How to Add Trading Metrics to Form a Fitness Function

So let's say we have defined N metrics that we think measure trading performance in some meaningful ways. Call the values of the metrics $m_1, m_2, \ldots, m_N$. Next let's say we can normalize each one in a meaningful way to form normalized metrics $nm_1, nm_2, \ldots, nm_N$. For this next section we'll look at how to "add" the normalized metrics in a way that makes sense. Suppose we want to talk about the sum and call it the "Trading Performance" metric (TP).

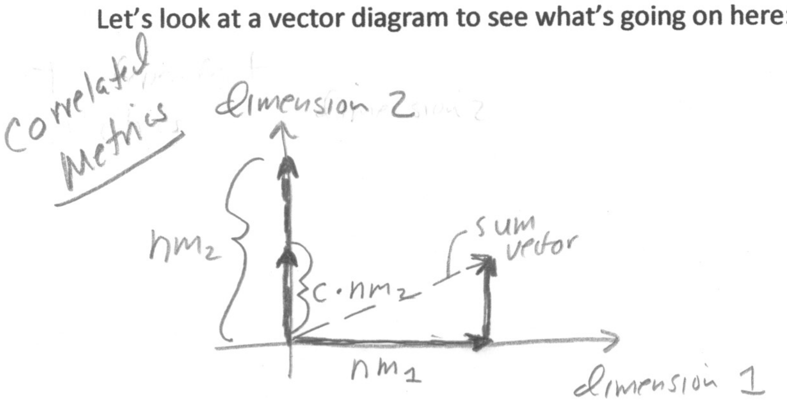
We have to look at the problem as if it's a vector-space system. Here's why: suppose you have two **independent** quantities and want to add them. In that simple case it makes sense to simply add them and renormalize such as

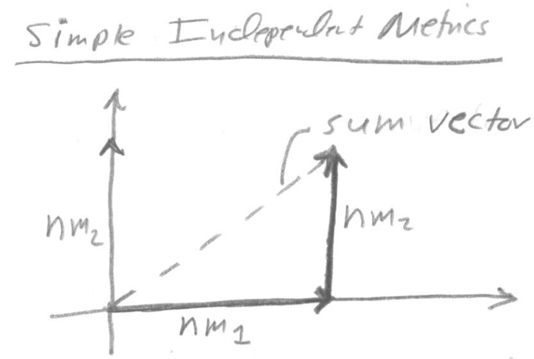
$$TP = \frac{nm_1 + nm_2}{2}$$

But what happens if $nm_1$and nm_2 are not really independent? In other words suppose there's *correlation* between them. Then how do we add them? Suppose there are say 10 metrics we define as contributors to TP?

The solution is to look at each normalized metric as a vector in a vector space and then add them as vectors, but using the correlation coefficient to determine how much each metric contributes to the whole. Said differently, each nm contributes to the whole if it's not totally correlated with another nm and adding them as vectors allows us to sum them fully accurately according to their correlations with each other.

Let's look at a vector diagram to see what's going on here:





So if two nm's are uncorrelated they look like two independent vectors and then the magnitude of their sum is

$$TP = \frac{\sqrt{{nm_1}^2 + {nm_2}^2}}{2}$$

But suppose the correlation coefficient between them is c (0 means there is no correlation so the metrics are independent, 1 means they are fully correlated, -1 means they are anti-correlated), then the vector-based sum looks like: