

## On noise, power, dispersion and baskets.

By Dave Bradfield

One of the positives of conducting research on the JSE is the excellent record of data on trading statistics available to researchers.

One of the negatives is that we deal with noisy data and our tests most often lack the power to unearth the gems we are looking for. The issue of *the power of a statistical test* has been the undoing of many analysts worldwide – precisely because stock market data is notoriously noisy.

Research analysts have sometimes reached erroneous conclusions as a consequence of the lack of statistical understanding of the concept of power. Often tests that don't find statistically significant results attract a conclusion claiming proof of absence. However a possible conclusion that is often overlooked is that the tests may have lacked the power to find the evidence. "Absence of proof is not proof of absence". A classic case involves one of the most famous models in Finance: the Capital Asset Pricing Model (CAPM). The model essentially purports that the higher systematic risk an investment has, the higher the expected return. Almost all investors would hope that this model has some element of truth to entice them to take on some form of systematic risk. In the 1980's many researchers published articles based on tests of the Capital Asset Pricing Model and arrived at alarming conclusions suggesting that *one should not expect higher rewards for bearing higher systematic risk?* This conclusion, if true, must have been discouraging and somewhat confusing to investors. Unbeknown to these researchers the tests they were conducting typically had less than a half chance of finding proof of the validity of the Capital Asset Pricing Model – even if it was perfectly true (in their data)! In other words the power of the test was less than 50%. Of course they should have instead concluded that perhaps the tests weren't powerful enough to detect the Capital Asset Pricing Model!

Researchers with basic statistical knowledge however often recall their elementary statistics lessons that advocate larger samples as a solution to the power problem – and consequently run to shorter interval return data to increase sample sizes. But this is often a trap. Moving to daily return data from monthly data for example typically increases the noise (because it increases

the residual risk of models). The trade-off between gaining power because of a larger sample and losing power because of the increased noise most often favours staying with the longer return intervals - because the noise in shorter return intervals in stock market data typically decreases power more than the gain from the increased sample size. That's why for example it turns out to be more efficient to estimate stock betas from monthly rather than daily data.

So how can we improve the power of our tests and the reliability of our estimates using the noisy data of stock markets?

Well, moving to the longer return intervals in some cases increases the dispersion on the x-axis of our models and consequently increases the reliability of our fit (for example regression lines are typically less wobbly with more stretched out data points). In essence lower residual risk leads to an increase in power (and reliability).

Importantly, a great way to increase the power of tests and the reliability of estimates in stock market data is to form portfolios or baskets of stocks! Stock baskets typically have lower residual risks than individual stocks. It is well known for example that estimates of systematic risks of portfolios are far more reliable than equivalent estimates for individual stocks. Academic researchers are well aware of this and often conduct tests on portfolios of stocks designed to reflect the feature they are researching, rather than conducting the test on the underlying stock.

Finally the takeaway insight for portfolio managers and investors is that if one has a particular view, it is far better invest in a basket (or collection) of stocks that reflect the view than a single stock. Clearly the higher residual risk to the view associated with a single stock can result in your view being squandered. In other words the view would be far more reliably embedded via a collection of stocks than a single stock - thus increasing the probability of success!

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