BIAS

#4 Information part 2

UNDERSTANDING AND OVERCOMING BIAS

Last time we talked about the *information* bias, and how poor we are at dealing with statistics and probability, often making irrational decisions. I would like to explore this bias further.

I left you with a question about the US Government's recommendation for women in their forties with no relevant history not to have a routine mammogram, and yet the public was overwhelming upset with this advice. Why did the US Government make such a recommendation? Because Bayes Theorem showed that given the low rate of breast cancer in women with no history of breast cancer, the uncertainties of the test reliability, and the risk associated with follow-up treatments this was the best course of action. Why were the public upset? Because they ignored the Base Rate!

***OK; SO I'M NOT TOO BRIGHT WHEN IT COMES TO STATISTICS, BUT I GET BY!***

As noted previously, our heuristics work generally well. But when we are working with our data and probability in our work in the hydrocarbon sector, these biases can wreak havoc with our interpretations, judgments, and decisions. I would like to bring two of my colleagues, Peter Carragher, Managing Partner Rose & Associates and Graeme Keith, Owner and CEO of Stochastic ApS to provide more insight into the *information* bias. Their wealth of experience and expertise should add some great insight into this bias.

Peter has over 45 years industry experience as a geoscientist, with extensive experience in designing exploration strategy, process, and organization capability. Graeme has a PhD in Mathematics, and he uses his vast experience in using statistical modeling to help geoscientists make better decisions.

Peter and Graeme have been invited to share their perspectives, one from a geoscientist and the other from a mathematician, on why we struggle with data.

***THE GEOSCIENTIST …..***

**Marc:** Peter, welcome to my Understanding and Overcoming Bias blog. I appreciate you taking the time to give our readers some of your insights on the *information* bias and the related representative heuristic.

> ***Peter:*** *Thank you for having me Marc.*

1. **Marc:** Ok, first question. Why do you think geoscientists are so bad at grasping the concepts of statistics and probability?

> ***Peter:*** *Geologists and geophysicists are in general, as a class of people, very visually and spatially orientated; it is one of the great talents that we have. Geoscientists are able to think*

*in three-, and even four-, dimensions. So, there are a series of thinking skills that are not present in the general population but are great skills for geoscientists. Given this hypothesis, geoscientists see what is 'available' in front of our eyes. The availability and the processing of available data is a fundamental root cause of why we can be poor at grasping these concepts.*

*This is exacerbated in that our task is to apply our expertise and experience to make estimates of both the presence and size a prospect, that is valid statistically, from a varied collection of often sparse well and seismic data.*

2. **Marc:** Can you give us an example where you have observed the *information* bias and the impact it had on judgments and decisions in our industry?

   ***Peter:*** *What we have found in many years of training at Rose & Associates and many consulting reviews, we are systematically making these errors. For example, if we take the concept of porosity, the available data from our petrophysicists is generally a list of porosity values every 15cm; therefore, the available data is a list of numbers. However, what we actually need when we are doing a calculation of the resources in our prospect is the average porosity. The average porosity is not readily available; you have to work hard to figure out what the average porosity is from this list of numbers. Further, you have to determine the range of average porosities across the prospect. So, we have to go from the available list of numbers to an average (which in itself is conceptual); and then to determine the range of this conceptual number.*

   *So although the geoscientists have the great skill of visually grasping the geology, it is harder to grasp the conceptual nature of the data. The good news is this is a learnable and trainable skill; it just needs constant care and attention to detail. Having a diverse group of people looking at these concepts and data is recommended.*

3. **Marc:** I have heard you talk a lot about Performance Tracking. Can you tell us what you mean by this and why it is so important to mitigate the *information* bias?

   ***Peter:*** *As a team of assessors, we have to ask ourselves if we are calibrated on our resource and chance assessments. We only know this by looking at our previous performance, using an evidence-based approach to evaluating our predictions .You have to develop need properly calibrated assessments that are based on evidence from the data. Performance tracking is simply comparing your predictions with the actual outcomes, allowing you to become better calibrated and learn from your mistakes. It allows you to look-back at a series of events and measure whether or not people have captured the range of uncertainty in their decisions.*

   *A fundamental issue of Performance Tracking for many companies is that it is a real-score card of whether or not you delivered on what you predicted. This can be particularly challenging if you are an individual business unit that is not drilling many wells. Hence, it is imperative that performance tracking has to be done on a company-wide aggregated manner in order to make any statistical valid judgments. Unfortunately, what we have observed in our work with companies is that some companies do not undertake performance tracking and sharing of learnings on a systematic basis. If there is anything that should not be a variable commitment in our industry, it is performance tracking. This strikes me as a major shortcoming in our industry that we do not rigorously performance track everything, including our exploration subsurface predictions. The only way you can learn and become calibrated, and therefore attempt an intervention, is to know how well you did.*

4. **Marc:** Can you give us an example where this technique has had a positive influence?

   ***Peter:*** *A great example is the Rose & Associates DHI database of several hundred wells which consistently assess a prospect for DHI properties. Many lines of evidence are methodically evaluated, which allows us to have a reliable chance of success estimation for the prospect that is calibrated against a large dataset. Taking the guesswork out of subjectivity is what we are trying to do.*

5. **Marc:** So, are we just a victim of our own mental shortcomings or is there something we can do?

   ***Peter:*** *Over the past few years "big data", "Artificial Intelligence", and related subject matter has come into vogue in the oil & gas industry. At a deeper level this is suggesting that the answer is in the data; so, if we throw enough data into a machine, we will come up with a correlation which can drive to the answer which we could not see before as our brain cannot absorb such a large amount of data. These techniques are trying to mitigate our biases; however, whether the programming of the machines is introducing the biases of the analyst is a subject of another discussion! I think there is a role for artificial intelligence in the future to process data which can help us to make better, unbiased judgments and decisions.*

***THE MATHEMATICIAN …..***

**Marc:** Thank you Peter. Graeme, thank you for joining us.

***Graeme:*** *It's great honour to be invited to your Bias blog.*

6. **Marc:** I know you are not a geologist, but from your perspective, why do you think us geoscientists get it wrong so often?

   ***Graeme:*** *Well first, I'd really like to say what an astonishing accomplishment it is to be able to say as much as you can say about what the subsurface looks like at several kilometers of depth on the basis of staggeringly detailed and accurate accounts of what happened millions of years ago. I really got into the subsurface end of upstream oil & gas ten years ago, and that sense of sheer awe at that colossal intellectual accomplishment never left me. It's an incredible multi-disciplinary effort with astonishing levels of ingenuity in every discipline. And the exploration geoscientists who are able to master and synthesise this knowledge are, honestly, the constant object of my deepest admiration.*

   *But that said, what strikes me is the contrast between the depth and brilliance of the geoscience that goes into working up a prospect and what to my mind seems like at best very simple, and at worst hopelessly naïve, practice around the quantification of uncertainty and the way in which that quantification is used to make decisions. I've seen project teams wait three months for a sequence stratigrapher with post-doctoral research qualifications in exactly the relevant epoch for the prospect in question, but the same team doesn't hesitate to take all the results of that analysis and cram it into a quantitative model that frankly any first-year math student wouldn't hesitate to kick on to the scrap heap.*

   *I do think geoscientists get it right an astonishing amount of the time, but I also think that a lot of that sense of disappointment of poor performance (i.e., lower resources than expected) comes from really quite naïve practice and logic around how we quantify uncertainty and make probabilistic predictions.*

*My observations are that we are fairly good at chance assessment, although at times overenthusiastic; rather, it is in our estimation of resources where we go wrong. More generally, doing statistical work well is difficult; statistics and probability are not easy concepts, and people make 'rules of thumb' and use heuristics. People try to persuade themselves they understand the uncertainty and use intuition that are disconnected from the simplest principles of mathematics, which in turn can lead to poor judgments and decisions.*

*For example, I have seen companies fix the low (P99) value of a probabilistic distribution of resources to a specific value such as 1mmboe. In principle this is good, in that they are recognizing that their predicted resource ranges are too narrow with the low end of the distribution too high. However, this becomes a "rule" company-wide that people blindly follow. Whereas it may be appropriate for a specific basin or play, it can be completely and utterly wrong in another basin.*

*I have found that geoscientists will incorrectly apply the more simplistic statistical situations, such as flipping a coin or rolling a die, to the more complex uncertain environments. Statistics and probability are not easy concepts, and one needs an immense amount of experience and knowledge to understand the inherent nature of uncertainty, just as the geoscientist needs to understand the subsurface.*

7. **Marc:** Ok; fair enough; but then why do we often do get it right? We have found an incredible amount of hydrocarbons through our ingenuity and creativity, and I don't buy the concept that we were just lucky as others have suggested; rather, we tend to make our own luck (i.e., skill meets opportunity)!

   ***Graeme:*** *I think the luck question has two components. There is a sense that when we say we were "lucky", it is really saying we're rubbish and that any success we have is just good luck. I don't buy that. Sure, we can be a lot better at articulating our uncertainty mathematically and both optimizing our portfolios and managing our investor expectations as a consequence, but where we drill is overwhelming much more driven by what we're good at (i.e., geoscience) than what we're bad at (i.e., putting numbers around it).*

   *The other sense of saying we're lucky is just recognition that the subsurface is massively undetermined by the data we have. It is simply not possible to distinguish success and failure cases based on the data we have before we drill. This is unavoidable. The consequence is that our statistics are incredibly volatile. And that means that the best geoscience in the world is going to have bad runs. And there is always the chance that mediocrity will have a good run.*

   *What's interesting is how many wells you have to drill that your run of luck actually reflects how good you are and not just the statistical whimsy of the day. Therefore, one must drill many wells to make statistical valid judgments (however, even with a small number of wells drilled, you can still gain a good understanding of how good your predictions are and become better calibrated). I would expect that by looking at the industry as a whole many of the cognitive biases you teach in your course will cross company boundaries, but I think the information bias is more company specific. In both cases, the idea is to capture the biases, feedback to the teams, put in place bias mitigation strategies leading to improvement of workflows. From my limited experience, though, companies that have conquered bias are few and far between.*

8. **Marc:** For a probability perspective, what do you think is our biggest issue?

***Graeme:*** *Hard to choose! Some problems are common, but not that disastrous; and others are disastrous, but not that common.*

*If I were to plump for something that was a bit of both, I'd say it was a tendency to take models and interpretations off the table too early, effectively ruling out entire categories of entirely plausible outcomes, and then spending way too much time and effort refining what's left.*

*I often hear that we don't do that is because we don't have time to model everything, but I think that misses the point and is an easy excuse. The basic level of uncertainty is what-does-this-thing-even-look-like level, so refining a single interpretation much below this level of uncertainty is just modelling under the noise floor. This practice, rather than reducing uncertainty, is ignoring it. It's far more correct to leave all the conceivable interpretations on the table and model them at a more appropriate, coarser level.*

*After that, I think confusion about to what events you're assigning a probability and how the resource distribution relates to those events is a common problem. This is just a question of definitions and a quick win to remedy. For example, you sometimes hear a lot about risking the P99 value. While this is vocabulary rooted in basically sound practice, it is both incorrect vocabulary and mathematically nonsensical; and that kind of logical sloppiness can easily get you into trouble.*

9. **Marc:** Can you give an example of where you have seen mathematicians influenced by the *information* bias?

   ***Graeme:*** *The ability to communicate the uncertainty to the prospect assessors and decision makers. Statisticians make probabilistic statements, yet they can often be too dogmatic that their model is the right one often ignoring the uncertainty. I have also seen the opposite where statisticians say that they are utterly unwilling to say anything without an enormous amount of high-quality data.*

***FINAL WORDS …..***

10. **Marc:** If you could leave us with just one single piece of advice in helping to mitigate the *information* bias, what would it be?

    ***Peter:*** *Perhaps simply I can leave you with this quote by the philosopher Will Durant, based on Aristotle: "We are what we repeatedly do. Excellence, then, is not an act, but a habit". In other words, develop rigorous and systematic best practices, and stick to them.*

    ***Graeme:*** *Recognise that your geoscience workflow is only as good as the final step where all that work and knowledge is turned by teams into a handful of numbers, and that all that amazing work can go straight down the drain if that step is not exposed to as much scrutiny and rigour as everything else you do. To address this, we should get engineers and economists involved upfront to help understand the project drivers and put in place the workflow required.*

**Marc:** Peter, Graeme. Thank you for participating in this interview and sharing your insights.

***UNTIL NEXT TIME***

On my next blog article we will talk about the relationship between bias, evolution, and creativity.

As the year ends, I would like to wish everyone all the best for the Holidays and a more “normal” New Year!

Stay safe and healthy.

*Marc Bond*
*Rose & Associates.*