Robin Hood Finance Limited

The Cracked Bell-Curve

Isaac Newton was a great physicist. He was also from the same county as me, Lincolnshire, but that is where the similarities end. Newton gave us laws which have proved very useful ever since in all sorts of practical ways, from predicting the movements of heavenly bodies to building railways and bridges. As Alexander Pope put it:

"Nature and Nature's Laws lay hid in night;
God said, 'Let Newton be!' - And all was light."

But Newton's theories are wrong. They break down at the extremes-the classic example was small variations in the orbit of the planet Mercury. Einstein demonstrated this. But they are nonetheless useful for practical, everyday purposes.

The basis of most credit analysis, especially in the realm of securitisation, is the bell-curve or Gaussian copula. This familiar analysis is, in normal times, pretty good at predicting the outcome of a given set of probabilities, or risk. That is, on how many occasions out of 1000 throws of two dice will the total be seven? The arithmetic mean is (6/36*1,000) 167. But how likely are we to throw 175 or 195 sevens? The probability can be derived from the bell-curve.

In the same way, the useful "Monte-Carlo" analysis which is often used in structured finance gives us a bell curve of probabilities for the default of a given set of assets. It does this by running a simulation which is more complicated, but in essence no different, from throwing dice, and logging the outcome.

Unfortunately, the real world is not so amenable to bell-curve analysis as throwing dice, since there are many unknown variables. As Vernon Smith, the 2002 Nobel prizewinner for Economics said in his acceptance speech "We do not know why markets work as they do". Or George Box, the economist's "Essentially, all models are wrong, but some are useful".

As with Newtonian physics, the bell curve when used for pools of assets is good in "normal" circumstances, but breaks down at the edges. That is, it is good at analysing the risk round and about the average, and often disastrously wrong at the extremes.

An illustration: the October 1987 stock market crash was an event which was way off the scale of probabilities. A 23% fall in a single day was later calculated by economists to be an unlikely event even if the market had been open since the beginning of the universe. But it happened. Indeed, even at over 20 years' distance, no-one really knows *why* it happened. The same applies to the 1998 Far Eastern/Russian crisis. That happened too. Such events should not occur more than once in many thousands of years-but they did.

Let's now look at the 2007 credit crunch. A six standard-deviation event should occur no more than once every 10,000 years. In 2007 there were two in as many months: the S&P leveraged loan index fell 3.35% in July, and quantitatively-managed funds experienced record losses. In fact David Viniar, the Goldman CFO, termed the latter a 25-standard deviation event-which should normally occur only once every 100,000 years!

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What does this mean in practical terms? Beware of models: like fire, they are a good servant and a bad master. If we keep our feet on the ground, and use quantitative models as part of an overall credit process, we are being prudent. If the model takes over, and investors follow it blindly, it is a recipe for trouble.

A few illustrations:

- Long Term Capital Management (LTCM) was a bit of a misnomer. It was a hedge fund which aimed to profit from discrepancies between markets, and assumed that, over time, there would be a reversion to a norm. LTCM had two Nobel-prize winning economists on its staff (Merton and Scholes, who had developed the famous Black-Scholes model along with the late Fischer Black), as well as a number of former Salomon star traders. They had powerful computers, massive databases and were very well-connected. They did well for a time, but came unstuck in the 1998 crisis, which their models did not predict. Roger Lowenstein summed it up: "Merton's theories were seductive not because they were mostly wrong but because they were so nearly, or so nearly often, right". LTCM's downfall was caused by a mixture of leverage and hubris. And an excessive belief in their models.

- CPDOs –Constant Proportion Debt Obligations-were invented in 2006. They are a leveraged play on an index of asset-backed bonds. Gearing is typically 15 times. Would Warren Buffet invest in CPDOs?
  The rating agencies rated them AAA-but they yielded 200bp, ten to twenty times more than conventional AAA asset-backed bonds at the time. Anyone smell a rat? Many of us did at the time: it was just too good to be true, whatever the models said. Needless to say, this year's "once in a thousand years" market developments have caused severe problems in this sector. According to Moody's, the most recent average net asset value averaged 65%.

- CDOs (Collateralised Debt Obligations) are portfolios of loans or bonds. They are usually analysed using the Monte-Carlo approach to produce a bell-curve of probabilities. It doesn't always work well, particularly in extreme market conditions. We have seen the results since the middle of 2007: *"Many of the downgrades took the CDO securities from investment grade directly to high-yield. In one case, Moody's cut the Aaa-rated slice of a CDO deal called Vertical CDO 07-1 by 14 ratings notches to B2, and still left it on watch for further downgrades."* (FT 1st Nov 07)

Another variant which is common in banking is Value at Risk. This is basically a method used by banks to predict, to as many decimal places as you like, how much they are likely to lose if markets behave as they did in the past. It is, of course, based on the bell-curve. And it doesn't work in extreme markets, which is the very time it is needed.

Paul Ormerod in his book "Why Most Things Fail" pointed out the inadequacies of the Gaussian analysis, and suggested that a power law analysis better fitted the facts. A power law distribution is where there are a small number of large occurrences and a large number of small ones. For example, few rich people/many poor people; few cities/many villages. There is a good argument that this is a better representation of how markets and portfolios behave, rather than bending and distorting the Gaussian model to take account of the so-called "fat tail". However, I am not aware of the power law model being used to any extent in structured finance as yet.

To sum up, models are useful, but none has yet been developed which accurately takes into account all of the factors. Models should be an aid to analysis and, most importantly, common sense. SatNavs are often an excellent tool for motorists-but there are many cases where someone following blindly the instructions from the machine can end up in the wrong place, or stuck going the wrong way up a narrow street.