Looking Ahead

"An extrovert quant? When talking to one, he looks at your shoes rather than his."
It's not a kind joke, and many quants can even hold a conversation, but today I will talk about an area of trading where quants have been staring at their own feet for far too long.

Over the years, I have worked in both systematic (quant) and discretionary shops. Quants are very good in managing risk and sizing bets. We have various frameworks to handle the optimal allocation to a bet, starting at the seminal mean-variance optimization framework by Harry Markowitz and continuing with the Kelly criteria used so effectively by Ed Thorp. My good friend Rob Carver writes extensively about optimal risk allocation, and I always enjoy his blogs.

Discretionary traders spend more time analysing specific trades and then hold a much more concentrated position. Quants hate this approach and deride discretionary traders: we don't like to "bet the house". Nevertheless, spending time analysing trades can be valuable.

Playing It Out

At one discretionary shop I worked in, the traders were interested in understanding what CTAs would do "if". I wrote for them a CTA model that ran Monte Carlo simulations, "playing the position forward": if bond prices were to go up 3% in the next 10 days, CTAs would buy $X of treasuries, leading to a price impact of $Y. But if the price goes even higher, volatility is likely to rise, leading to CTAs selling. The discretionary trader had their own expectations about prices, but playing these scenarios helped them figure out what was the best way to put on their own trade and how the trade is likely to play out.

Groundhog Day

Conversely, in CTA land, every day we magically discover a set of new optimal positions. With complete shock of our new discovery, we then set about chasing this new magical optimal equilibrium. This is precisely what you should do if you are a Bayesian and live in cost-free land, but unfortunately, trades cost money.

Quants have spent considerable time and energy thinking about optimal trading from current position A to the new magical optimal position B. Along the way, there have been beautiful mathematical successes. We know that given linear cost (in size), we trade from A to within a small buffer around B. Given a quadratic cost structure, we trade a fixed portion of the distance between A and B.

But for all these improvements, quants still insist on living in Punxsutawney, waiting for tomorrow's positions hedge(fund)hog to peep out of its hole.

The Dead Zone Trend and The Trend Fade

We did sense long ago something was amiss.

Once upon a time my friend, Nick the Greek, did not like trading when trend was "small" in magnitude. His intuition was sound. CTAs spend most of their costs trading near the origin: a short-lived trend forms, and we chase the price up, only for the trend to reverse and for us to chase it going down, only to reverse

again. Since the stationary distribution of our signal is N(0,1), we spend *most* of our time near the origin, spending money waiting for the big trends to form: a little like a surfer paddling back and forth waiting for that big wave. Nick's intuition was to have a "dead zone" near the origin where we do not trade at all when trend is too small. Why don't we wait for trend to reach (say) 0.2 in magnitude and then we start paddling (building up risk) furiously?

Brilliant idea. Shame it did not work.

A related issue happens when the trend becomes too strong: we spend our time building up a sizeable position as trend reaches 1.5, but by the time trend becomes too strong (say, 4) we reduce our position. This is known as the "trend fade". Trend fade is expensive: we sell our position but when the trend reverses and goes back to 1.5 we buy it all back again! And then sell it all over again when trend goes back to zero.

So I tried hysteresis: On the way back from 4 to 1.5 I did not rebuild the position but instead waited till trend hits the origin before starting afresh.

Brilliant idea. Shame it did not work.

The Three Bodies Problem

As it turns out, both these ideas are sensible but also need a framework to make sense. We sensed we were not trading the right way, but we were lacking the mathematical tools to express our intuition.

And here is where we take a leaf out of our discretionary traders' book. We have to think not about moving from A to B, but where trend will be tomorrow, and the day after. It turns out to be surprisingly easy to do.

Let us examine the exponentially weighted moving average. Tomorrow's EWMA is given as: SLOW_EWMA(t+1) = W * SLOW_EWMA(t) + (1-W) P(t+1). And P(t+1) is, in expectation at least, close to P(t). This is a good approximation not just for t+1 but also quite a few days forward:

$$E[SLOW\_EWMA(t+n)] = W^n * SLOW\_EWMA(t) + (1- W^n) P(t)$$
$$E[FAST\_EWMA(t+n)] = V^n * SLOW\_EWMA(t) + (1- V^n) P(t)$$

We subtract the slow from the fast and can estimate MACD(t+n), for n=1,2,…

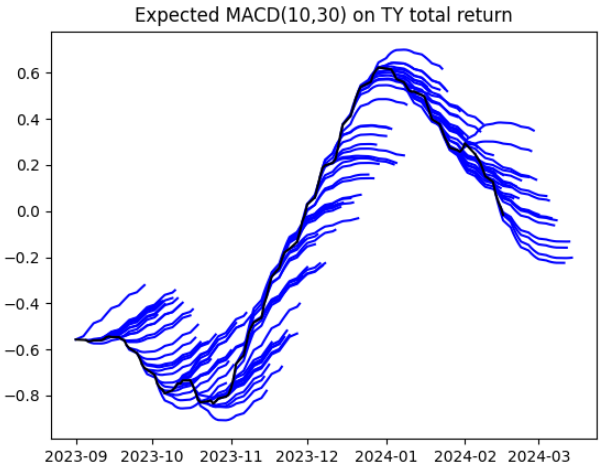

Figure 1: Exponentially weighted moving average crossover (in black), played forward in time (in blue)

Here is a plot playing this MACD(10,30) (in black) twenty days forward each day (in blue) and as you can tell, it works nicely in predicting where the black line is likely to go to.

It is a three bodies problem: the expected future depends only on three points: FAST(t), SLOW(t) and P(t) and will have slightly different behaviour depending on where P(t) sits in relations to the two averages.

There are two effects. Initially, FAST convergence to P(t) can dominate, so if P>FAST>SLOW, the value will drift up: not only is the trend positive, but tomorrow we expect it to increase. Eventually though, both FAST(t+n) and SLOW(t+n) converge to P(t) and MACD(t+n) decays to zero. If FAST>P>SLOW, we actually expect MACD to revert to zero straight away.

Stepping Out

You can feed this expected path into your trading optimizer and start calculating multi-day optimal paths. It works nicely and should improve your execution, whatever cost structure you use. Intuitively, if you want to understand your results, you want to think about excursions: what is the expected future path for our trend before we undo the trade we are about to take? The excursion balances the expected risk (and alpha) gained from the trade versus the costs associated with opening it. Interestingly, this leads to different dynamics between opening trades and closing trades and I am unaware of existing cost models that exhibit this asymmetry.
My own excursion into discretionary land has been an eye-opener: quants do tend to solve problems by staring down at their own feet. Yet sometimes, both you *and* your trading system, should look up and look ahead.

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