Interdependence

History shows that the risk of interdependence is higher when exceptional events occur. This is particularly true in periods of crisis, when interdependencies are exacerbated and do not follow the patterns observed under normal conditions. The understanding of extreme events is a strategic field in (re)insurance as such events can cause significant damages. However, it is difficult to foresee their frequency and impact as they are rare (by definition).
Faced with insufficient data to perform standard statistical techniques, a new and reliable method that would have enabled (re)insurers to cover these risks under satisfactory conditions while controlling their exposure was needed. To achieve this strategic target, SCOR has developed an innovative and effective scientific method: PrObEx.
PrObEx is based on a mathematical model that allows the synthesis of three complementary information sources:

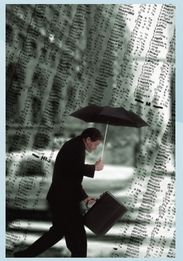
- Prior information (e.g. the past experiences)
- Observation (i.e. the statistical data)
- Expert opinions (i.e. the knowledge of the experts).

The combination of these three sources as part of an internal model provides improved risk assessment as well as optimised capital allocation and proposed tariffs.

"Dependence tends to become more apparent in periods of crisis."
Michel Dacorogna, Deputy Chief Risk Officer, SCOR

Protection from extreme risks and their concomitance

Extreme risks are the most serious threat to (re)insurance companies and the financial sector. Their consequences are manifold and their impact severe. In other words, when an extreme event occurs (e.g. earthquake, pandemic, financial crisis, etc.), a (re)insurer has to deal with many simultaneous and costly claims. Its solvency can be weakened in such circumstances. This is even more the case if several extreme risks have a significant probability of occurring at the same time.
Furthermore, it has now been proven that dependence between risks increases in periods of crisis, namely in periods for which historical data is less available. The current financial crisis offers an example of lack of diversification among different risk types. When the crisis triggered a series of simultaneous events, it actually underscored that a contagion effect can cause multiple events previously thought to be independent. To gain a better understanding of and anticipate possible concomitance between events, standard statistical approaches are insufficient. Precise assessments of these correlations of extreme risks must however be conducted.



"The financial crisis underlines the importance of diversification."
Daniel Dubischar, Head of Group Financial Modeling & Risk Analysis, SCOR

In order to model these dependencies, SCOR's actuaries calibrate parameters of so-called "copula" functions. Copula functions allow one to prudently model the probability, given that an extreme event has affected one risk portfolio, that the same event will also impact another risk portfolio.
"Copulas" have the significant advantage of properly modelling any identified behaviours in the extreme values. However reliable information is essential when calibrating the parameters of these functions.

Eliciting the relevant information

The lack of statistical data on extreme events makes conventional mathematical tools ineffective. PrObEx has been designed to overcome this issue by grouping together multiple information sources. An innovative scientific method is used to process the relevant information so that it can be incorporated into an internal risk calculation model.

In order to reduce significantly the uncertainty around the parameters, PrObEx combines up to three different sources of information: Prior information (existing information), Observations (statistical data) and Expert opinions.

The combination of all these information sources provides additional knowledge about each variable and, most notably, its correlation with others. Their joint use can severely reduce the parameter uncertainty and result in pure mathematical figures that can be directly applied in the model.

The workshops provide an opportunity for SCOR's experts (shown here in London, Zurich, Paris and New York) to compare their points of view.

PrObEx stands for

Prior information

Existing information is taken from the results of prior studies. It mainly comes from two sources:

1. Regulator documentation. Some regulators publish benchmark values for the correlation of some risk portfolios, such as EIOPA for the European Union and the Financial Market Supervisory Authority (FINMA) for Switzerland.

2. Similar situations. For example, the characteristics of claims following a fire in a major city can be compared to those for a nearby city. This approach can be compared to that of credibility theory, in which collective data can be used as a basis for the estimation of individual parameters.

Observations

Observation means data processing for statistical purposes. Even rare data must be taken into consideration, but their use should remain cautious. It will be given importance within the model depending on its availability and reliability.

Expert opinions

Expert opinions are increasingly used in addition to statistical data to anticipate events. The Swiss Financial Market regulator explicitly suggests taking expert opinions into account for the estimation of internal models' parameters if data is scarce. A major innovation of PrObEx is the mathematical treatment of expert opinions, based on a rigorous scientific process.

Aggregating expert opinions

Expert opinions lie at the heart of PrObEx. They are collected during workshops that meet two objectives: obtaining the most precise and relevant information, and aggregating this information so that it can be used in a mathematical model. The conversion of an opinion into a scientific measurement requires compliance with an extremely strict procedure, in order to ensure that the results obtained are objective and recognized as such. For this reason, the psychological dimensions of experts' quantification of opinions must also be carefully taken into account.
In order to complement the experts' opinions, which are centred on their own areas of expertise, the seminars are also attended by managers. Their global vision of the challenges at hand brings greater balance to the results.

A rigorous process

The expert opinion elicitation process complies with the following five principles:
1. Reproducibility. All data collected must remain available so that it can be assessed by competent specialists, and the results obtained must be reproducible to allow them to be checked by auditors or regulators.
2. Accountability. All questionnaires are archived and each opinion expressed can be traced back to the expert who gave it, in case further clarification is needed.
3. Empirical control. In theory, it must be possible to conduct future checks of expert opinions on the basis of measurable events.
4. Neutrality. The process must enable experts to give their real, unbiased opinion. There should be no incentive, whether financial or of any other kind, to give an answer that differs from the expert's own opinion.
5. Fairness. Each expert must be treated in the same way, and their answers may be treated differently only on the basis of a sound mathematical approach.

An independent report with a statistical analysis of the results obtained from the experts was drawn up by Professor Sébastien Van Bellegem from the Toulouse School of Economics. This report includes tests which demonstrate that the process performed ensured both the statistical relevance of the results and the absence of any material bias.

Workshops

Workshops always follow a standardized protocol and last on average 4.5 hours.
They focus on a specific risk portfolio in order to identify the possible correlations of the underlying causes. Each risk portfolio recognised to have a relevance within the company therefore has its own workshop.
The workshops begin with a training session on the aims and methods used, with a reminder of the mathematical tools. The psychological aspects inherent to this type of questionnaire are also discussed.
The core issue is then addressed with a brainstorming session: experts come together to discuss the theme in question and determine the various causes that could lead to extreme events, the conditions of their occurrence and the consequences in terms of dependence. Experts are specifically requested not to express any figures during this session. The phase is useful as it brings together experts from the different areas of expertise concerned by the risk under study who can then share their viewpoints and analyses. Namely, workshop's attendees come from a variety of functions within the (re)insurance company, such as actuarial reserving, claims management, underwriting, actuarial pricing, etc.

"This multidisciplinary approach benefits all participants"
Eric Lecoeur, Chief Actuary, SCOR

The session ends with the questionnaire to be completed, a carefully designed stage that can last up to 90 minutes. Each expert must then give their personal quantification of the dependence considered.
The questionnaire is designed in advance by the PrObEx team, according to the specific characteristic of each risk, in compliance with the most up-to-date scientific literature on elicitation techniques. A draft questionnaire is then tested and validated via a dry-run with a selected first group of experts. The entire elicitation process leverages from the works done on behavioural economics, in particular the research conducted by the Nobel laureate for economics Daniel Kahneman.

The real strength of these workshops is clearly to propose a synthesis of collective knowledge within a company. A reinsurance company is made up of top-class specialists and boasts a high level of both scientific and geographic diversity (and complementarity). PrObEx is an original and effective means of harnessing their expertise.

The PrObEx model

The experts' opinions are taken into account, together with the information provided from prior studies and observations, as part of a so-called Bayesian approach. PrObEx takes care of combining multiple information into a unique, more accurate estimate, to provide SCOR with the finest calibration of the targeted dependence parameter.

As part of the entry into force of Solvency II, regulators request that (re)insurers estimate the dependencies between their main risks. Rather than opting for a simplistic covariance approach, SCOR has preferred to use copulas and to calibrate their parameters through PrObEx.

PrObEx as a strategic advantage for the internal model

Among the advantages of PrObEx there is its immediate application to a (re)insurer's risk management tools, via the consequent improvement of the internal model. This is typically used to:

- Determine as accurately as possible the capital required to ensure solvency
- Allocate the capital
- Define an underwriting and investment strategy
- Support management of the underwriting cycle
- Report to regulators, rating agencies, etc.

It is therefore a key asset, as it covers the (re)insurance company's solvency and capital allocation, and thus its capacity to generate value. Its fine level of calculation is the foundation of its comparative advantage.

"PrObEx has a direct and decisive impact on portfolio diversification and capital allocation."

Victor Peignet, CEO, SCOR Global P&C

PrObEx at SCOR

SCOR uses PrObEx (and has proposed its acronym) to optimise its capital management.
The first implementation of PrObEx was intended to calibrate the dependencies between and within the P&C risks.

In 2011, 33 workshops brought together more than 100 experts in seven different Group locations. All employees with considerable responsibilities, in particular the CEO and Chairman and the entire SCOR Global P&C management team, have taken part in at least one of the PrObEx workshops. In addition to its real application in terms of risk management, PrObEx has also become an emulation tool within the Group.
A new P&C calibration exercise is planned every three to four years, but can also be organised ad-hoc for a given risk portfolio undergoing a significant change.
The PrObEx framework has also been used to calibrate the dependence between inflation and (re)insurance claims, and it is also intended to be used in the future to calibrate dependencies in the Life portfolio.

"Beyond its concrete application to risk management, PrObEx is thus becoming an emulation tool within the Group."

Denis Kessler, CEO, SCOR

Scientific recognition

SCOR has been working on PrObEx for seven years. The initial research was launched due to the observation that the calculation of dependence is overestimated for low risks and underestimated for high risks. The inclusion of expert opinions in the computation rapidly proved to be a promising development. The challenge was to successfully make it a reliable source that could be readily used.

PrObEx has been built up gradually. The various stages of the process have been validated by the scientific community. In particular, two SCOR Papers have been published on this theme (by Davide Canestraro and Michel Dacorogna, and by Philipp Arbenz and Davide Canestraro) and two PhD thesis on the subject have been written by two SCOR employees (Philipp Arbenz and Davide Canestraro) which led to a scientific article being published in the prestigious ASTIN Bulletin.

"PrObEx is now a familiar concept within the scientific community."

Philippe Trainar, Chief Risk Officer, SCOR

Finally, Davide Canestraro was asked to chair a seminar on PrObEx at the first European Congress of Actuaries in June 2012, Brussels. His presentation has been awarded the prize "for the best Scientific Presentation by a Young Actuary at the First European Congress of Actuaries".

Today, PrObEx is an innovation that is recognised by the scientific community. Several seminars on PrObEx have been held at prominent Universities (in Canada, France, Italy, Switzerland, etc.) and more have already been scheduled.

PrObEx is not limited to the insurance sector. Instead, any kind of (financial) institution may benefit from it, as this innovative method represents a scientific breakthrough for the statistical approach used to calibrate dependencies (and also to take into account extreme events). SCOR plans to disseminate its results as broadly as possible. Not only will this result in improved risk management in the economy and society, but the sharing of practices and experiences can only strengthen a tool based on the contributions of the best-in-class experts.

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SCOR S.E. 5 avenue Kléber | 75795 Paris Cedex 16 | France
+33 1 58 44 70 00 | scor@scor.com

PrObEx,
a scientific innovation to assess the dependence between risks

When a (re)insurance portfolio is acquired, each risk is assessed by experts. Yet for (re)insurers, it is essential to determine the dependence between the different risks, i.e. their statistical correlation. Sovereign defaults, changes in oil and gas prices, depreciations of national currencies and the return of inflation in a currency area are all (individual) events that are likely to be linked by a level of interdependence, either due to the occurrence of an event increasing the probability of another occurring, or because different events can be triggered by common causes. Individually, each risk is generally well known by (re)insurers. However, their dependence, and therefore the probability of their concomitance, remains insufficiently managed. These links between occurrences of risks are a major challenge for all (re)insurers.

A new method has therefore been developed at SCOR to properly quantify and strategically manage dependence among risks: PrObEx.