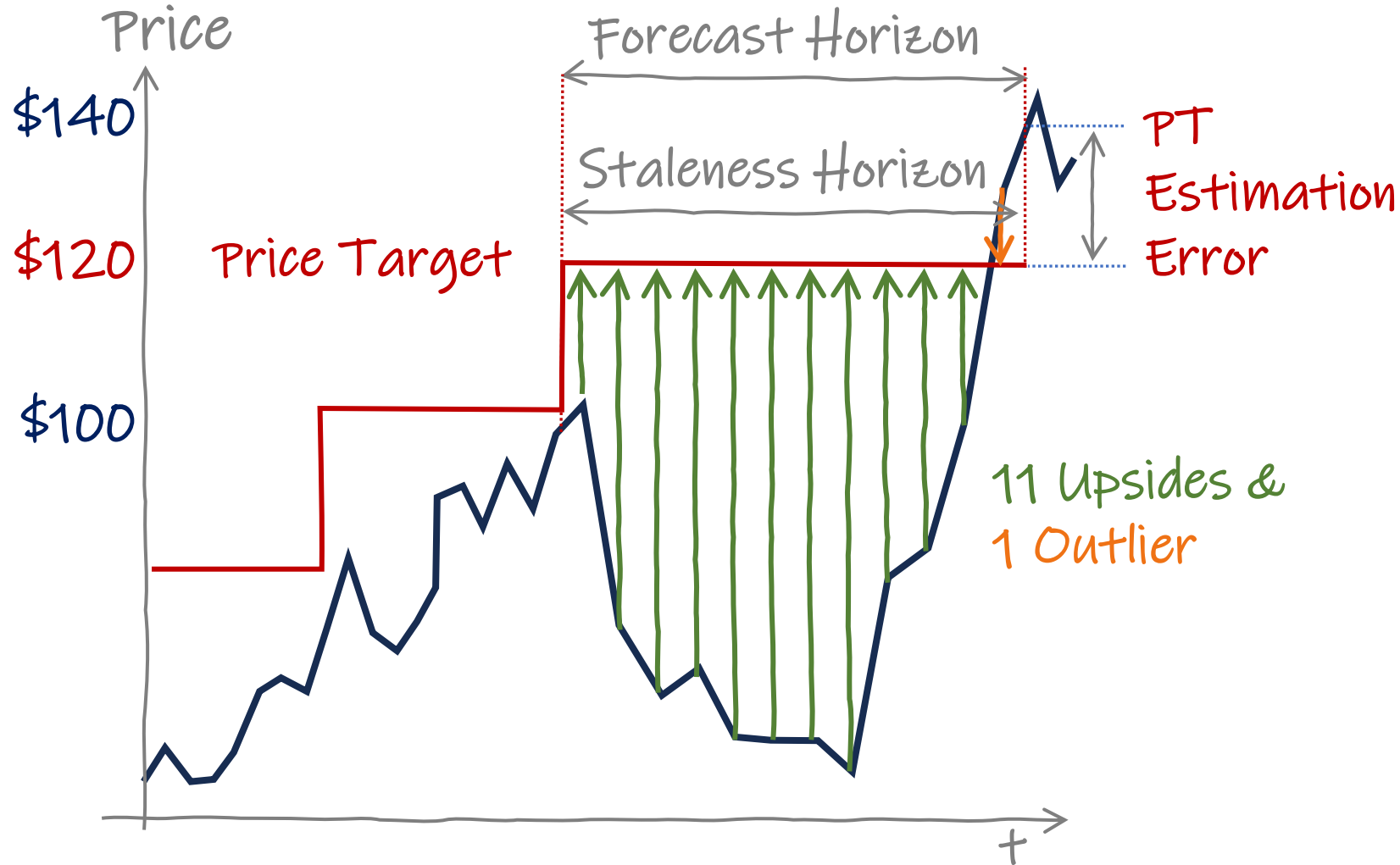
CUSUM

- Method of choice in industrial quality control.
- Optimal balance of responsiveness and false alarms.
- d_i must be independent (non-overlapping)
- Serial error cancelation

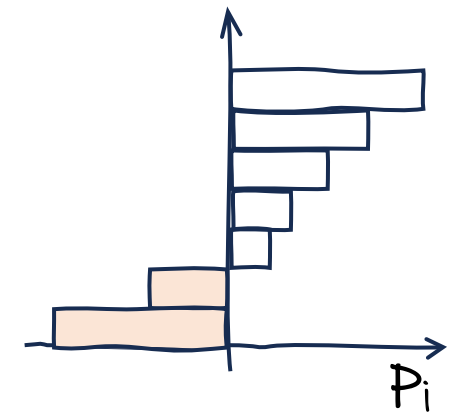


*) for an in-depth discussion of the Cusum see, D.M Hawkins, D.H. Howell, Cumulative Sum Charts and Charting for Quality Improvement, Springer (1998)

Today's talk is about measuring the quality of price target forecasts and their upside return forecasts



Across all stocks



Dictum: Score longs & shorts separately

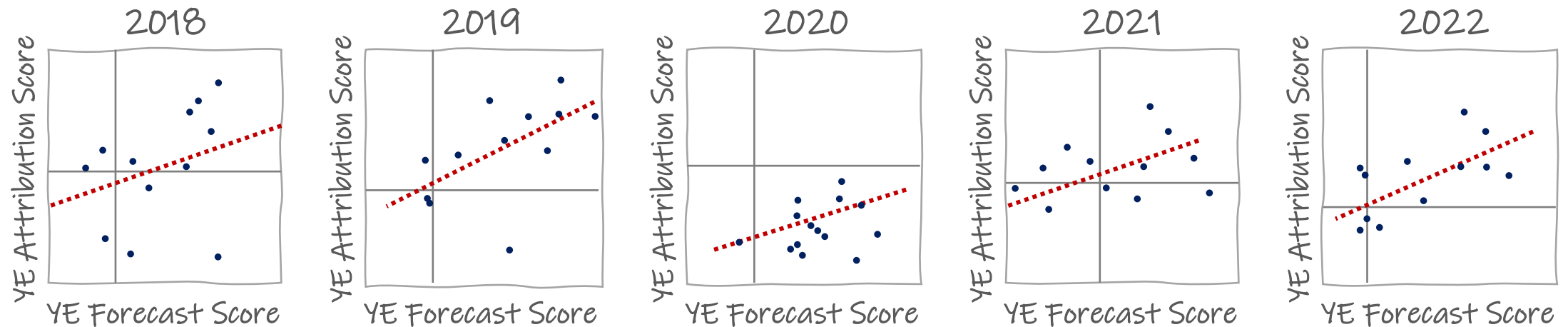
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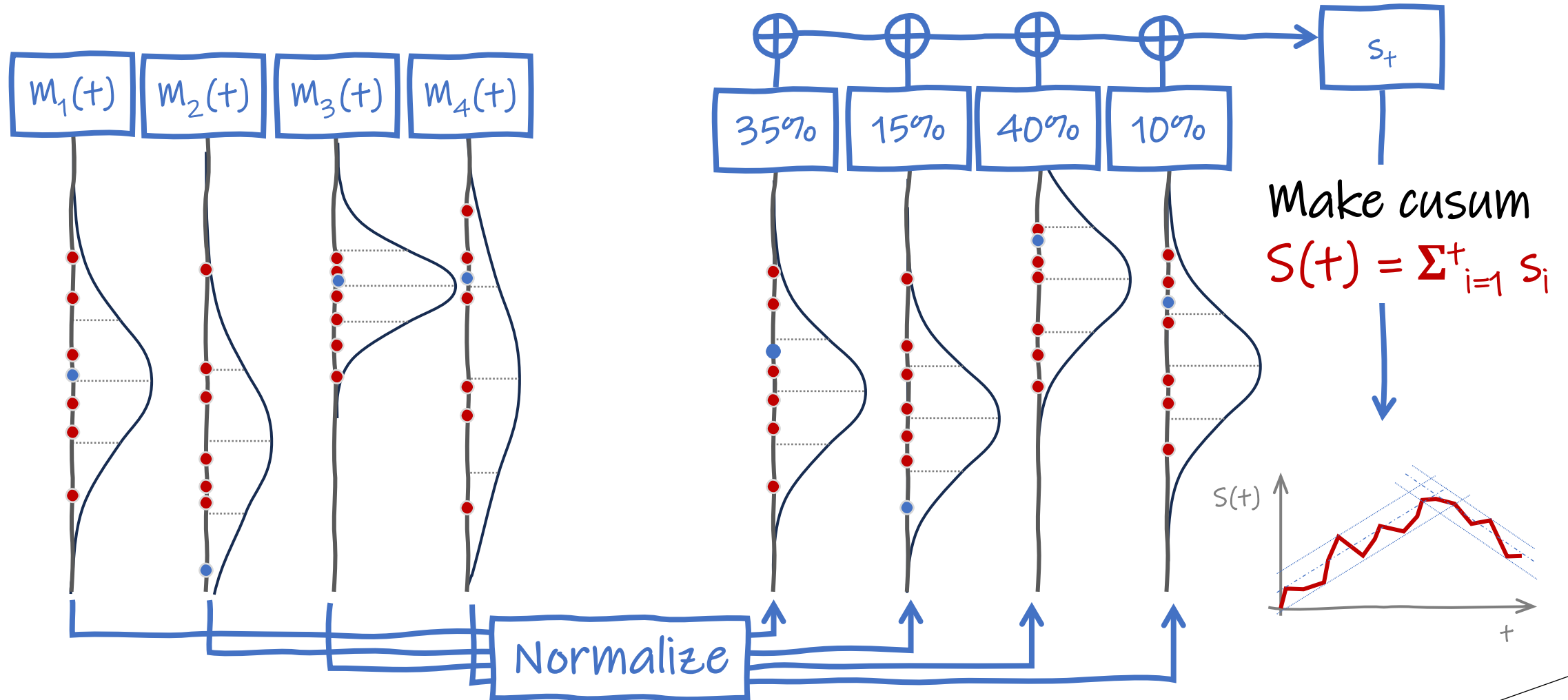
Improving Forecasts

Reliable measurements require accuracy, which can be gauged using other, independent measurements



For analysts covering 50-150 stocks and maintaining 10-40 active price targets the typical R^2 was 0.05...0.35 range out of sample

Robust statistics and error compensation (both serial and crosssectional) are key to meaningful scores



The reference point are individual attribution scores from a standard attribution* grouped by analyst

International Equity Fund vs MSCI World Ex-United States*

2 Factor Brinson Attribution

	International Equity Fund			MSCI World Ex-United States			Attribution Analysis (Base Currency)			Attribution Analysis (Local Currency)			
	Port. Average Weight	Port. Total Return	Port. Contrib. To Return	Bench. Average Weight	Bench. Total Return	Bench. Contrib. To Return	Allocation Effect	Selection Effect	Total Effect	Allocation Effect (Local)	Selection + Interaction (Local)	Total Currency Effect	Total Effect
Total	100.00	27.24	27.24	100.00	26.00	26.00	-0.07	1.31	1.24	-0.26	0.90	0.59	1.24
Adam Abramowitz	10.60	36.38	3.60	11.58	26.58	3.05	-0.01	0.81	0.00	-0.02	0.84	-0.02	0.00
Ben Baker	7.66	21.05	1.75	10.72	24.97	2.70	0.07	-0.27	-0.20	0.08	-0.30	0.01	-0.20
Carla Chaplin	9.42	19.61	2.00	6.53	17.49	1.15	-0.13	0.24	0.11	-0.16	0.30	-0.03	0.11
Dirk Deutsche	19.49	30.93	6.07	23.14	26.37	6.16	0.02	0.80	0.82	-0.01	0.68	0.15	0.82
Erin Esper	10.32	9.49	1.26	9.76	19.42	2.02	-0.00	-0.92	-0.92	-0.02	-0.95	0.04	-0.92
Frank Falone	15.45	28.63	4.34	13.59	29.54	3.92	0.07	-0.11	-0.04	0.06	-0.17	0.06	-0.04
Gil Germont	6.58	44.06	2.75	5.67	42.70	2.20	0.14	0.12	0.25	0.13	-0.05	0.17	0.25
Hanna Horten	7.85	29.82	2.34	8.10	28.73	2.29	0.02	0.10	0.13	0.02	-0.12	0.23	0.13
Ian Islander	1.86	19.04	0.33	3.41	18.06	0.62	0.13	0.01	0.15	0.08	0.05	0.01	0.15
Judith Jenkin	7.47	25.91	1.88	4.11	20.78	0.89	-0.15	0.29	0.14	-0.17	0.48	-0.17	0.14
Unassigned	2.36	37.71	0.84	3.23	26.96	0.86	-0.00	0.24	0.24	-0.00	0.14	0.10	0.24
[Cash]	0.92	8.80	0.08	--	--	--	-0.15	--	-0.15	-0.17	--	0.02	-0.15

M1

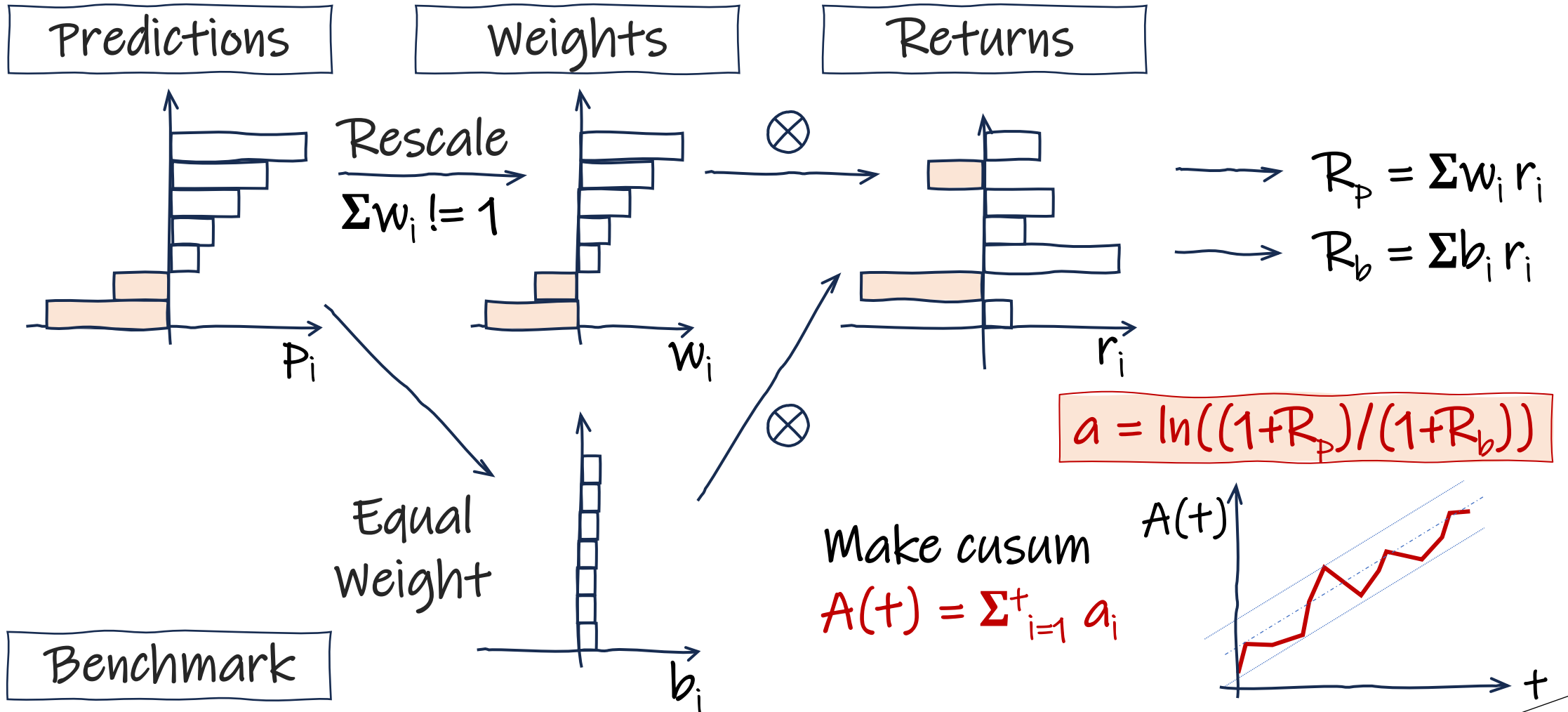
M2

M3

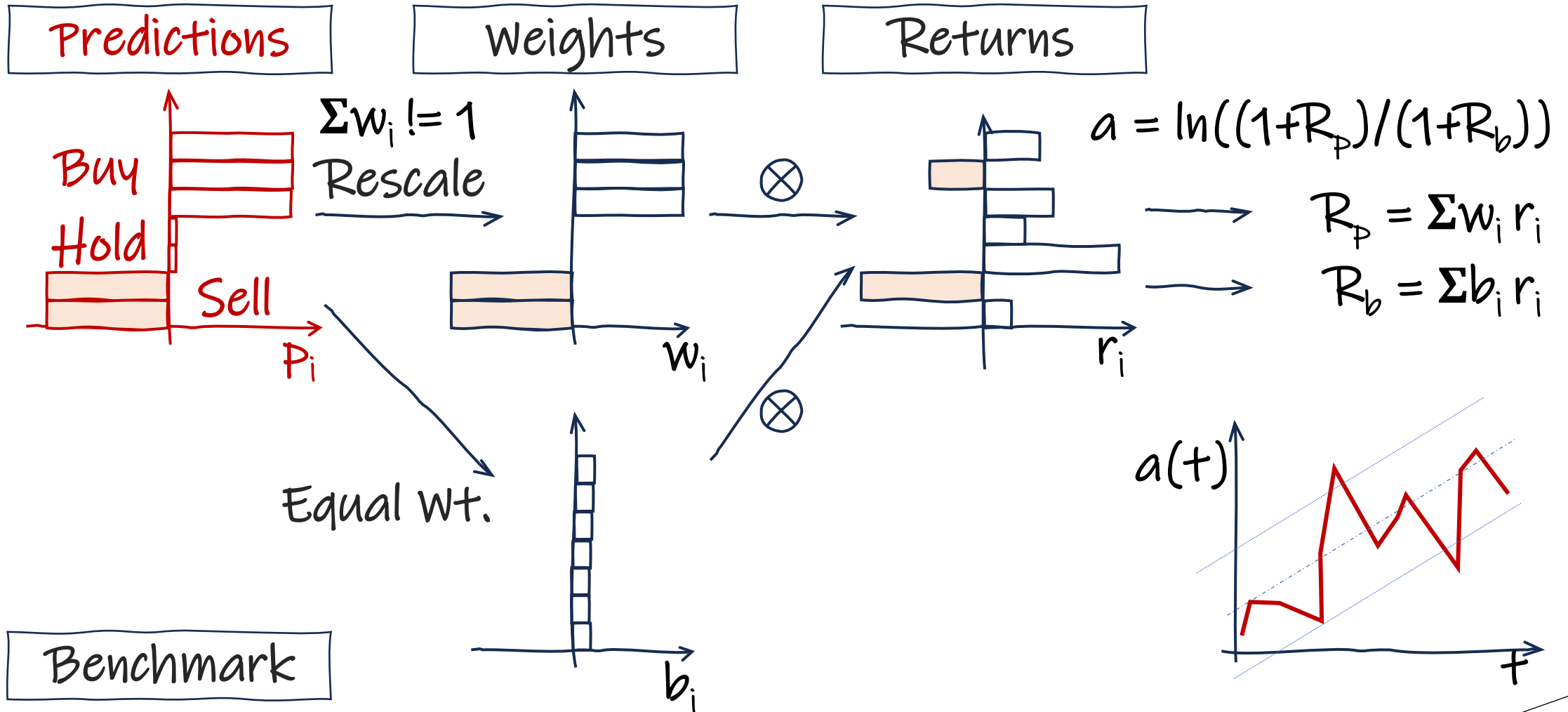
M4

*) Source: FactSet Research Systems, Inc.

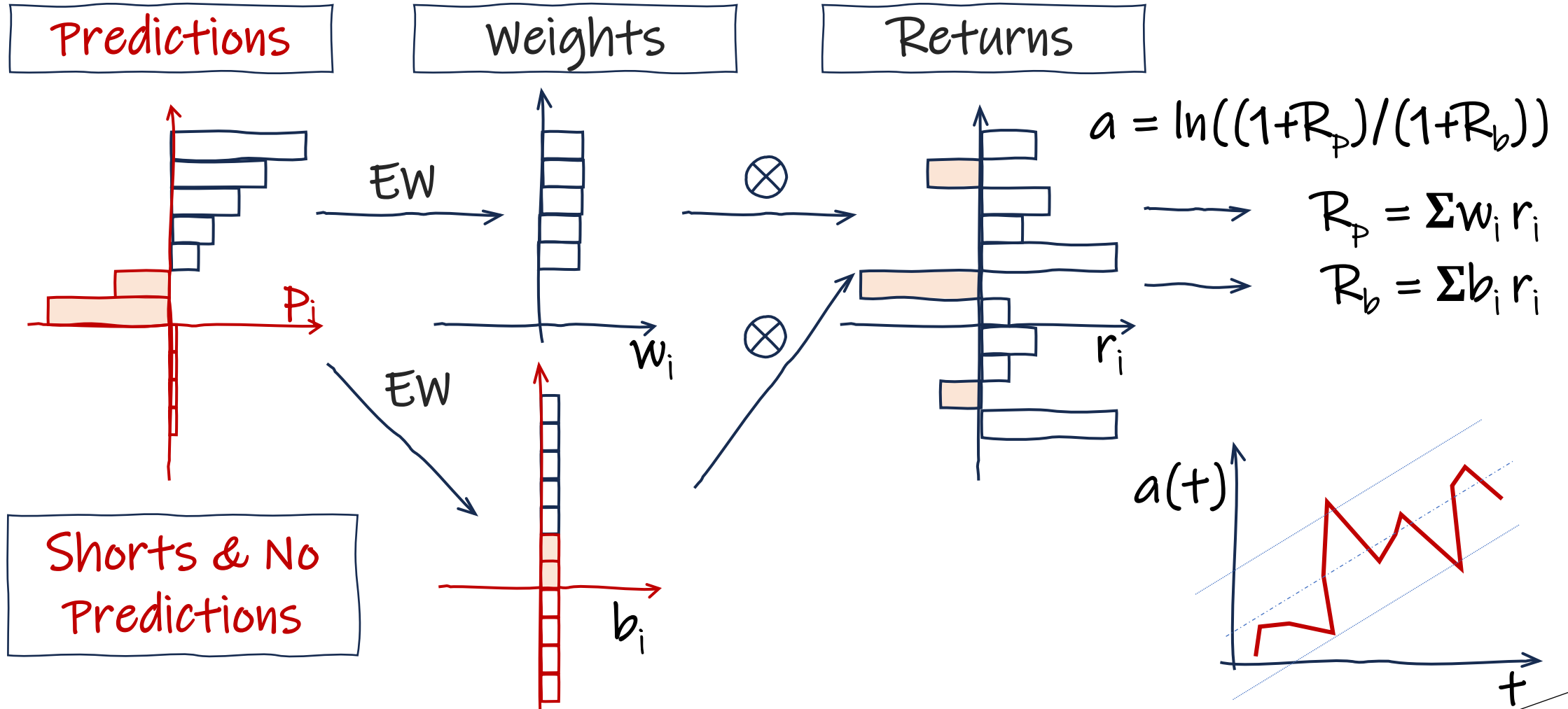
Portfolio type performance measures



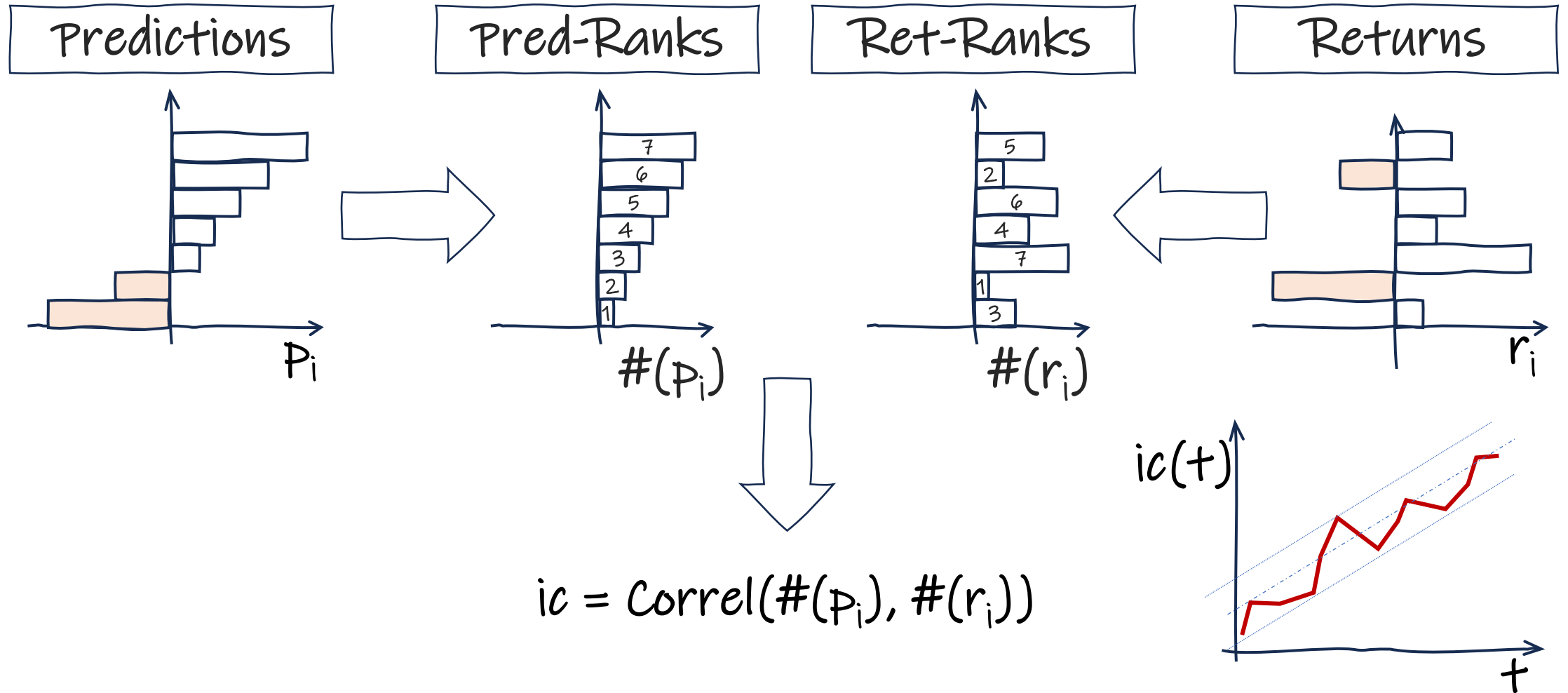
Portfolio type performance measures with buy-hold-sell recommendations (same, same, only more volatile)



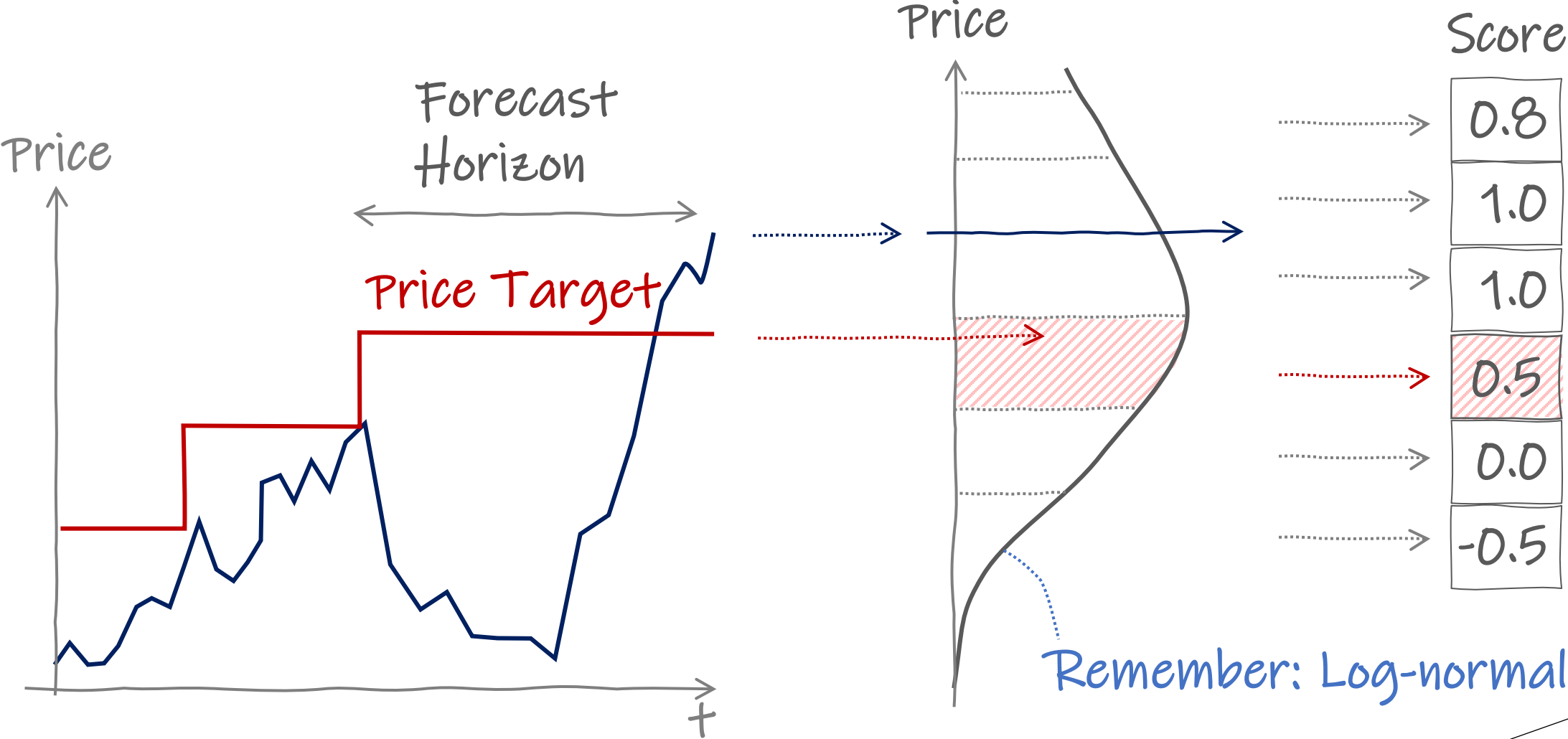
Portfolio type performance measures - stocks with predictions vs. all stocks in coverage



Correlation type performance measures

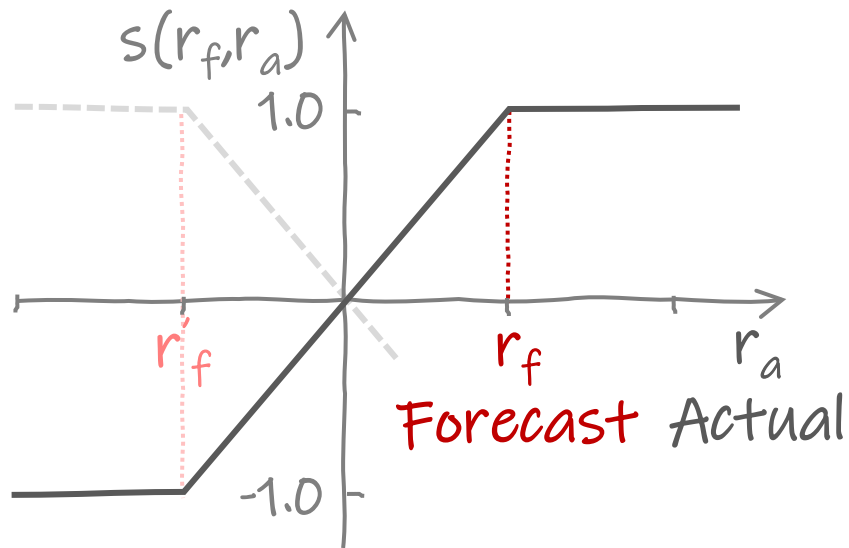


Proximity type forecast measures - Z-score mapping



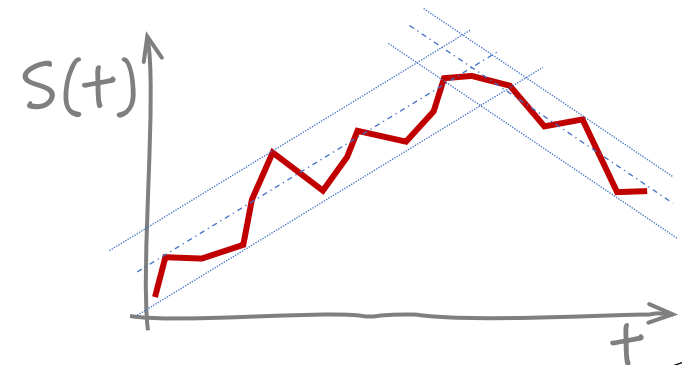
Proximity type forecast measures - Fractional Success Score

How much of the outcome was predicted, capped at 100% and -100%



$$s(r_f, r_a) = \begin{cases} \text{sign}(r_f, r_a) & \text{for } \text{abs}(r_a) > \text{abs}(r_f) \\ r_a/r_f & \text{for } \text{abs}(r_a) \leq \text{abs}(r_f) \\ 0 & \text{for } r_f = 0 \end{cases}$$

Make cusum $S(t) = \sum_{i=1}^t S_i$



This is a great way to quickly monitor forecasts over time in Excel, R, or Python

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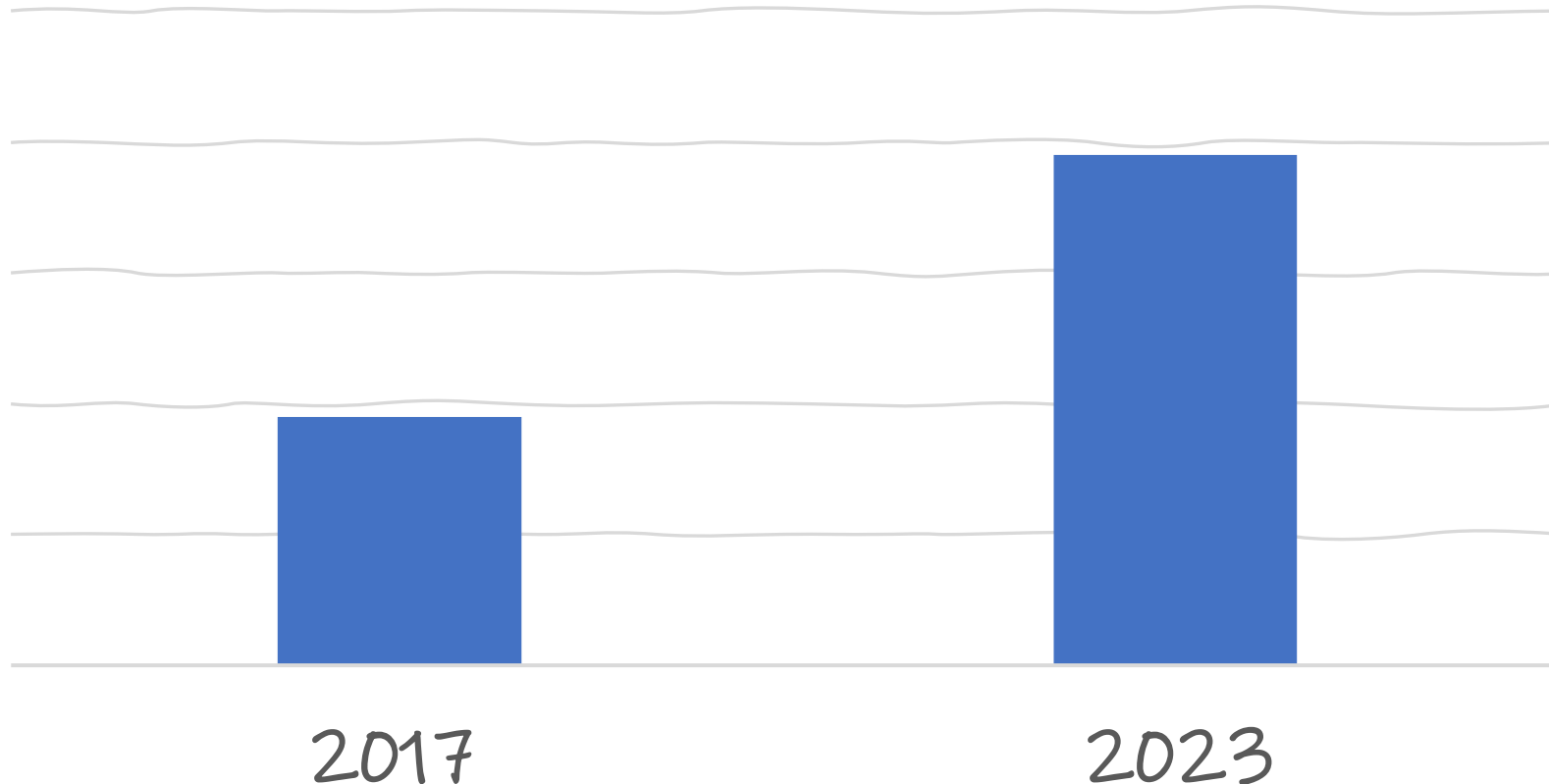
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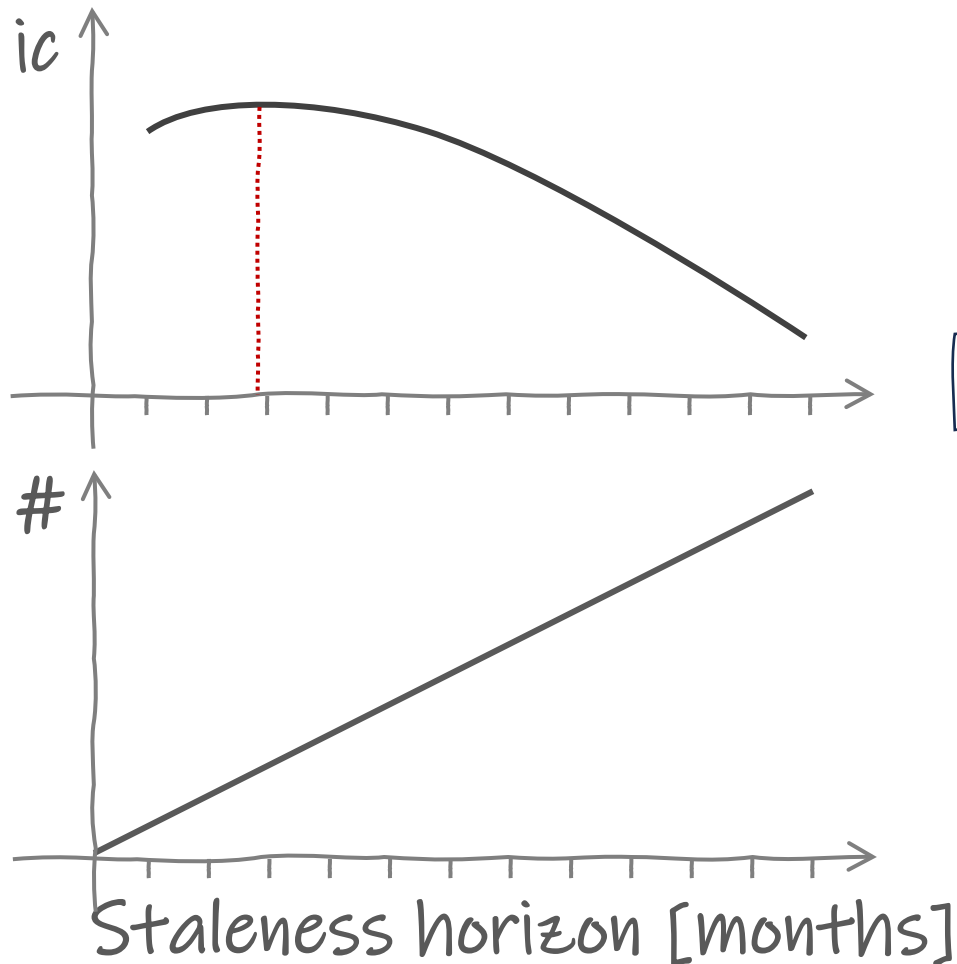
Improving Forecasts

Six years of improvement effort doubled forecasting performance

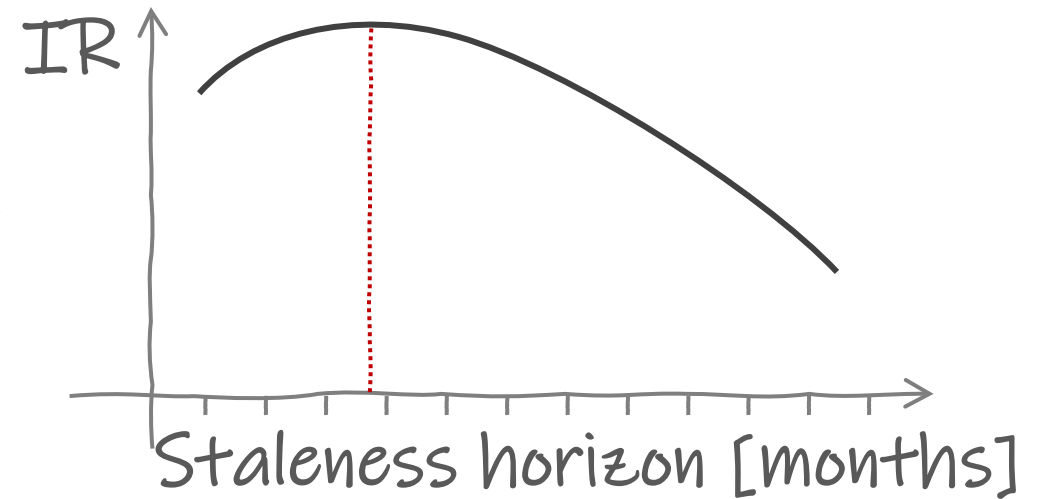
Firmwide All-time Median ic



Optimal staleness horizon improved forecasting strength by ~30%

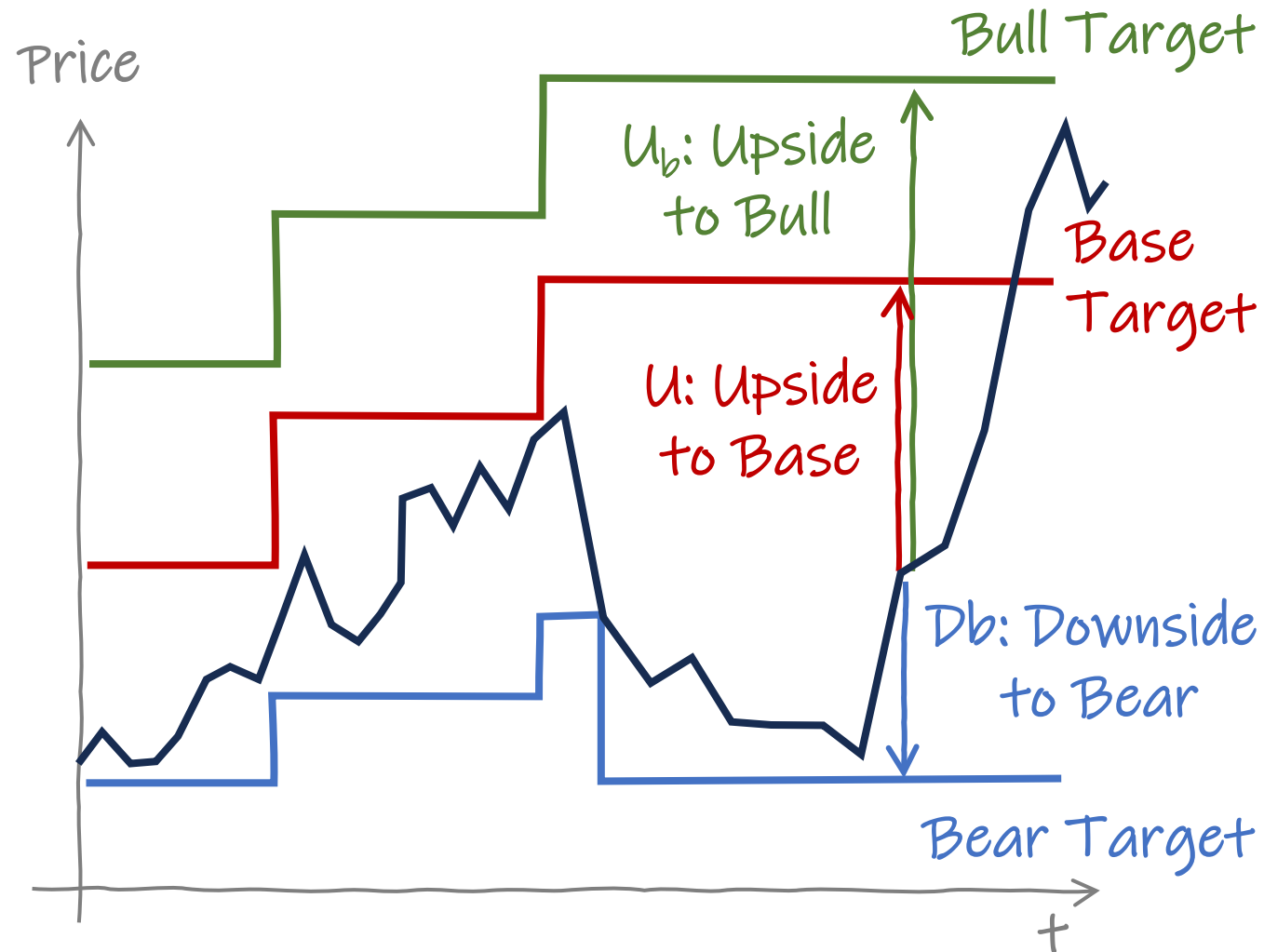


$$IR = ic \cdot \text{sqrt}(\#)$$



optimal staleness horizon for forecasts of fundamental analysts is ~3 months

Many analysts produce upper and lower limits to their price targets. How use them for forecasting?



Return Predictors p

$$p = U$$

$$p = \frac{U}{D_b}$$

$$p = \frac{U}{D_b} U$$

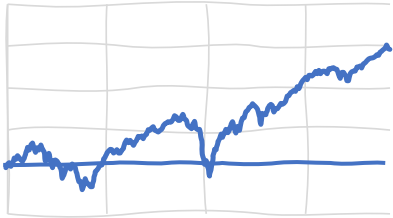
$$p = \frac{U + Ub}{2}$$

$$p = \frac{aU + bUb - cDb}{a + b + c}$$

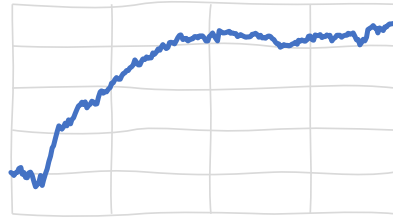
$$p = \dots$$

Excuse: Can quant research help fundamental investment managers make better predictions?

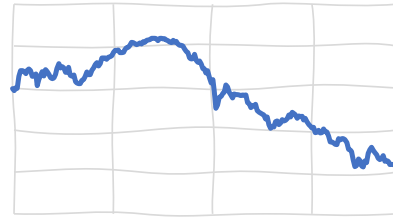
Market



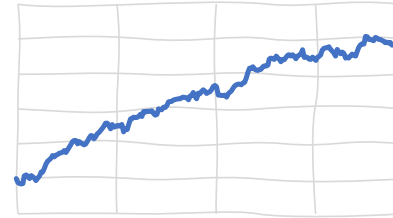
Value



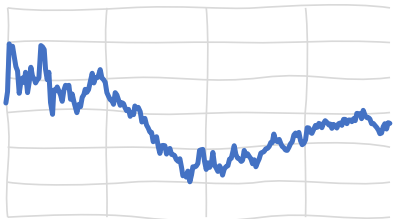
Book Value



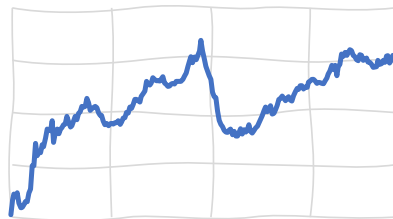
Dividend Yield



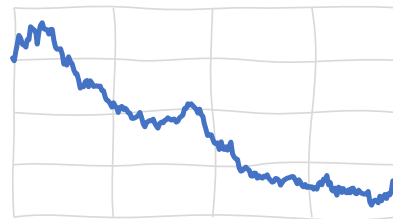
Liquidity



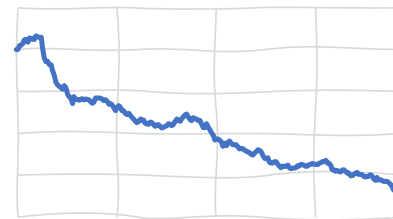
Momentum



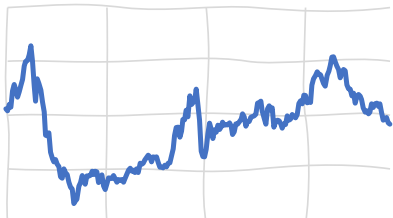
Size



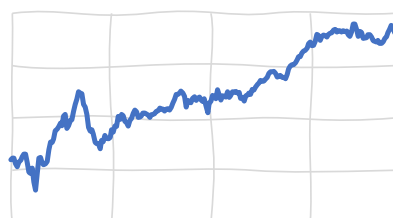
Earnings Var.



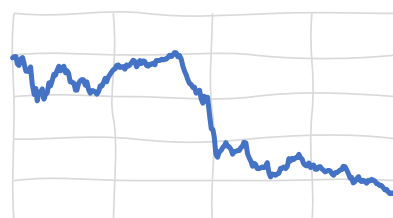
Growth



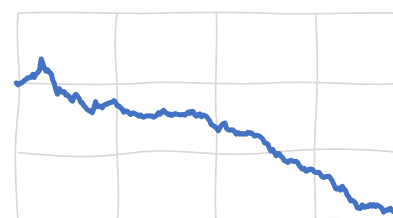
Revenues



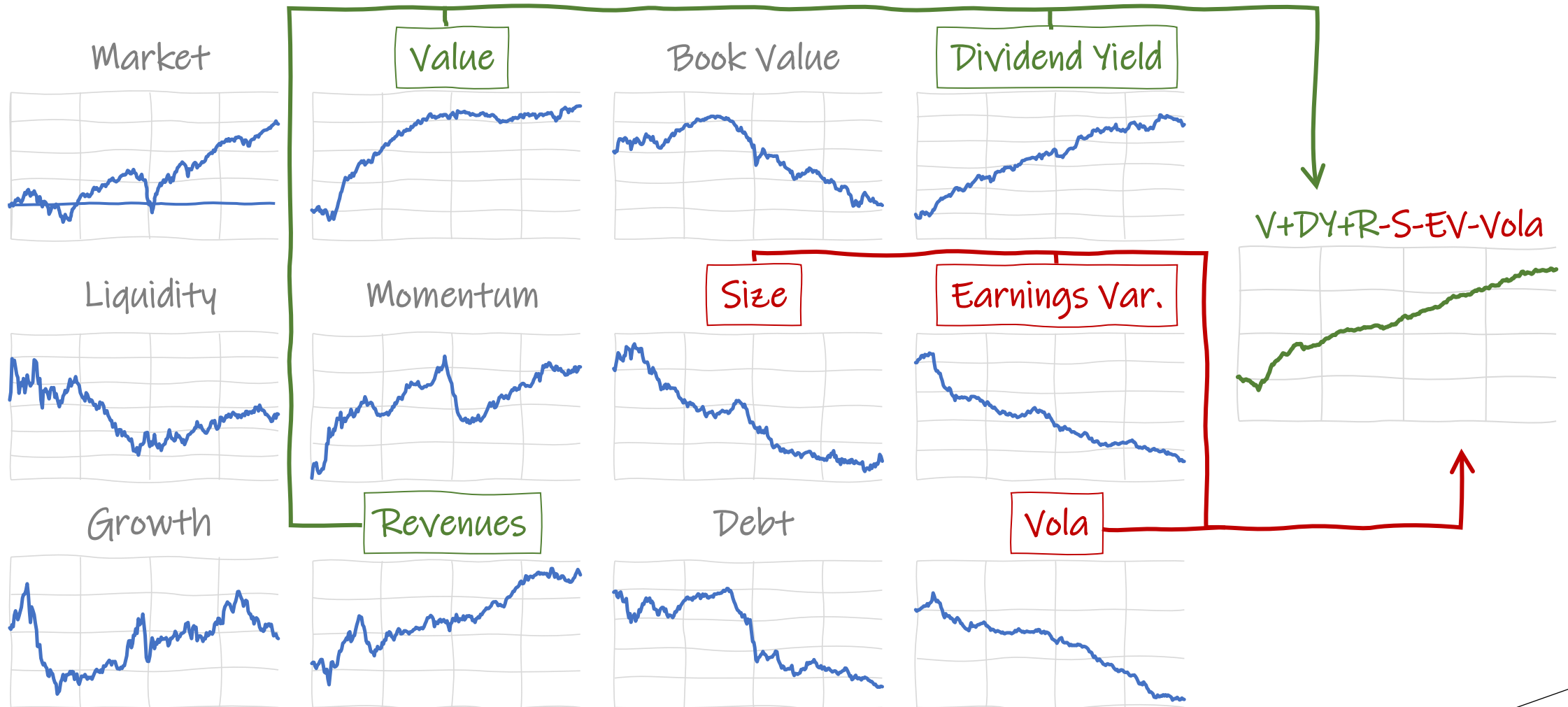
Debt



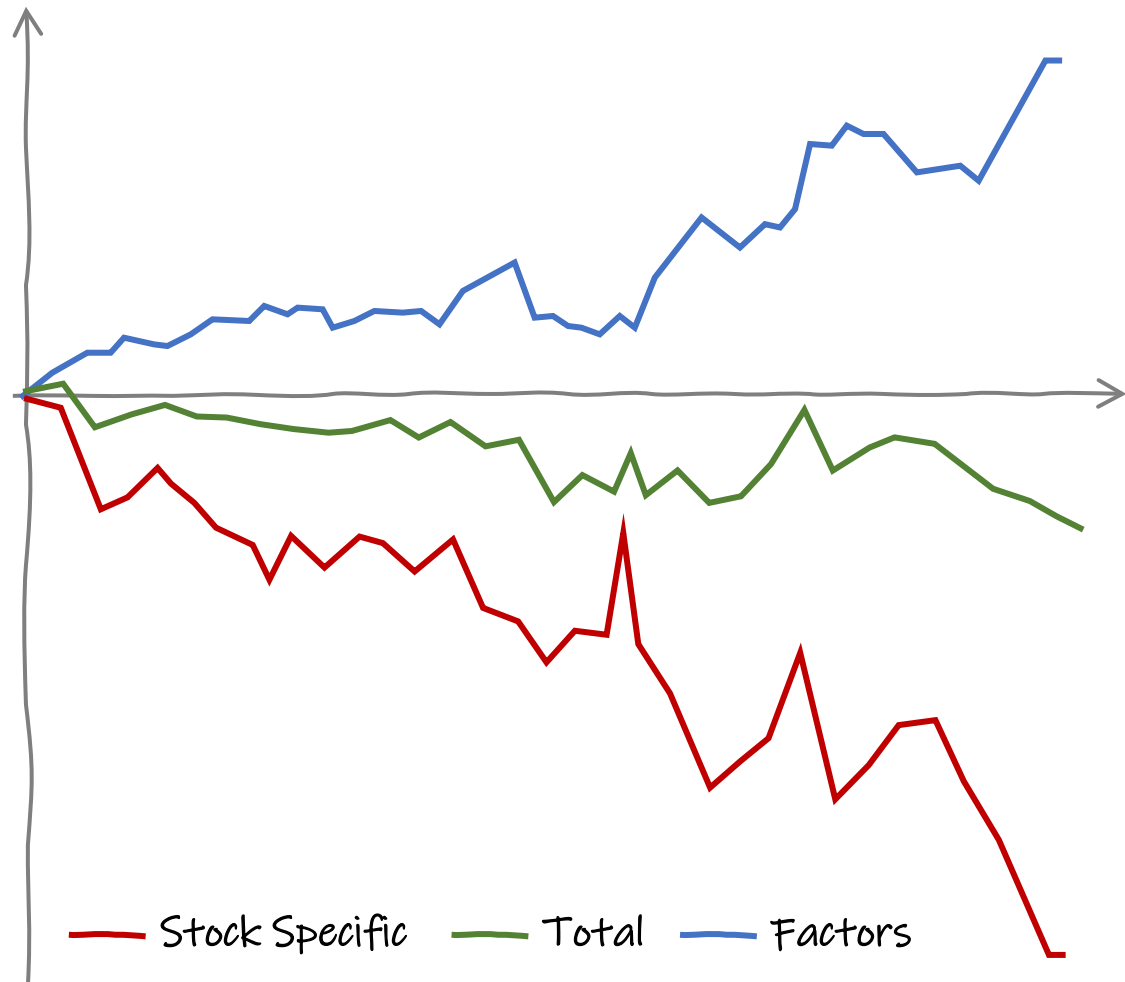
Vola



Excuse: Can quant research help fundamental investment managers make better predictions?

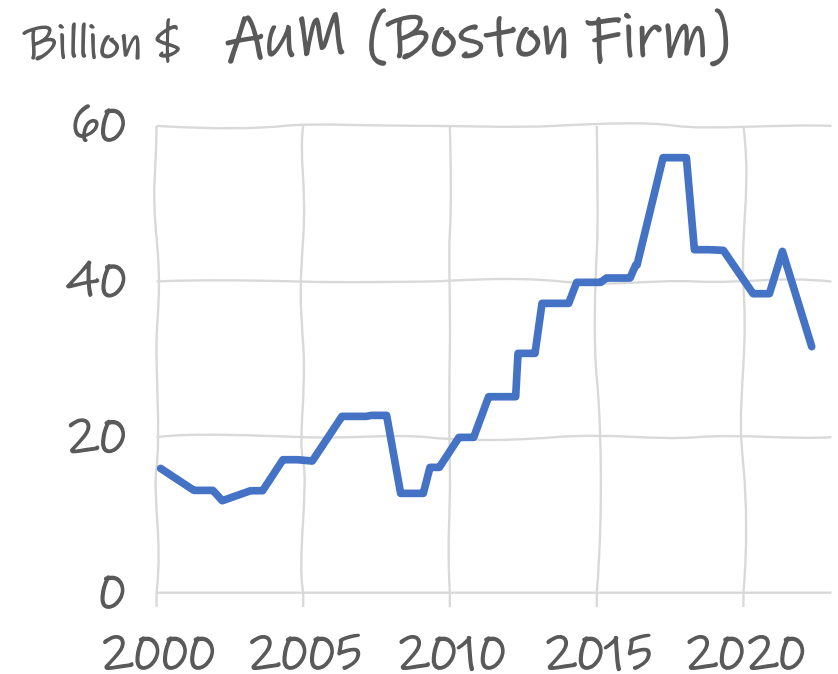
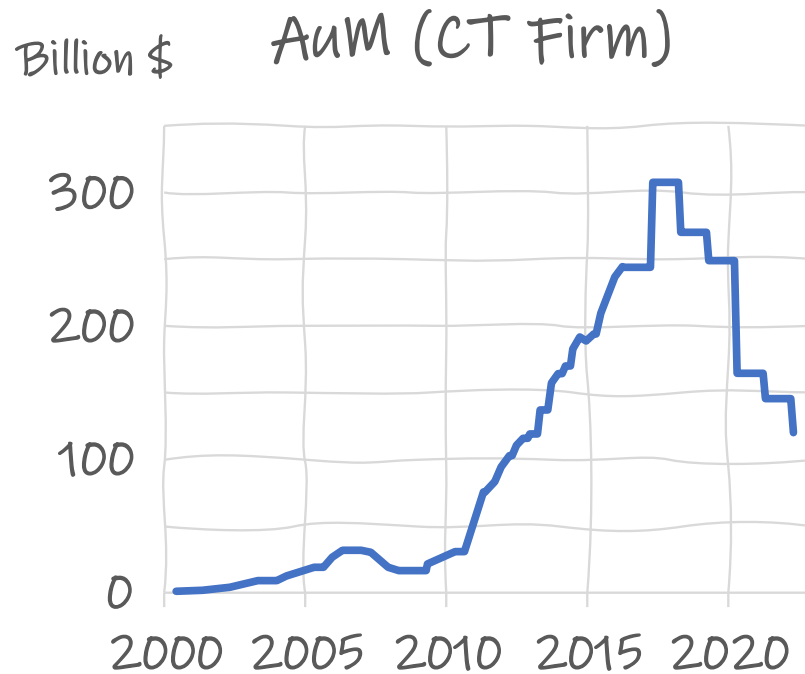


Excuse: Can quant research help itself? Three and a half years of after hours work in one chart



- Use forecast factor performance and factor loading to make stock level return forecast.
- Build unoptimized portfolios that
 - Are long only
 - have ~120 stocks
 - Are industry or sector Neutral
 - Are "equal" active weight
- Model 10y in sample – 5y out of sample
- Explored ~12 different strategies
- Started with constant factor premiums
- Then made increasingly sophisticated forecasts (robust regression, various ARIMA models, various ETS models, various LOESS models, neural networks)

Excuse: Can quant research help itself?



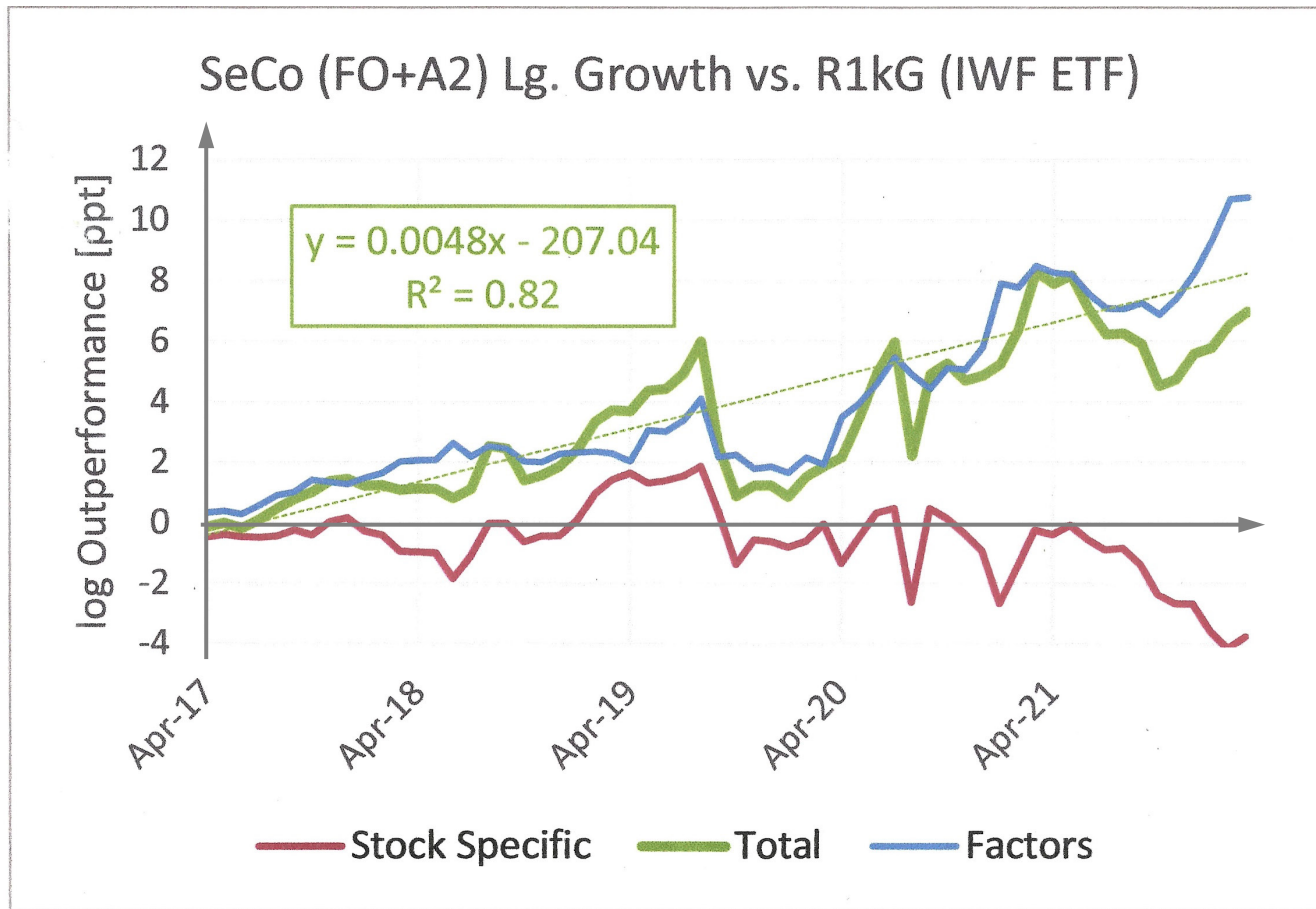
Source: <https://aum13f.com/>

2/13/2024

From Measurement to Mastery - Elevating Forecasting Performance

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Combining quant and fundamental forecasts solves the issue and leads to 70% improvement of return predictor



$$\vec{w} = \frac{1}{\gamma} \hat{\Sigma}^{-1} \vec{U}$$

$$\hat{\Sigma} = \begin{pmatrix} \sigma_1^2 & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & \sigma_N^2 \end{pmatrix}$$

$$w_i = \frac{U_i}{\gamma \sigma_i^2}$$

Return Predictor p

$$p = \frac{U}{\left(\frac{1}{4} (U_{bull} - D_{bear}) \right)^2}$$

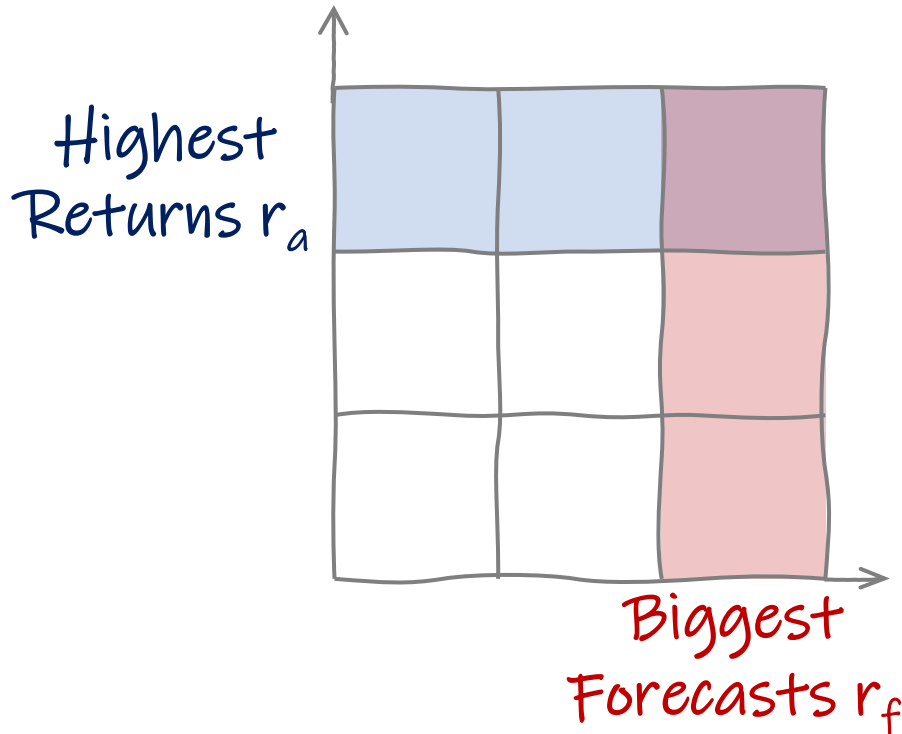
Summary

- Measuring is the prerequisite of improving
- Improvements are to be measured in terms of client value
- Measurement should assess different aspects of performance to exploit cross-sectional error cancelation. I.e., use portfolio-type, correlation type, and proximity type measures.
- Measurement should employ a cusum time series approach of statistically independent measurements to enable serial error cancelation
- Use all available forecasts and use them as they are intended.
- Beware of the idiosyncratic dog eating your factor lunch

Thank you!

Questions, comments: armin.grueneich@web.de

Filtering can improve error cancelation of scores. The Brier score is used for probability forecasts.



Brier Score

$$BS = 1/N \sum_{i=1}^N (f_i - o_i)^2$$

Filtering forecasts or outcomes produces a "new" score improving error cancelation

Brier Score is used to score the accuracy of probability type forecasts