Challenges communicating uncertainty of risk estimates

Tom Bolt
Lloyd's of London

LLOYD'S

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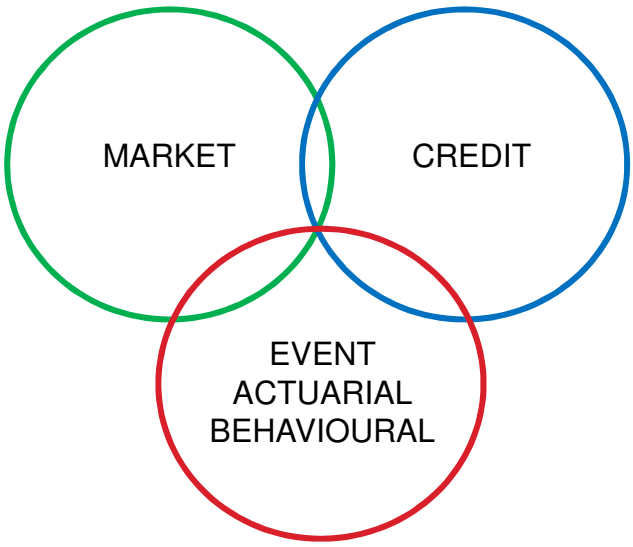

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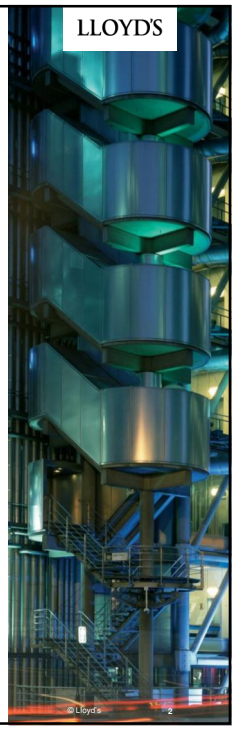

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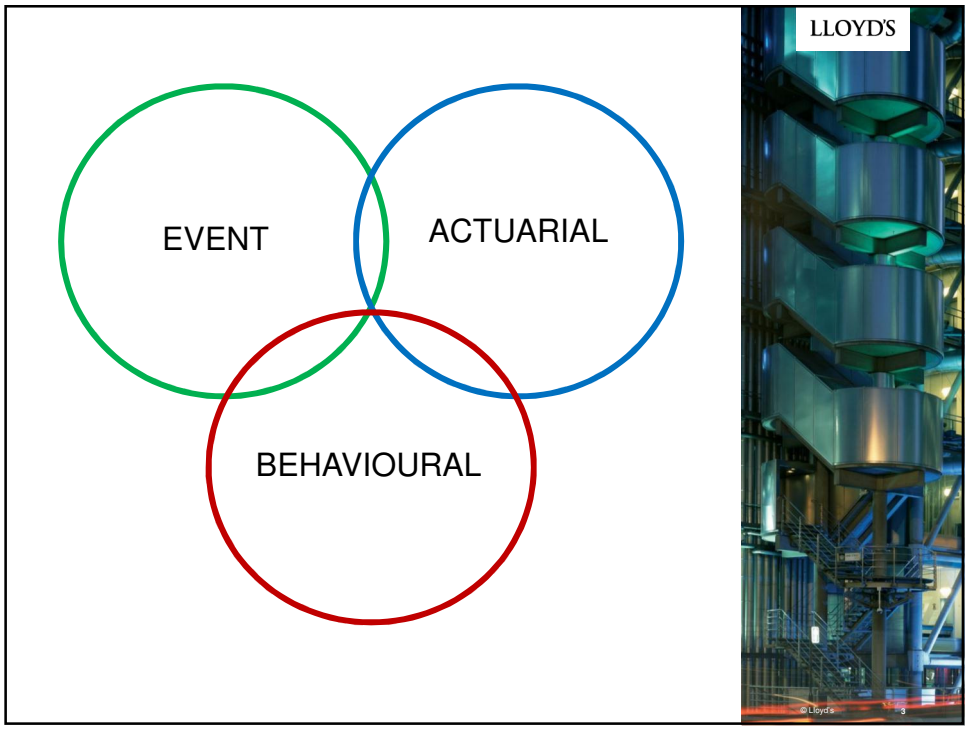
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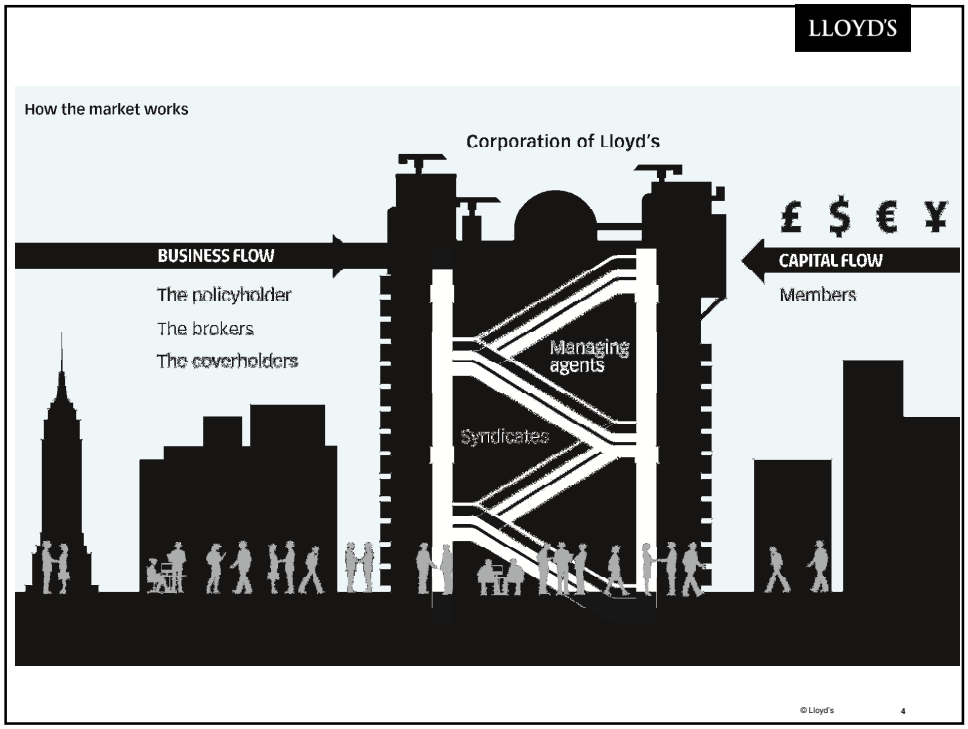
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How the market works
Corporation of Lloyd's
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BUSINESS FLOW
CAPITAL FLOW
The policyholder
The brokers
The coverholders
Members
Managing agents
Syndicates
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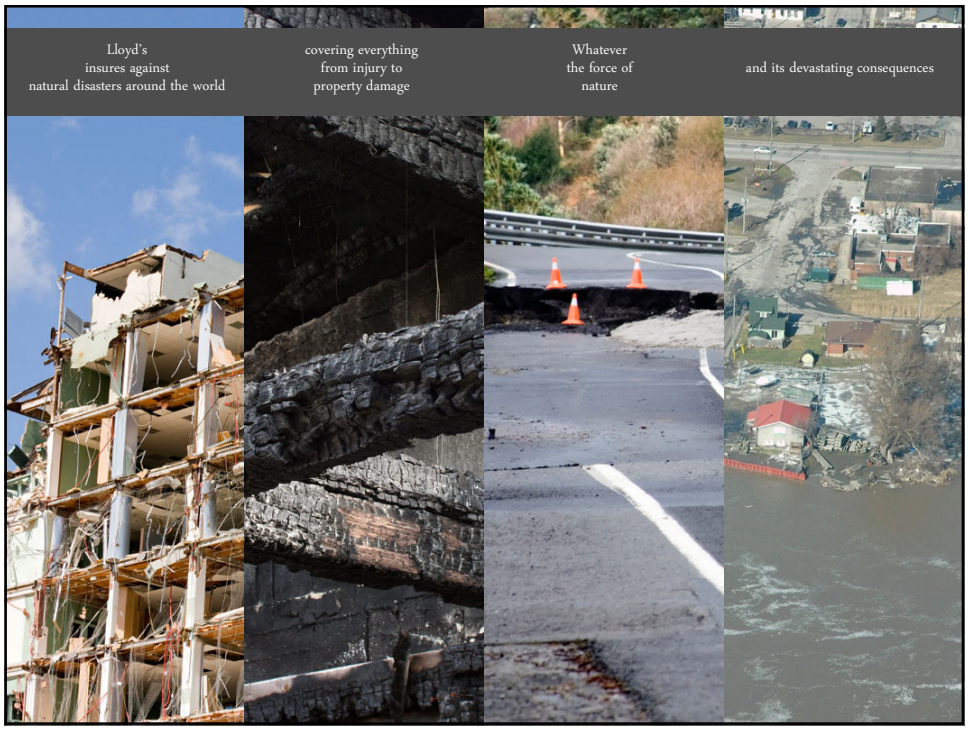

LLOYD'S

$$\text{Price} = \text{Expected Claims} + \left(\gamma \times \text{standard deviation}\right) + \text{Expected Expenses} + \left(K\% \times \text{Capital Held}\right)$$

LLOYD'S

Model Uncertainty
Model Inadequacy
Model Risk
Parameter Risk
Calculation Error

Data Uncertainty
Wrong Location
Understated Values
Building Risk Profile
Schedule out of date

Unmodelled Uncertainty
Secondary Perils
Contingent BI
Policy Wordings
Loss Adjustment Expenses

Source: Peter Taylor

How to Communicate Uncertainty in Insurance

Lords, Ladies and Gentlemen, eminent fellows

It is a great pleasure – indeed an honour - to speak to you this evening. I have been asked to talk about the challenges of Communicating Uncertainty in Insurance. So there is a great temptation to say “I’m not sure” and leave it at that. Perhaps it would be better for you if I did. But I will plough on.

It seems to me, as it relates to science and life, today we know more things for certain and are also more uncertain about more things. While the facts about life are better known than ever before, the uncertainty about our daily lives feels no less than in the past.

But one thing is certain: every successful economy that has ever existed has found a way to manage risk. And risk is just a cooler word for uncertainty. Formal risk transfer – when a business removes uncertainty from its balance sheet by taking out an insurance contract has been around for centuries. The basic premise remains. The insurance industry exists to absorb other people’s uncertainties, so they can plan – and critically grow their businesses. So in some ways Lloyd’s is a public repository of uncertainty.

Specifically, let’s look at banking and insurance. In Insurance, at least at Lloyd’s for the last 325 years, our underwriters have specialized in decision making under uncertainty. Until the derivatives boom of the late 80’s and early 90’s, bank balance sheets were reasonably fixed and determinable. Deposits were fixed and loans were absolute amounts. With options, futures and other financial instruments, banking institutions introduced uncertainty to their balance sheets in unprecedented ways. Black Scholes models and xl spreadsheets made this all possible. While much of the 2008 and 2009 financial crisis was down to an age old

problem of overleveraging, a large part of the problem was down to Bank Boards not fully appreciating how probability driven their financial statements were.

I am not here to talk about banks, but insurance enterprises. These businesses are largely firms which buy and hold 'jump risk'. Derivative risks largely trade on the concept that there will be a continuous market for the instruments. Jump risk is the risk that comes from discontinuity; for example, if the Japanese Stock market were to close following an earthquake, or a country were to stop the convertability of their currency. Jump risks are the things that are the most difficult for a derivatives trader. At Lloyd's, we have an entire building of jump risk underwriters. They have to manage their book of risks knowing that they may go to sleep, waking up to a new disaster that has occurred with very little opportunity to hedge, manage or mitigate the event after the fact.

The key points I hope to get across this evening:

- Lloyd's manages uncertainty and we are good at it
- The insurance industry has tools and techniques for communicating levels of risk
- We are better off with models than without them: however, we are well aware that they are approximations and have weaknesses we will discuss later

First, a description of the key risks we try to address at Lloyd's. (First Venn diagram in accompanying Powerpoint). We do not take on pure market (commodity, interest rate, stock market valuation risks) or credit risk (loans, corporate bonds, solvency, etc.) To a minor degree, we take these risks on the asset side of the balance sheet but not as potential liabilities through insurance policies we issue. There is a little overlap in trade credit and political risk (shown in Venn diagram).

So what risks do we cover? (Second Venn diagram) Event risks I like to characterize as acts of God such as earthquakes, hurricanes, tsunamis, floods, brushfires caused by lightning, hailstorms etc. Actuarial risks are those events or acts of God which have enough data or observations where the law of large numbers may be used to determine frequency and sometimes quantum. Behavioural events are those acts of man where the law of large numbers can be applied to begin to assess the risk (motor, etc).

Lloyd's typically cover the risks that people find hard to insure in their local markets – for example property on the east coast of the US which is at risk of hurricane damage – or property in California at risk of Earthquakes. A great deal of our business is commercial risks; these may include construction projects, off shore oil platforms, major buildings owned by property companies, aircraft, ships, professional negligence – in short just about any aspect of the economy.

[See losses slide] This is why over the years we've paid out on: Piper Alpha, World Trade Centre, Costa Concordia, Deepwater Horizon, Hurricane Katrina, Thai flooding. Most disasters in fact. Although as we noted in our "Global Underinsurance report" last year – unfortunately there are uninsured losses. For example the insured damage from Typhoon Haiyan in the Philippines will likely fall short of 100 million dollars compared with over 100 billion dollars loss in well insured regions in 2011. Insurers can help the global economy to manage uncertainty by taking the risks off business balance sheets and onto ours.

A few facts about Lloyd's: At year end 2013, we had around 184,000 policies in place. This represents uncertainty transfers from policyholders. These decisions were made by around 3000 underwriters working for one of 93 Syndicates at Lloyd's. They were brokered or sold by over 7000 brokers working for 204 Lloyd's broking firms. The premium totals for these risks, including brokerage, exceeded £25billion, or about 1.7% of the world's non-life insurance and reinsurance premium.

We had about 239,000 claims valued at £16.8 billion at year end 2013.

Pricing risk is an art and increasingly a science We must estimate the likely costs, but with humility. We understand that our estimates can be wrong and this is where capital comes in. A simple pricing formula is illustrated in the next slide [Pricing slide]. I don't claim that any underwriter at Lloyd's uses this explicitly but it captures the fundamentals of their process.

You can see that estimates appear several times in the formula. We have to estimate the expected level of claims. We do this either by using statistical models ranging in complexity and often based on past claims experience or physical models of the claims process often merged with engineering models and scientific hazard models. I have also included a factor for the volatility in the average estimate from a formula put forward by Rodney Kreps in a paper presented to ASTIN a number of years ago. The factor, r, denotes the reluctance to risk from the underwriter. Kreps believes that underwriters charge about 33% of the standard deviation, unless you were Tom Bolt, then at Berkshire Hathaway, a large US property and casualty insurer, who seemed to want 100%. Kreps also used the amount of standard deviation to account for the return on capital. In today's regulatory environment, we look at return on capital separately. The capital required may be driven by other factors then the event risk.

We also need to calculate expenses; allowing for any inflation since the prior year including repair costs, raw materials, regulatory compliance, medical costs, legal fees and general inflation. Then we need to earn a return (I've called this k% in the slide) on the capital held. This is an expected return – if claims and expenses are as we expect then the additional margin will produce profits that are k% of the capital held. In reality our contracts cover multiple risks at once, hence there will be many elements to the expected claims and the price is an aggregate of the total risks covered. For simplicity I'll proceed assuming that we are only covering one type of risk.

We can see uncertainty coming in several places here. The expected losses arise from assumptions around the frequency of events. For some types of business such as motor this is well supported by statistics – unfortunately there are plenty of traffic collisions each year to finely tune our estimates. For other classes such as earthquake insurance the claims are far rarer. This makes estimation of frequency troublesome – scientists have proved invaluable here by augmenting the small amount of actual claims experience we have with proxy data. Even so, investors in these sorts of risk demand a higher return on capital due to the additional uncertainty from Earthquake business than motor.

Uncertainty is also explicitly included in the capital calculation. The UK insurance industry (and soon to be the whole of the EU) is subject to a 1 in 200 minimum solvency standard. This means that capital should be held such that the probability of failure over one year is less than one half of a percent. Indeed to be a highly rated insurer significant amounts of additional capital must be held. At Lloyd's we insist on 35% additional capital for each Syndicate and then top this up with our Central fund – this mitigates some of the uncertainty in the capital calculation.

This is a good example of policymakers communicating the level of solvency uncertainty they are prepared to tolerate – they don't seek a zero failure regime and recognise that for perfectly valid reasons companies will become insolvent from time to time. They also recognise that the costs of zero failure are far too large to bear, this would inevitably lead to much increased costs to the policyholder.

The best summary of the sources of uncertainty in using models comes from Peter Taylor of Oxford University. As the slide shows, there are items of model uncertainty, data uncertainty and unmodelled uncertainty. The Tohoku earthquake, which caused the 2011 Tsunami in Japan, caused some to criticise the Equecat model, for example. But the loss was a one in 900 year event, and most people do not look beyond the 500 year mark.

This is my most important point: **we scrutinize members of the market and their use of models to ensure that they understand the strengths and weaknesses of their models, the nuances and the appropriateness of fit for the model against their portfolio.** We also seek to ensure that these uncertainty factors around the use of the models are communicated effectively to the Board of the underwriting entity when providing a number from the model.

We have minimum standards of underwriting and claims at Lloyd's. These are currently being reviewed to take account of trends in good practice and also the implications of strengthening regulatory systems globally. We are currently consulting with the market and are considering including a requirement to communicate the level of uncertainty in modelled outputs to the Board and senior managers. Our hope is that this will stimulate discussion around the areas of uncertainty in the models and how they can be taken into account in decision making.

Now I don't have any line management authority over Lloyd's underwriters but I do have sanctions I can bring to bear if a business threatens the market as a whole. On the whole, it seems to me preferable to use logic and persuasion wherever possible.

The other tool that our Council and Franchise Board have are ensuring that the businesses are properly capitalised, and it is a kind of iterative process: as we understand more about the aggregations and correlations of different risks within and between the various businesses, we can put this understanding to use in capital setting.

There is a natural tension between prudence and maximising returns on equity. And human nature being what it is each market participant wishes the process to be as tough as possible on his or her peers and as lenient as possible for themselves.

This is where the communication of uncertainty kicks in. Unlike many eminent members of the audience I claim no formal expertise in this area - my job is to cajole each market participant into managing his or her business in a way that enhances rather than threatens the overall community.

Unfortunately there are two commonly observed patterns at play here: first, confidence is essential for anyone seeking to climb the corporate ladder and in a business where there are many uncertainties, the incomplete nature of our knowledge of the risks means that there is a fair chance that such confidence is misplaced. The second is survivorship bias: the mere fact that businesses are alive and kicking encourages management to believe they are highly skilled at managing risk, and it is human nature to take credit for good results rather than put them down to chance.

So how much do we know?

Lloyd's assumes risks from all over the world by way of insurance, simply issuing policies to companies or in some cases individuals that cover their risks, or by reinsurance whereby an insurer's portfolio of risk is protected in the event of a loss greater than a certain pre-agreed amount, or sometimes simply shared. We insure and reinsure first party risks, that is, loss or damage to the client's own property, and third party risks where we are defending and covering clients in the event they are sued by others for negligence causing loss, damage or injury.

In each case we have underlying data of varying quality. The underwriter's job, often these days in partnership with an actuary, is to make a best estimate of the likely future claims on a particular policy, build in a margin for profit and charge an appropriate price, and that is what many of them do. The really good ones make a serious stab at understanding the limits to their knowledge and the gaps and inadequacies in their data, and trying to make a

coherent guess as to the scale of the uncertainty attaching to the number they have come up with.

So clearly, the pricing process is a difficult one to get right.

Broadly speaking there are two complementary approaches to pricing risk:

First, you can build a model of the entirety of the sector of risk, for instance Gulf of Mexico windstorm or California earthquake, trying to quantify the return periods for differing sizes of total financial and insured loss, then try to understand from the various characteristics of your risk or portfolio how it sits in the overall structure of risk;

As well, or instead, you can analyse the loss history, adjust for inflation and any changes in the nature of the activity or the coverage sold, add something for Black Swans or whatever you are calling the unexpected adverse event this week. Then you can combine the output of the two models, add a further margin for the other unknowns, known or unknown.

This is property insurance, the easy part. In third party liability coverage, or casualty as we call it, insurers are trying to price a risk that may take decades to emerge. During that time legal doctrines may change, the propensity to sue may vary, there could be landmark verdicts in cases that indirectly affect your client, or your claims team could slip up in the defence of a case.

This however is only the pricing.

To manage a business you have to model the aggregation of all the risks you have assumed but I want to concentrate on how to price uncertainty here.

Bear in mind that operating in a market, your team are not always going to achieve your target price - sometimes with a fair wind, they might get more, but often the force of competition will drive you below where you want to be. You need them to be honest about the times they settle for second best, which is always going to be tough, when if they do it too often you will fire them.

Regulators and boards want to know your estimated 1 in 200 year loss would be. This is tricky given that the modern insurance industry is really only about 25-30 years old and earlier loss data is hard to model with any degree of confidence. At this level it is easy to see that uncertainty can swamp the known knowns in your model, which is obviously not a model of 200 years of prospective experience but instead an attempt to imagine 50,000 or 100,000 parallel universes and speculate as to how badly the business would suffer in 250 or 500 of those universes.

At the end of all this you report your outcomes to a board that is trying to manage expectations in the cut-throat environment of publicly traded companies. Shareholders and analysts don't like variable outcomes very much, and they value certainty above almost everything else: the most popular shares are mostly those with steady earnings growth, and a missed trading forecast can destroy a company's standing in the market.

There is a risk that board members, who as I said, are likely to be naturally confident, could see your carefully constructed caveats and detailed description of the various uncertainties merely as weakness. It takes courage to be utterly candid about the limits to your knowledge in such an environment.

My job is to hold the hand of the people who are trying to do it right, so they and their boards do not lose their nerve, and to encourage those who are tempted to be over-confident in their forecasting to think again.

In particular, I have to ensure that we reduce the threat of the inherent uncertainty by maximising the market's skill and understanding of the data they do have.
My focus is on the areas that present the biggest danger to the market as a whole, and chief among these are the big accumulations of property values in earthquake zones in the US and Japan, and in windstorm zones in the Gulf and Atlantic states of the US and in Western Europe.

Fortunately I have some good tools and so do the people in the market. I try to encourage businesses in the market to make the most intelligent use they can of the models at their disposal, and to take a sceptical view of the capabilities of the models.

In particular, market participants should test model output against that of other models or against their own proprietary data sets if they have them, as some do. The variability between the models should act as a deterrent to anyone having unwarranted confidence in model results. The models are heavily parameterised, and the parameters are estimates tinged with a great deal of judgment, so there is great scope for honest disagreement.

I also need to ensure that participants in the market have the technical knowledge to trim the boundaries of the uncertainty - they know the loss history and understand the key legal arguments, the intricacies of different policy forms and their likely effect on claims quantum, and the nebulous interaction between broader economic conditions and the level of insurance claims in different classes of business, particularly liability classes.

We watch the development of people's business plans very carefully; it gives us an idea of which market participants have a tendency to downplay the risk in their portfolios, and in certain cases we can ask them to reflect a more cautious view of the uncertainty in their portfolio, or demand that they hold more capital if we think their estimate of a likely loss is unduly low. We also have rules on the maximum exposure people can assume on an individual risk, and the maximum amount they can put at risk in a given prescribed scenario, so that the 1 in 200 estimates they use in their capital models are on portfolios constrained where necessary by limits imposed centrally to protect the broader community in Lloyd's.

Protecting it is a serious responsibility: nobody wants to be the person on whose watch the whole thing fell over after 326 years. As you can imagine I put a lot of effort into trying to understand and manage the many uncertainties our market has to wrestle with.