Poisson In The Wind

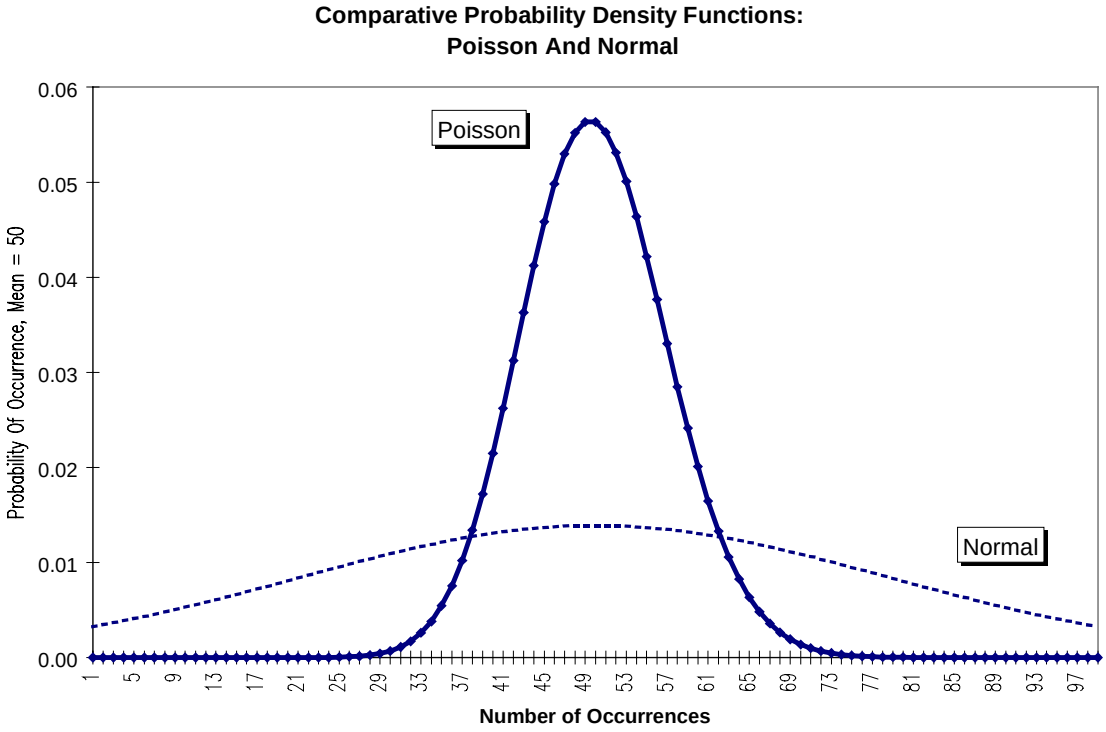
"Reinsuring risk, like refrying beans, wouldn't be necessary if done correctly the first time" - Anon.

A recent study of federal flood insurance discovered 2% of the policies accounted for 40% of the claims. This conclusion is wholly consistent with past studies of other populations and other risks, and should be familiar enough to all of us in our daily experiences to pass without comment; each and every day, only a few items occupy a disproportionate share of our time and attention.

So it is with markets as well. It is the low-probability, high-impact events that create the biggest changes in underlying value and therefore the most pronounced price changes: Witness the massive re-pricing of world financial markets over the past year in response to events in Asia and Russia. Yet our standard approaches to measuring risk, including the venerable Black-Scholes model and its descendants, assume at their core a continuous process of random and normally-distributed percentage prices changes, the so-called lognormal distribution.

However, as our industry changes before our eyes and faces new challenges, the time has come to think a little more like the insurance industry does, and a little less like the capital markets have. Price distributions tend to be "leptokurtotic," or fat-tailed; this means that they have greater-than-expected probabilities of both extreme events occurring and non-events occurring. Predictable human behavior at price extremes accounts for this characteristic distribution, which manifests itself on charts as price spikes (see "Why Johnny Can't Hedge," *Futures*, November 1996).

Event distributions, especially for low-probability, high-impact events, tend to follow the Poisson distribution illustrated below in comparison the standard normal distribution. This graph shows us that if a series has a mean of 50, then the probability of 50 occurrences of an event is 5.63% in a Poisson distribution, but only 1.39% in a normal distribution. However, the probability of a lower number of events occurring, say 20, is dramatically lower, less than .00008%. Sure, the probability of Russian defaulting on its debt at the same time the Fed is threatening to raise interest rates at the same time the President is being threatened with impeachment is minuscule, but the impact of such a low-probability event is colossal.



Convergence

The reinsurance industry is used to dealing with these singular events; for years, Lloyds of London engaged in well-publicized stunts like insuring a movie star's legs. However, even the venerable Lloyds met its Waterloo in 1989 with the conjunction of Hurricane Hugo, the explosion of the Piper Alpha platform in the North Sea, and the settlement of asbestos claims. The reinsurance industry had to regroup, rethink, and relocate (to Bermuda). One of the new initiatives for the industry has been to compete with capital market products, such as futures, options, and OTC derivatives, for risk management. The code word for this is "convergence," meaning that the reinsurance industry will start to look increasingly like an investment bank, and that capital markets will start to offer products that will hedge longer-dated, higher-impact, lower-probability, and corporation-wide risks. The latter is referred to, in consultant-speak, as either "holistic" or "enterprise" risk management, and is designed to cover the entire corporation's commodity and financial risks in a single package.

The advantages for the insurance approach include the ability to package a number of non-correlated risks together in a portfolio that would in turn be unrelated to other investments. This would allow for "securitization" of commodity risks just as mortgages, credit card receivables, and other asset-backed obligations have been securitized. The reinsurance industry had hoped to market favorable tax treatment, but a draft opinion by the Financial Accounting Standards Board held that commodity risk protection is a derivative product and not a tax-favored insurance product.

If past experiences are any indication, acceptance of commodity and financial risk by the reinsurance industry will result in increased demand for exchange-traded futures and options in order to lay off residual risk. The futures and options industry, for its part, will need to accommodate the needs of this different class of customer, one dealing in a low frequency of trading, in large size, and in longer-dated risks. What form will this accommodation need to take?

Barrier Options

Any insurance contract is essentially a barrier option, one that becomes active or inactive as the barrier price is reached: You drive your car into a barrier and the policy suddenly becomes active. Let's assume that an American investment fund active in British equities wants to protect its holdings against a catastrophic devaluation of the pound from $1.6725 on September 11, 1998 to $1.50 on March 9, 1999, instigated by notorious speculator Soros Buffett. The fund could sell the British pound forward in either the futures or interbank market at current levels, it could buy put options and/or sell call options, it could swap its floating pound risk into fixed risk, or it could purchase an insurance policy based upon a barrier option. How would this barrier compare to, say, an American put option?

Let's define the problem further. At the present volatility of 8.34%, the odds of the pound dropping making this move can be calculated as

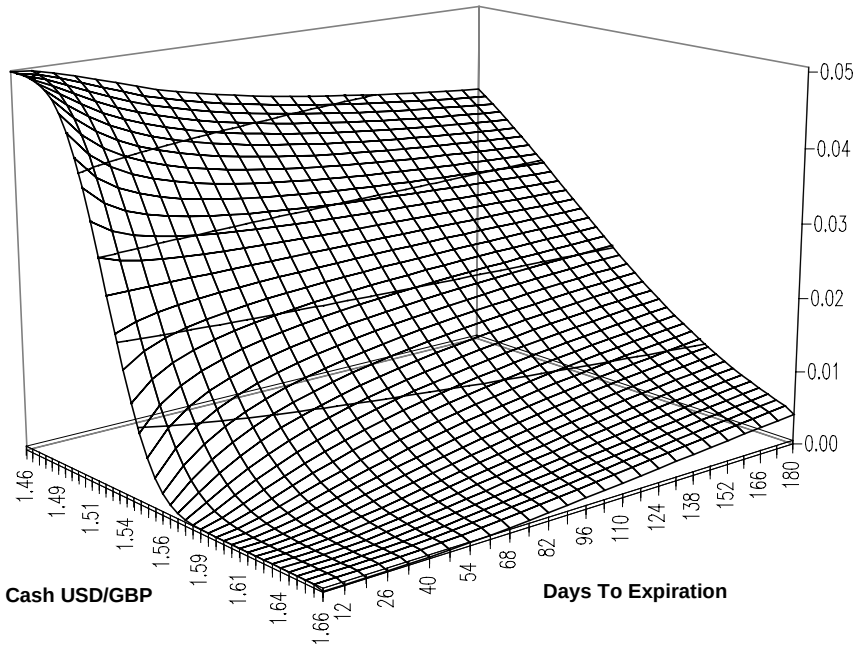
$$Z = \frac{\ln(1.5 / 1.6725)}{.084 * \sqrt{\frac{180}{365}}},$$

where Z is the number of standard deviations of the normal distribution this move represents. At the Z-value of -1.845, the probability of the move is 3.25%, or odds of 29.8 : 1 against. In our Poisson distribution, this would correspond to having an event occur 42 times in our series with a mean value of 50. Most of us would agree that this is not the way to bet unless we faced the risk of ruin, in this case being that such a devaluation would put our fund out of business.

An American $1.50 put option, if one were available in commercial size, would be priced theoretically at $.0017, and that would be the beginning and end of the matter. However, we could structure a barrier put option at a $1.50 strike that would become active at a slightly higher strike price, say $1.525, and that would be priced at only $.0013. We could also add an interesting feature unavailable in exchange-traded instruments, a rebate. The writer of the put – the insurer – has the use of the put buyer's money over the life of the put. If the put does not become active, the insurer can rebate some of the interest earned as a dividend to the buyer just as insurance companies often pay dividends to policyholders.

As is so often the case in the world of exotic options, however, the barrier option is cheaper because it is worth less, (see "Why Be Average?," *Futures*, October 1997) as illustrated below. More importantly, the relative gain increases as the adverse event, a weaker pound, approaches. While the objective of an insurance program should be to have superior coverage, and not just lower premiums, human nature dictates the opposite. We overestimate the frequency of low-probability events, but we greatly underestimate their impact when they do occur, as the events of October 1997 and July-September 1998 attest.

Long American $1.50 Put / Short $1.50 Barrier Put



Opportunity

While the reinsurance industry is only in the initial phase of developing long-dated, company-wide, multi-commodity risk products, the rest of us should take some time now to decide how we will cash in on the financial disasters certain to arise from one more episode of children playing with matches. Remember portfolio insurance in the stock market prior to the 1987 crash? Or the astonishing surge in the yen during early 1995? Both were related to barrier-type insurance products; portfolio insurance was nothing more than a massive stop-loss order on the S&P 500, and it was reputed that a large number of barrier options had been written on the yen at 95 to the dollar.

The presence of insurance alters behavior; once traders believe that their worst-case is covered, then they will take fewer defensive actions as that barrier level is approached, which raises the probability of it being reached. It also encourages the assumption of risk (see "Games People Play," *Futures*, July 1998). Therefore, one of the safest predictions we can make is that the entry of the reinsurance industry into commodity price risk management will lead eventually to a massive move in the direction of the insurance barrier. If, for example, you find policies written against the return of $30 crude oil, start buying the furthest out-of-the-money crude oil call options you can. Eventually you will win, and win big.

The entry of the exchanges into direct competition with the reinsurance industry in the form of commercial-sized barrier options would increase the visibility of these barriers to all traders, would provide a new strategic direction for the futures and options industry, and would facilitate the entry of the reinsurance industry into commodity risk management.