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The Appeal of Numbers

His domain is statistics, but thanks to his expertise in this field he is active in a number of other fields too. Peter Ruckdeschel gives us a few insights into his research, the details of which are often confidential

It was not your usual cowboy film. It was an epic documentary about the last cow herders in Italy and he saw it with a fellow student at a film festival in Hof, Upper Franconia, some 20 years ago. Peter Ruckdeschel is a film enthusiast, but this is not why he is telling this anecdote from his university days – he's using it to illustrate one of the downsides of his academic discipline, mathematics.

Because while one advantage of maths is that it can be done anywhere – "all you need is pencil and paper" – it also means that "once you have a problem in your head, you can't let it go and it keeps popping up at the most inconvenient moments." Like back then at the film festival, recalls Ruckdeschel, who is now a statistics professor and has been teaching and conducting research at Oldenburg since 2015.

Right at the beginning of the documentary an old cattle herder talks about how, on his first day of work, his boss gave him 20 cows to look after and told him each of their names. At the end of the day – much to his dismay – he could only remember five of their names. "As a mathematician you can't let this drop, you keep asking yourself whether five is good or not. It's a classical problem with a beautiful solution. And according to that solution five is extremely good. But we didn't know that at the time and so we walked through town as if on autopilot, discussing different approaches."

Today Peter Ruckdeschel seeks solutions in a number of different fields: How much capital should a bank set aside as a buffer to cover vast sums lost by employees on the stock market, for example? How can tax inspectors most efficiently track down offenders who may have evaded millions of euros in taxes? How to calculate the total cumulated damages if a physician has systematically submitted false claims for reimbursement? These are the sort of questions that the 46-year-old mathematician and his working group spend their days trying to answer.

When he talks about his research, he weighs his words carefully. Because whether he's dealing with banks or flood protection, whether the search is for tax evaders, fraudsters or the right combination of planned operations to achieve maximum cost-efficiency in a hospital – in the many and ever new areas in which Ruckdeschel is applying his expertise, suspected crimes, criminal investigations or substantial economic interests are quite often involved. "For obvious reasons many of the specific details in these cases are confidential and are therefore not published" he says.

One of the focal points of Ruckdeschel's research is risk quantification, in which he addresses such things as so-called operational risks for banks. Banks are obliged to protect themselves against losses, for example through fraud, by setting money aside. "But capital is expensive, which is why banks need these risk quantifications to be as accurate as possible," he says. And this is where statistics come in. What is the probability of specific events occurring, and what is the severity distribution of the respective damages or to which degree is the bank exposed to these risks?

But even for a statistics expert the answer is anything but trivial. Because damages that occur frequently but mostly on a relatively small scale – credit card fraud, for example – cannot be assessed in the same way as cases like that of former trader Jérôme Kerviel, who accrued stock market losses running into billions. "Damages on this scale don't occur very often so the statistics are trickier," Ruckdeschel says, explaining that statistics achieve their full potential and precision when case numbers are higher.

In order to also do justice to rare and extreme events he resorts to so-called robust statistics. "They bring a fundamental scepticism to calculation models designed to describe reality, because in this school of thought you never know whether a past event will be recurrent, reproducible in the future or whether it was just a one-off," Ruckdeschel explains. „Consequently you try not to give too much weight to any single event, including the more extreme ones."

This approach is also applied in fraud detection: "When you generate a procedure that picks out Uli Hoeneß from thousands of tax files, it is doubtful that there will be another Uli Hoeneß any time soon," the statistician stresses. "In other words, it is doubtful whether a procedure tailored to the specificities of a small minority can be used to make predictions in other cases. And here the robust approach is more sceptical. It demands empirical evidence that such – or similar – cases won't just occur once, but more often."

"Tackle problems that actually come up"

Aside from isolated cases involving millions in dodged taxes the statistician is aiming for "a procedure that substantially improves on tax inspectors simply reaching blindly into the files." Ruckdeschel elaborates: "It's about being able to quantify more precisely how valuable the presence of a particular feature might be for identifying something as suspicious." In this task, as a mathematician, he says, here, as in all domains, he relies on the domain knowledge of experts in the respective field. This is crucial to avoid false alarms, as a computer easily needs to check thousands of features in order to sort tax returns, for example, into the more suspect ones and the less suspect, he explains.

To ensure that statisticians everywhere are able to make calculations according to the latest technical standards, for several years Ruckdeschel has also been involved in contributing to the statistics software "R", together with many other experts. Using this open source software – "which is actually the computational foundation of what we are working with here" – together with his group, he is maintaining about 20 extension packages. When it comes to large data sets parallelization, i.e. dividing the workload among many computing units, helps to substantially reduce computation time, and "R" provides a powerful infrastructure to this end. "We have the necessary computing clusters here in Oldenburg so that a task that a normal computer would take 100 days to perform can be completed in one and a half days."

Large volumes of data are also the reason why Peter Ruckdeschel has been called in as an expert witness in lawsuits in cases of medical billing fraud. When the prosecution is not able to check each individual bill submitted for reimbursement, a carefully selected sample is decisive in helping to determine a lower confidence limit for damages with 99.5 percent certainty. This, too, requires the expertise of a statistician like Ruckdeschel who, together with other colleagues, is currently setting up the "Centre for Statistics in Oldenburg & Bremen" as a hub for other scientists from the two universities, as well as for businesses.

He has already started to create links between his research and a number of other disciplines in Oldenburg, for example healthcare research, biology, economics and the neurosciences. Statistics is by definition an "interface science", Ruckdeschel believes, "and going outside the field provides a constant source of new ideas. In this way, its applications trigger new research. You tackle problems that actually come up." Indeed this is one reason why he ended up in statistics in the first place. "One day you're working with a biologist, the next with a judge – it's very varied. You have to constantly reassess your ideas, but that's what makes it so exciting." (ds)