A SIMPLE QUANTITATIVE TRADING EXAMPLE: SPREADS

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1. Working Out A Spread Trade

Let's work out what the bones of a quantitative trading strategy might entail by examining one of the simplest examples: the spread trade. These have a long history and many current forms.

1.1. **What Is A Spread?** Let's say we monitor prices or returns on a pair of securities. For sake of argument, we will say we are monitoring the prices $f_t^{(2)}, f_t^{(5)}$ of 2 and 5 year CME treasury note futures [1]. We can construct a new variable consisting of the difference between them

$$s_t := f_t^{(5)} - f_t^{(2)}$$

This value s_t is called the *spread* between the 2 and 5 year note futures, and we often think in terms of trading spreads, even when in practice the trades are expressed in underlying securities such as futures contracts.

1.2. **Reversion To The Mean.** We might find that, during the 20 years from 1995 to 2015, the average of s_t was $\bar{s} = 8.5$. It is easy to conceive of a strategy that would plausibly make money by always making bets that, whatever the value of s_t, it is expected to revert back to around 8.5. How would such a spread trading strategy look?

It probably does not make sense to make bets when the current s_t is very close to 8.5. So, for example, if $s_t = 8.499$ or $s_t = 8.501$ we should not hold a position. On the other hand, if $s_t = 4.0$ this looks like a good opportunity to bet that s will soon rise. We do not necessarily know if $f_t^{(2)}$ will fall or $f_t^{(5)}$ will rise, but we think some combination of those things will happen. So it makes sense to both short some 2 year note futures and buy some 5 year note futures. We call this "buying" the spread because we are trading securities in such a way that we think the spread will rise.

For similar reasons, if we see $s_t = 12.0$ then we ought to buy some 2 year note futures and short some 5 year note futures. We call this "shorting" the spread.

[1]We will ignore details of futures and bond fractional pricing in this discussion.

Now, if $s_t = 14.0$, it is easy to argue that the opportunity is greater and we should be shorting even more of the spread. But remember, it probably only got to 14.0 by going through 12.0 at some point. We are likely *already* short the spread and, since it has risen further, have lost money on the position. Are we prepared to lose more?

In spread trading, it is common to have some point at which you admit that your hypothesis (of spread reverting to its mean) has been so contradicted by market data that you are no willing to believe it, at least not with your dollars. Such a point is often set in terms of dollars lost to the position, and is called a stop loss level. Once you have reached it, you resolve to close out all positions, and perhaps wait a while before attempting a similar spread trade again.

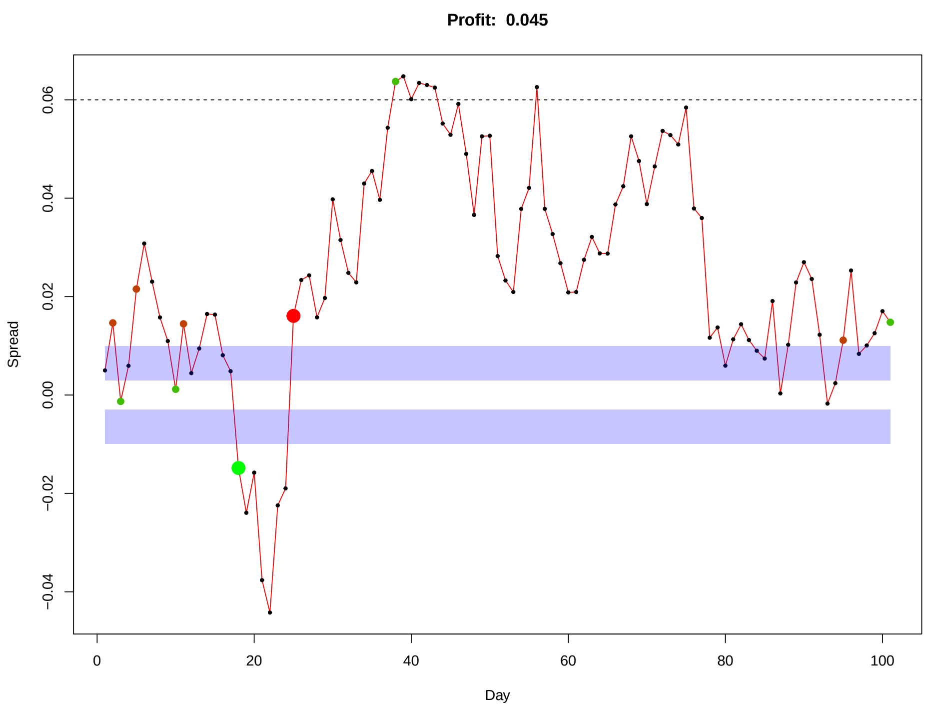

Figure 1. Trading A Hypothetical Spread

The *human* complexity of spread trading is very low. It can be done in 50-150 lines of R or Python, and is feasible even in Excel. However, when we consider how might approach it in practice, we find there are many parameters to determine and they are likely to make us run simulations over and over. These parameters include

- Which security pairs to run on

- Entry and exit boundaries
- Hedge proportions, if not 1:1
- Hedge determination algorithms
- Lookback periods for hedge (and possibly returns) computations
- Stop loss/ position sizing boundaries

Testing 16 possibilities for each of the above would, in an exhaustive grid search, lead to running over 15 million backtests. If each one takes 5 seconds, we will need about 3 years to run them all.