



4.6 Technological Change and Competence in New Areas

Hotspot Description

The risk that actuaries may not adequately understand the latest modelling techniques and approaches; for example, the move towards Machine Learning models.

Current Influences

Generally, there are risks when the available statistics are inadequate to estimate the cost of future uncertain events. This may occur when actuaries enter new areas (such as banking) or insurers issue new covers such as cyber risk. Also, there are risks of actuaries acting where they do not understand the model processes; for example, when new techniques start to get used such as Machine Learning models.

Key developments and JFAR member regulators' actions during 2020/21

In order to try to understand a particular aspect of the world an actuary will build a model, which is a simplified representation of the aspect in question. This model will usually rely on assumptions in order to produce results of possible future outcomes. In order for the model to be robust, the actuary needs to:

- understand that which is being modelled (although in practice this often means they rely on experts in the relevant subject matter);

- understand the inner workings of the model itself; and
- be in a position to form sensible assumptions.

A 2019 survey by Deloitte²⁰³ concluded that Cyber needs more executive attention and collective thought. It is also worth noting that as datasets get richer and larger and as technology becomes ever more connected, the Cyber Risk associated with this becomes ever more important to manage. There are different views²⁰⁴ on whether Big Data²⁰⁵ compounds the problems²⁰⁶ or is part of the cure.²⁰⁷ General consensus points to the need for a structured and considered approach before a cyber-attack occurs.

The pace of development

Technology is advancing quickly, and this means new modelling techniques are becoming available to the actuary. These new techniques are significantly different to the existing techniques and therefore there is a risk that some actuaries won't have the necessary understanding or familiarity to be able to use them effectively. The IFoA recognises

²⁰³ <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/finance/us-the-future-of-cyber-survey.pdf>

²⁰⁴ <https://www.digitalistmag.com/cio-knowledge/2018/08/27/how-big-data-helps-avoid-cybersecurity-threats-06184059/>

²⁰⁵ https://en.wikipedia.org/wiki/Big_data

²⁰⁶ <https://cybersecurityventures.com/cybersecurity-almanac-2019/>

²⁰⁷ <https://bi-survey.com/big-data-security-analytics>

that IFoA Members need to be up to date with technological change. Some of the IFoA qualification exams are computer modelling based.²⁰⁸ In addition, the IFoA is offering a Certificate in Data Science²⁰⁹ course for all IFoA Members.

The IFoA has also held virtual data science conferences²¹⁰ to include education aimed at actuaries.

Another issue is how actuarial regulation will keep pace with these developments. The FRC produces the Technical Actuarial Standards (TASs) and they are reviewed and refreshed every five years, but if the pace of change is rapid there may be a need for more frequent guidance to be issued between formal reviews of the TASs. This is an issue that the FRC is considering as part of the Post Implementation Review presently being conducted on the current TASs.

Big Data

Big Data is the term used to describe the situation where the datasets are large, created and collected quickly, and often very diverse in terms of content. The format of the data tends to vary. The data can be gathered from social networks, websites, apps on mobile phones, questionnaires, product purchases, and many other areas. The data is usually stored in a computer database specifically designed for the purpose and is analysed using software, again specifically designed for the purpose.

The advantages offered by Big Data are that new insights are possible given the larger volume of data, and these may lead to new and innovative products or services being developed in response to perceived customer needs. However, there are risks including the fact that it is easy to find spurious

correlations,²¹¹ and these could potentially lead to conclusions that are suspect. Financial products may be developed which are not, in fact, needed by customers. This could then lead to wasted product development costs and possible mis-selling of the newly developed products. This may be compounded by the introduction of a new product changing behaviours and therefore invalidating past statistics. In addition, there is the risk that increased use of wider data sources distorts the balance between commercial decision-making and customer fairness, and may potentially lead to the poorest risks, who are often those in greater need of insurance, being priced out of the market.

The other key risk is that the quality of the Big Data may be lower than the quality of data from more traditional sources. The reason for this is that the data tends to come from less structured sources and the validation the data goes through is often less robust.²¹² This may in the extreme case lead to inappropriate conclusions²¹³ being drawn from the data, if the actuary fails to take account of this.

Artificial Intelligence and Machine Learning

Artificial intelligence²¹⁴ (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Areas where Artificial Intelligence is overlapping with the work of the actuary include autonomous vehicles and Robotic Process Automation.

Autonomous vehicles are those which have some form of assistance to the driving, ranging from cases where the human remains in overall control to where the vehicle drives itself and the human has no input. These are described

²⁰⁸ <https://www.actuaries.org.uk/studying/curriculum/modelling-practice>

²⁰⁹ <https://www.actuaries.org.uk/learn-and-develop/lifelong-learning/certificate-data-science>

²¹⁰ <https://www.actuaries.org.uk/learn-and-develop/lifelong-learning/what-data-science-actuarial-viewpoint>

²¹¹ <https://towardsdatascience.com/correlation-is-not-causation-ae05d03c1f53>

²¹² https://www.researchgate.net/publication/326519154_Big_Data_Quality_A_Survey

²¹³ <https://dataanalytics.report/articles/three-big-mistakes-in-big-data-you-never-knew-were-mistakes>

²¹⁴ <https://www.britannica.com/technology/artificial-intelligence/Reasoning>

as levels 1 – 5²¹⁵ (where 1 represents assistance to the driver – e.g. adaptive cruise control – to 5 where the vehicle does not require a driver to be present at any stage of the journey). In practice in all developments to date the human has the power to retake control in an emergency (in most cases the autonomous vehicle insists on this). As the control of the vehicle is ceded from the human intelligence to the AI there are issues raised about what happens when things go wrong. For example, if an accident happens when the AI is in control where does the blame lie? This is important in determining insurer liability.

Robotic Process Automation (RPA) is where software robots are used to automate certain tasks. This ability is not new: there have been limited versions of RPA for several years. However, the breadth and depth of the tasks that can now be automated has reached a threshold where it is possible to use this technique for significant operations within a company. An example that is relevant to the actuary is within general insurance claims reserving. RPA can collect the data, format the data, upload the data into the actuarial reserving software, perform the initial modelling following rules, and output the data in a meaningful way for an actuary to review. This is much more efficient than getting a human to do these tasks and can potentially reduce operational risks if the process is robust. However, there are downsides with RPA.²¹⁶ For example:

- when timescales are tight there is a danger that the RPA output may be used without critical human consideration; and
- RPA is usually unable to adapt to any changes to the data sets.

Machine Learning, which is a subset of Artificial Intelligence, is an approach to modelling that is becoming much more popular. The approach is to build a mathematical model that is

developed based on a sample of data without any explicit programming²¹⁷ or instructions relying on patterns and inference instead. The model is then used to make predictions on a different sample of data. As more data is fed into the model it gets better at predicting, and the model is therefore said to learn.

One potential issue with Machine Learning is bias. The chosen mathematical model is based on a set of initial data and any bias in this data will be replicated in the model. For example, if a model is fed with data about all successful applicants for jobs in an organisation with a view to using it to help screen candidates, then any historical biases will be replicated.

Another potential issue is that the chosen model can perform very well at prediction but can be difficult to explain, and possibly replicate. This is an important issue for an actuary to consider, as the need to be able to explain and validate the results can be critically important.

It is worth noting that the FCA are increasingly employing machine learning techniques to identify firms or individuals that could pose a risk to their objectives.²¹⁸ The FCA is trying to explore how technology can drive new products, services, and firms in consumers' interests, and what technology can do to reduce the compliance burden of existing ones and make them more effective.

Ethical Implications

These new techniques also give rise to ethical implications as they allow actuaries to take more information about the risks into account when doing the modelling. This can be a double-edged sword, as on the one hand it can allow the pricing of risks to be more accurate whereas on the other hand it can disadvantage some groups of individuals. There is also the risk that if taken to extremes it can

²¹⁵ <https://www.smmf.co.uk/wp-content/uploads/sites/2/SMMT-CAV-position-paper-final.pdf>

²¹⁶ <https://www.forbes.com/sites/jasonbloomberg/2018/11/06/why-you-should-think-twice-about-robotic-process-automation/?sh=44cccc415fe1>

²¹⁷ Arthur Samuels of IBM is credited with this definition. Widely taken to be in a 1959 paper but probably first appears in a subsequent paper in 1967.

²¹⁸ <https://www.fca.org.uk/news/speeches/financial-conduct-regulation-restless-world>

start to undermine the risk-pooling principle which underlies insurance, as well as making insurance potentially unaffordable for certain members of society.

When the roles of the actuary and the data scientist are compared, one of the key differences are the ethical and professional skills and training needed for the role of the actuary. This enhances the value the actuary brings when the output of complex models is presented to decision-makers, and this will get more important as the models get more complex. The IFoA and the Royal Statistical Society have jointly produced A Guide for Ethical Data Science,²¹⁹ and in February 2021 the IFoA also produced specific guidance for IFoA Members working in this area: Ethical and professional guidance on Data Science: A Guide for Members.²²⁰

Updating skills / Continuing Professional Development

As the pace of technological change quickens it is critical for the actuary to keep their skillset up to date. For student actuaries this means having access to an up-to-date curriculum, and for experienced actuaries that means having

access to up to date CPD material. Some of this (especially in the case of student actuaries) can be provided by the IFoA, but there will always be a need for the actuary to take personal responsibility for keeping their knowledge up to date and making use of the available material.

Further Reading

Autonomous Vehicles:

<https://www.theguardian.com/technology/2019/oct/03/driverless-cars-in-new-london-trial-in-complex-urban-environment>

<https://www.bbc.co.uk/news/av/uk-scotland-50409991>

<https://www.bbc.co.uk/news/technology-50713716>

<https://www.bbc.co.uk/news/technology-50047449>

Communicating AI Models:

<https://ico.org.uk/about-the-ico/ico-and-stakeholder-consultations/ico-and-the-turing-consultation-on-explaining-ai-decisions-guidance/>

²¹⁹ <https://www.actuaries.org.uk/system/files/field/document/An%20Ethical%20Charter%20for%20Date%20Science%20WEB%20FINAL.PDF>

²²⁰ https://www.actuaries.org.uk/system/files/field/document/IFoA_Ethical_Professional_Guidance_Data_Science_Feb_2021.pdf