South African
ACTUARY

LEADERSHIP

QUESTION

MEASURE

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DISCUSS

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THEORETICAL DATA SCIENCE

ARTIFICIAL INTELLIGENCE

MACHINE LEARNING

PRESIDENTIAL PERSPECTIVE

THE TASK OF LEADERSHIP

Lusani Mulaudzi,
President, 2020-21

To muster the courage to write an article to be read by many brilliant minds is commendable. It is a response to the call to leadership and I encourage more actuaries to take up this challenge.

Members of the Actuarial Society of South Africa are involved in an ever-increasing number of fields of practice. This is one of the goals that we had set for ourselves, ASSA should be known as a global leader in context-based solutions. I wish to draw your attention to Barry's article on the vaccination programme. The article illustrates the operational challenges involved in delivering critical public services and I do hope that more actuaries will get involved in the operational running of government departments and municipalities. I would like to also congratulate Rendani Mbuvha for graduating with a PhD in Machine Learning. Vho Dr Mbuvha vho ri ita vhathu, ri a livhuwa.

I would also like to welcome the new editorial team led by Michael Tichareva; we look forward to future thought-provoking editions of SA Actuary. I will not comment on every single article in this edition as Michael will give a good summary in his editorial piece.

My task is an unenviable task of leadership and I use this space to provide insights into some key dynamics for members of the profession to think about. I have pondered a lot about some of the tools that I find very useful in our actuarial toolkit. Over the past few years, I have not really had a real job, I have been floating from board meeting to board meeting while trying to clinch consulting tenders in between and trying to understand and influence public policy, I am now settling in an academic role. I have not done particularly well in these pursuits, but time is still on my side as I will be stepping down as President before turning 40. The next chapter can only be more fruitful as I practice lessons learnt from my experiences.

I often spend time thinking about the gaps between actual and expected and analysing the reasons for the gaps. I combine this with my interest in history. I enjoy studying the rise and fall of empires and ask myself what those leaders would do differently if they could see the outcomes of their decisions. Were there any unintended consequences in their actions? Was there a way to identify such consequences at planning stage?

Many policy decisions were made over the past 18 months as part of the COVID19 response. Some of those decisions had disastrous consequences on the economy, education, and health. South Africa's National Income Dynamics Study – Coronavirus Rapid Mobile (NIDS-CRAM) recently reported that as many as 750 000 school children in South Africa may have dropped out because of the pandemic. I wish this could be undone. With what we know now, should we have made different decisions? When we consider what we expected back in April last year and what transpired, what do we learn from that?

The role of leaders is to lead people to a destination. A leader should have a clear vision and ability to persuade people to follow. The best leaders tend to be not only visionaries and persuasive speakers, as Adolf Hitler was, but also principled people with integrity.

Integrity is one of those overused terms that one tends to find in many organisational value statements. This brings me back to the actual vs expected analysis which may yield insights if applied to the integrity performance of leaders and organizations. There seems to be a widening gap or growing deficit in integrity in our society. I need not speak about various SIU reports, Auditor General reports, Steinhoff, Tongaat Hulett and the list goes on. What do all these things say about our leadership capacity? Surely for such failures to happen, many leaders would have chosen to look the other way.

In July we watched hopelessly as an estimated amount of R50bn was destroyed and many jobs lost, some of them permanently. Again, the deficit between what many expected a few years ago (Thumamina) compared to actual has grown. This is partially reflected in our increasing debt to GDP ratio as a country. Why do our deficits continue to grow and what can be done about it?

In my view, it comes down to leadership, starting with the person in the mirror. It requires a commitment from all of us to lead by example in every possible way and to minimize integrity deficits in our lives. What we see manifesting in society is an accumulation of our integrity deficits as a nation. Every suboptimal decision made points to failure of leadership somewhere in the chain of decision-making. We should, as individual actuaries and the profession, reflect on how we could have contributed to the failure we see in our country and how we can play a better role going forward.

When I reflect on my term as your President, I do recognize several deficits.

1. **Our level of engagement in relevant public issues is significantly less than I expected.**
2. **Our level of internal engagement on key issues is significantly less than I expected.**

How do I make sense of these deficits?

I started off with a restricted paradigm that I was unaware of. I was critical of people that I now hold in high regard. Why was I critical of such people? Mainly because I neither knew them nor understood them. I thought I knew better, now I am aware of just how little I knew. How many of us in the profession may be wittingly or unwittingly disregarding the contribution of others?

Prejudice is not only the preserve of certain races or classes it affects many of us in different ways.

The only way our profession will succeed in playing a leadership role in society is to develop an ability to engage openly internally (and this requires lots of humility) to be able to engage with humility and confidence externally. This is what I believe is the task of leadership that every one of us should embrace. We ought to encourage each other to express views and we need to be prepared to engage each other on those views.

I will continue to search for ways to make this a reality even beyond my Presidency.

The author of the Old Testament book of Ecclesiastes speaks about a city that was besieged by a great king, luckily there was found in that city a poor wise man who by his wisdom saved the city although he was later forgotten. May we as a profession nurture the ability to find the 'poor' wise amongst us and when we do to acknowledge their role.

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EDITORIAL

MICHAEL TICHAREVA

It is certainly exciting times as we hold the 2021 ASSA Convention with a record number of attendees - more than 1 500 I believe. We wish you all the best with the Convention proceedings. It is, however, also sad times having lost a mentor, colleague and friend, Wim Els, earlier this year. Wim will always be remembered for his contribution to the profession and society at large, and his always cheerful attitude alongside hardworking tendencies. As the new editorial team takes over from where Wim left, we continue to see how much work Wim used to do supported by Mike McDougall, Jo Coetzee, and the other team members at the ASSA office in producing the SA Actuary. The work of one person was essentially replaced with 5 people on the editorial team! The new editorial team will certainly not disappoint as we remember Wim. We promise to keep the promise!

This edition of The SA Actuary is filled with interesting articles, both technical and soft issues. We start by giving you the Presidential Perspective, followed by introducing the editorial team. We then give you a series of articles covering a wide range of issues that include the changing landscape of actuarial practice, customer retention management, climate change, micro insurance, risk management in infrastructure investments, women leadership, and innovation in healthcare funding to cater for the uncovered. The story of women in leadership stands out in these articles, as Jodi Christensen and Paballo Makupu narrate how they have benefitted significantly from the Leadership Development Programme run by the Actuarial Women's Committee. It is quite a refreshing story, a must read.

Then the summary articles on the Convention papers that focus largely on the application of data analytics tools such as machine learning and artificial intelligence in solving actuarial problems add flavour to this edition. This focus on new problem-solving techniques anchored by data analytics clearly shows the changing landscape of actuarial practice with actuaries needing to learn these new problem-solving techniques to remain relevant in a fast changing business landscape. It is not surprising that actuarial professionals produced such content on the same topic independently of each other, a fair reflection of the changing terrain in which we now operate. Can it be a coincidence? I really don't think so. We have to adapt or die, and luckily the actuarial profession has done remarkably well in always adapting to new environments successfully for more than a century.

We then have the captivating stories of Anthony Asher and Rendani Mbuvha. Anthony, a well-known senior actuary now based in Australia, gives advice to the young ones by reflecting on his four decades journey, and mentioning Wim Els at the start of his narration, both names most of us will always remember. There are great insights to take from Anthony's advice, and a must read for every actuarial professional as you build on your soft skills. Then Rendani, a young up coming actuary, was interviewed having become the first member of the Actuarial Society to attain a Doctor of Philosophy qualification specialising in Machine Learning in August 2021. This is so inspiring when young actuaries attain such achievements, certainly a hint to all young actuaries out there on what you need to do.

It always seems impossible until it's done", said Nelson Mandela. For those of you who tend to have feelings of giving up from time to time, please read the great story of Pieter du Preez who is a recent world and Paralympic champion. It's all in the mind, I often say. Pieter's story is a great illustration of this. Please read it and lift your spirits. Nothing is impossible, Pieter believes and proves it.

We end with our book review section for our avid readers, where Maseeha Rawat, one of the editorial team members, takes us through a review of "Grit" by Angela Duckworth.

This edition also carries a Covid supplement that sums up factual information, insights and opinions from a number of actuaries, some of whom have been closer to the action in advising on the rolling out of covid mitigation strategies in South Africa at various levels in both government and the private sector.

We trust you enjoy reading this edition anchored by the new editorial team, and one where you must certainly read every article, otherwise you will miss a lot of interesting stuff!

Bye for now! Ⓐ

Michael Tichareva
Lead Editor, on behalf of the Editorial Team

If you wish to comment or contribute to The SA Actuary, please send your contributions to

PLEASE CLICK HERE

ACTUARIAL SOCIETY OF SOUTH AFRICA

NEW EDITORIAL TEAM PROFILES

HANNAH CHIVAKA

Hannah Chivaka is a fellow of the Actuarial Society of South Africa and of the Institute and Faculty of Actuaries. She began her career at General Reinsurance where she worked on individual life and group risk pricing. She then moved to Metropolitan Life where she held various positions, first in the Corporate Actuarial department and subsequently in the Product Development department. In 2012, she decided to take a career break to focus on raising her children and she has been working as an Independent Consulting Actuary since 2014.

Hannah also works as a voice over artist and has provided voice overs, locally and internationally, for corporate videos, product training videos, documentary-style videos and radio promotions. She did a two year stint at a community radio station as a newsreader and contributor.

Prior to the pandemic, she could be found panting her way through her local 5km park run every Saturday morning, with her husband Richard, and their two children. She loves music, plays the piano and is currently working her way through the Trinity College London music theory and practical piano exams.

LYDIA MUTEPFA

Lydia Mutepfa is a junior actuarial modeller working for Barista Consulting CC. She completed her Bachelor of Business Science in Actuarial Science at the University of Cape Town in 2019 and is still studying with the intention of qualifying as an actuary. Lydia was eager to be a part of the editorial team because she considers it a great learning experience. She enjoys reading SA Actuary because of the captivating yet simple way in which technical concepts are presented in order to provide insight to readers of different backgrounds. Lydia loves picturesque views and would describe the Kirstenbosch Gardens as her happy place.

MASEEHA RAWAT

Education
· BSc Hons from the University of the Witwatersrand
· Student Member of ASSA

Employment
· Currently in a marketing actuarial role within the Business Development Team in the Life and Health business at Hannover Re South Africa.

What do you enjoy about your job?
· Building relationships and working with partners and colleagues to align interests between multiple stakeholders
· Facilitating innovation in, and broadening access to the life and health insurance markets in Africa.

How do you de-stress?
· Exercising, especially running
· Spending time in nature and on the beach
· Spa days

I am busy reading / watching...
· Reading "The Obstacle Is The Way" by Ryan Holiday
· Watching "The Good Doctor" on Netflix

On my bucket list
· To complete the Comrades Marathon

My biggest indulgence
· Chocolate

If not myself I would be
· A TV talkshow host (like Oprah)

ADRIAN BURKE

Education
· BBusSc from University of Cape Town
· Qualified under the Institute of Actuaries prior to ASSA having their own exams

Employment
· Retired towards the end of 2020
· Experience mainly in pension business, individual life business and finance/valuations
· Southern Life – for 16 years
· Merged Momentum/Southern Life - for 2 years
· Old Mutual – for 18 years

What do you enjoy about your job?
· Making a real difference in terms of the financial well-being of customers

How do you de-stress?
· Exercise
· Nature and the outdoors
· Photography – a never ending learning process

I am busy reading / watching...
· After years of too much work-related reading I am revisiting some of the classics
· Not much of a 'watcher' – where I do it tends to be

On my bucket list
· To see the Okavango before climate change takes to much of a toll

My biggest indulgence
· Time with a camera in nature

If not myself I would be
· A wildlife photographer

MICHAEL TICHAREVA

I am Michael Tichareva, a member of the Editorial Team of The South African Actuary. I am a Managing Director at National Standard Finance Africa and an Executive Chairman at Claxon Actuaries. In my work, I believe in developing impactful solutions that are suitable for Africa within a global context, and I am currently leading impact investing initiatives that I believe will, hopefully, contribute to Africa's continued socio-economic development and transformation to be able to compete sustainably in the global economy.

I previously worked as a senior investment banker at Nedbank, and in various actuarial roles in the UK at AON Hewitt, in South Africa at Metropolitan, Alexander Forbes, and Old Mutual, and in Zimbabwe at Old Mutual, over the past 22 years. On actuarial practice, I am a banking actuary who leads a team of actuarial professionals in delivering banking and risk management solutions.

I am a Fellow of the Actuarial Society of South Africa having qualified in 2004 as a pensions actuary, and I also hold an MBA from Wits Business School. How I grew up farming whilst also playing on the streets, and being an actuary today, combined with an MBA, shapes the way I think in approaching problems facing world communities. I believe that we exist to create solutions responsibly, and not to cause problems recklessly in the world!

I am a former member of Council, and a former Chairperson of the Education Board and the Banking Committee. I perform various other roles within the Actuarial Society, and I have led a number of key initiatives over the past few years, including development of the banking subject for actuaries. I have also produced an International Handbook for banking professionals with input from other actuaries. I am the current Chairperson of the Banking Virtual Forum of the IAA where we intend to produce a number of banking papers in the next 2 years, so watch the space!

I love engaging communities through speaking and writing to share information and knowledge, having written many articles, and presented at many forums locally and internationally. I am a devoted father of 5 and I have been married to Shorayi, better known as Shosho, for 26 years. I love golf, soccer, rugby, music, travelling and hunting, which is one of my favourite activities, although I have not done much of it in the last few years. I intend to resume hunting in 2022, so please place your orders for game biltong on time. However, I must catch the beast first, so don't get too excited before it happens, because it can be challenging on the veld! Ⓐ

THE CHANGING LANDSCAPE OF ACTUARIAL PRACTICE

Actuarial practice has not been a commonly understood field to the general population around the world, with many myths around it. However, in South Africa and some african countries like Zimbabwe, Ghana, Kenya and Nigeria, the actuarial profession has gained publicity and momentum over the years, with many actuaries having qualified through the system over the years, and making a real difference to business and society. The pace to qualification has also accelerated in recent years, so has the role of actuaries in business and society.

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Actuarial practice has not been a commonly understood field to the general population around the world, with many myths around it. However, in South Africa and some African countries like Zimbabwe, Ghana, Kenya and Nigeria, the actuarial profession has gained publicity and momentum over the years, with many actuaries having qualified through the system over the years, and making a real difference to business and society. The pace to qualification has also accelerated in recent years, so has the role of actuaries in business and society.

The aim of actuarial practice is to use technical and business skills learnt in Actuarial Statistics, Actuarial Mathematics and Business subjects, and combining them with specialised business fields of insurance, pensions, investments, healthcare, enterprise risk management, and banking among others, alongside modelling tools such as data analytics, artificial intelligence and machine learning to solve real world problems through application of judgment.

Decades ago, actuarial calculations were manual, then came computers. With the increase in computer power and digital technology, there came fields like data analytics, artificial intelligence and machine learning. Through all these phases of industrial revolution and business transformation, some would have thought that actuarial practice is going to become irrelevant. However, this is far from the truth. The actuarial profession has constantly adapted to remain relevant in the new environments. This remains the case and will continue for the foreseeable future. The business landscape will change, but the actuarial profession

should and will remain relevant as we constantly reinvent ourselves. Actuaries should, therefore, remain proactive in adapting to emerging ways of doing things, new fields of actuarial practice, and new business dynamics, whilst keeping the core of actuarial practice intact.

To illustrate the expanding field of actuarial practice, let's look at opportunities in specialised fields in the market, especially relating to emerging areas of actuarial practice such as banking, enterprise risk management, data analytics and digital transformation where the skills of actuaries are already relevant.

Banking practice

The roles by actuaries in banking are expanding, and South Africa continues to lead. These roles typically relate to governance, strategy and risk management. Risks range from credit risk, market risk, liquidity risk, operational risk and other business risks. Each of these risks can be broken down further. For example, credit risk is a major area of work that can be broken down into loan origination and pricing strategies, monitoring of portfolio trends, capital adequacy assessment and reporting, and expected credit loss provisioning. Given actuaries' quantitative abilities and understanding of business in the financial world, actuaries play a key role in these areas.

Banking practice for actuaries is gaining momentum around the world, with the Actuarial Society of South Africa ("ASSA") now offering an international banking exam, having launched a local exam in 2015. The Institute and Faculty of Actuaries ("IFoA") is also currently working with ASSA to launch a banking exam from 2022. Other actuarial associations around the world are thinking of the same. This is an illustration of how actuarial skills

can be expanded to completely new fields, thus redefining the actuarial practice landscape.

Enterprise risk management (ERM)

Actuaries in ERM can provide advice and guidance to management and boards of directors of financial and non-financial institutions in designing and implementing their ERM frameworks. The practice of ERM gained significant prominence in the aftermath of the 2008 global financial crisis, and now the Covid pandemic. Institutions of all shapes and sizes should take ERM as an integral component of overall business strategy. This should be engrained in the institution's culture.

An ERM framework helps to answer relevant business questions pertaining to an institution's risk appetite, business strategy, risk coverage, governance, policies, risk data, infrastructure, measurement, evaluation, control environment, response, and stress testing. With actuaries now heavily involved in ERM that was previously the domain of other professions, this is another illustration of the changing landscape of actuarial practice.

Data analytics

In all these areas of actuarial practice, Actuaries should use, among other models, data analytics tools in solving problems. With data analytics, raw data is analysed to detect trends, answer questions, or draw conclusions from a large batch of data. Using various techniques such as artificial intelligence and machine learning, raw data is converted into a form that allows organisations to analyse important metrics and make business decisions through application of judgement. The key phrase is "application of judgement", an area in which actuaries are well trained.

The global actuarial profession has recently adopted data analytics into its professional qualification track, with a number of undergraduate university programmes also considering including data analytics into their programmes, illustrating, once again, how the actuarial practice landscape is changing.

Digital transformation

Actuaries should be developing capabilities to apply systems and technology in assisting institutions in their digital transformation journey. Digital transformation is the cultural, organisational, and operational change of an institution by integrating

digital technologies, processes, and competencies across all levels and functions in a staged and strategic way. Actuaries should be able to leverage systems and technology to create value and new services for institutions through innovation, thus allowing institutions to acquire new capabilities to become future-ready, agile, and resilient in an increasingly digital economy. This is an area of potential actuarial practice that has not yet received much attention within the profession, but one that should gain momentum over the years.

Pursuing a career in actuarial practice

For those who have just started or considering doing so, pursuing an actuarial career requires you to have an undergraduate or a master's degree in statistics, mathematics, insurance, risk management, finance, or pure actuarial science, among others. You could also have any other degree with math and statistics as major components, but it will certainly be more difficult to complete the post degree professional exams to attain one of the designations for an actuarial professional without good mathematical background. On completing professional actuarial exams, you are awarded a technical certification, an associate certification or a fellow certification, with fellow status being the highest level of actuarial qualification and the others being intermediate qualifications.

As indicated above, the beauty of actuarial practice is that it is constantly changing with new areas of practice being adopted, and new tools of work being recognised and utilised. One should not feel constrained following an actuarial career, as there are a wide range of areas where one can apply actuarial skills. We have seen actuaries modelling the impact of climate change, for example, or the impact of pandemics. There are also one or two actuaries in telecoms, using their actuarial tricks to solve problems. With actuarial practice, the sky is the limit. You simply have to use your imagination to apply your actuarial skills, and then introduce others when you have figured it out.

Michael Tichareva is the Managing Director of National Standard Finance Africa and the Executive Chairman of its affiliate, Claxon Actuaries. He can be reached on mtichareva@natstandard.co.za or michael.t@claxonactuaries.com

MARCO SPAGNUOLO

(Head L&H In-force Solutions EMEA) - main author

ANGELIKI CARVOUNES

(Pricing Actuary) - contributing author

Customer retention management:
a story of 3 wins

by MARCO SPAGNUOLO and ANGELIKI CARVOUNES

Customer retention management can benefit the policyholder, the insurer and help to make society more resilient. This is imperative in a society that has a need to cover the protection gap.

The global protection gap for life, health and catastrophes was estimated to have grown to $1.4 trillion in 2020, according to Swiss Re Institute. The continent of Africa is estimated to have the largest protection gap globally. The reasons for this gap range from lack of affordability to people's limited awareness or access to insurance products, as well as the simple optimistic belief that "it won't happen to me". The protection gap is believed to have widened further as a result of the economic, health, social and mental wellbeing impacts caused by the COVID-19 pandemic. The COVID-19 pandemic and the

recent July looting in South Africa, however, have highlighted the importance of insurance as a safety net for unforeseen circumstances.

At the same time, a transformation in sales practices is beginning to take place in our industry. Historically, focus on growth has meant that corporate resources were allocated, and organizations structured, with the aim of expanding the company's customer base. Boosting sales was, for a long time, the ultimate corporate mantra – and to a large extent, it still is. In some cases, this has led to aggressive sales at the expense of quality. While this approach can have a positive impact on top line and market share, the industry is starting to realize that it erodes profitability in the long run. In fact, our experience shows that poor sales translate into higher lapses.

During the past decade or so, we have observed a paradigm shift within the industry in which the weight between sales and retention has been rebalanced; increasing attention is now given to customer persistency. After all, acquiring new customers is said to cost about seven times more than retaining existing ones, while each percentage point increase in customer retention is estimated to produce a 5% increase in profit.

The need for individuals to purchase and retain insurance is important in South Africa. The average South African earner was estimated to have an insurance gap of R2.2 million as at the end of 2018. This implies that additional insurance should be purchased to provide adequate protection for both their family and themselves in the event of death or disability. Funeral insurance is considered as the most popular form of insurance in South Africa. Many South Africans who purchase funeral insurance, however, do not have a good understanding of the product that they have purchased. This is reflected in the high number of complaints received by ombudsmen in South Africa. In 2020, 39% of all complaints finalised by the Long-term Insurance Ombudsman related to funeral insurance. Other life products accounted for 41% of total complaints finalised. This misunderstanding of life insurance products can also be expected to trigger lapses given that people do not fully appreciate the value of their product.

Given this context, it is therefore important for insurers to take measures to attract individuals to purchase insurance and also then take further steps to retain these individuals as their customers and keep them protected.

Customer retention is now moving up the agenda for CEOs and is increasingly gaining prominence in company strategies. At a societal level, it is also a prominent tool for closing the protection gap. Rather than solely focusing on selling new customers the right products, customer retention management can help to engage with existing customers and make sure their insurance is right for them.

South African insurers do recognize the importance of retaining customers and are at the forefront when it comes to customer engagement. This is testified by the various rewards programmes currently on offer in the market. Engagement, in fact, is what customers in South Africa are demanding from insurers, as reflected in survey results from the South African Customer Satisfaction Index for Life Insurance. Customers expect to receive instant feedback that is similar to their experiences with banks and retailers.

> **SOUTH AFRICAN INSURERS DO RECOGNIZE THE IMPORTANCE OF RETAINING CUSTOMERS** AND ARE AT THE FOREFRONT WHEN IT COMES TO CUSTOMER ENGAGEMENT.

WHAT IS CUSTOMER RETENTION MANAGEMENT?

Customer retention management is a multi-disciplinary, cross-functional approach drawing on three areas: business processes, communication and data.

BUSINESS PROCESSES

Designing and re-engineering business processes to remove friction or hiccups in the customer journey are key to ensuring an optimal customer experience. Insurers can make it easy for customers to remain protected by designing an intuitive and fast reinstatement process for missed premium payments, or by having procedures for diverting cancellation requests towards channels that lead to higher retention. Potential lapses can also be turned into product amendments to better suit the customer's changing circumstances. For example, insurers can help customers cope with affordability issues by offering them the possibility to easily adjust the sum insured or the scope of cover, and even provide a premium discount or waiver. Figure 1 shows a 2017 case study from a UK multi-line portfolio.
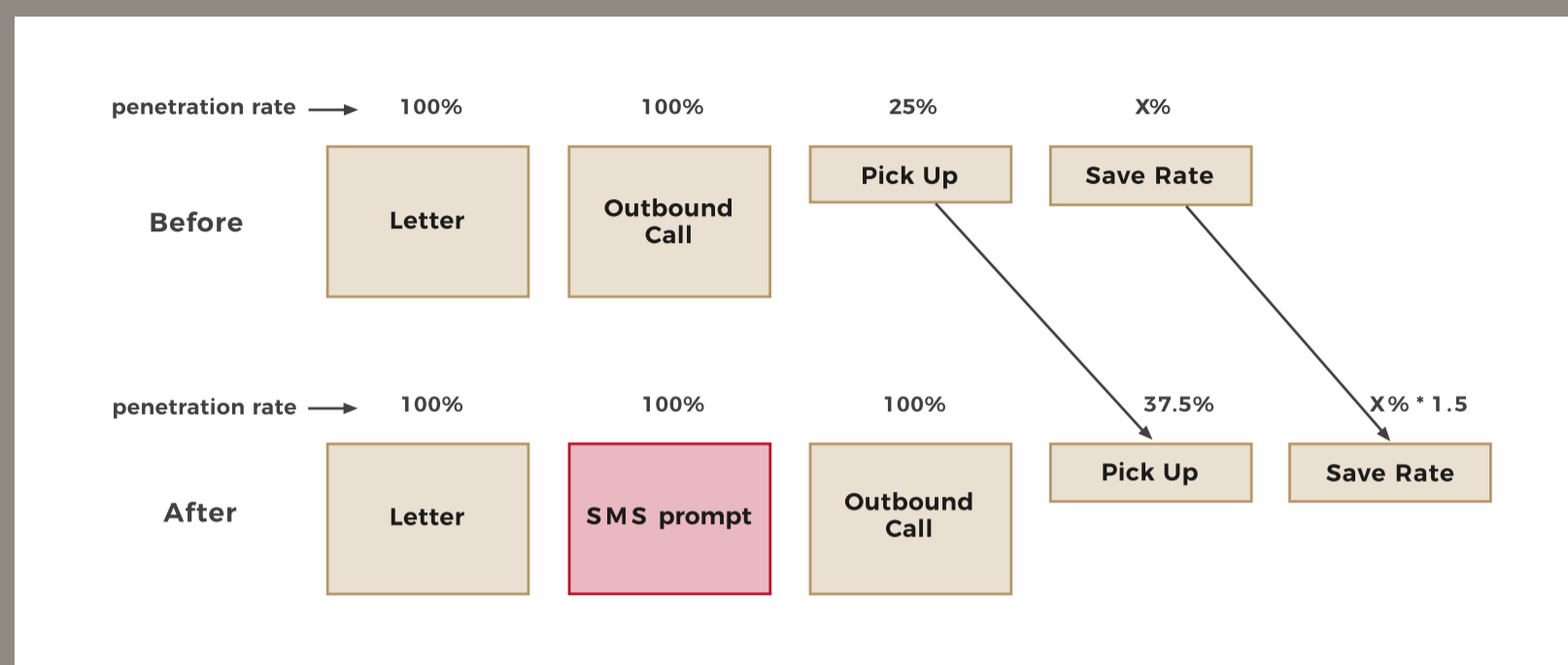
FIGURE 1: Penetration rate of premium reinstatement process in 2017 case study.

The premium reinstatement process was redesigned to introduce an SMS prompt to customers advising of outbound calls from the call centre; this boosted 'pick up rate' of outbound calls by 50%, and increased the save rate (the number of retained policies over the total entering the lapse cycle).

COMMUNICATION

Customer communication has to be engaging, relevant and regular. Too often, policyholders hear from their insurer only twice in what is meant to be a long-term journey: once at the point of sale, and then only in case of a claim. Unless they are regularly reminded why they purchased it in the first place, individuals tend to quickly forget the benefits of insurance, or to overestimate the cost relative to its benefits. Well-conceived and executed customer engagement campaigns can have a significant impact on persistency – and require only a relatively low investment.

Figure 2 shows a case study from a 2019 Spanish life portfolio.

More pro-active communication to customers, powered by behavioral economics, resulted in an average 20% fall in the lapse rate across multiple contact channels against the control group.

Too often, though, the rare customer touchpoints are left under the care of call centres, which
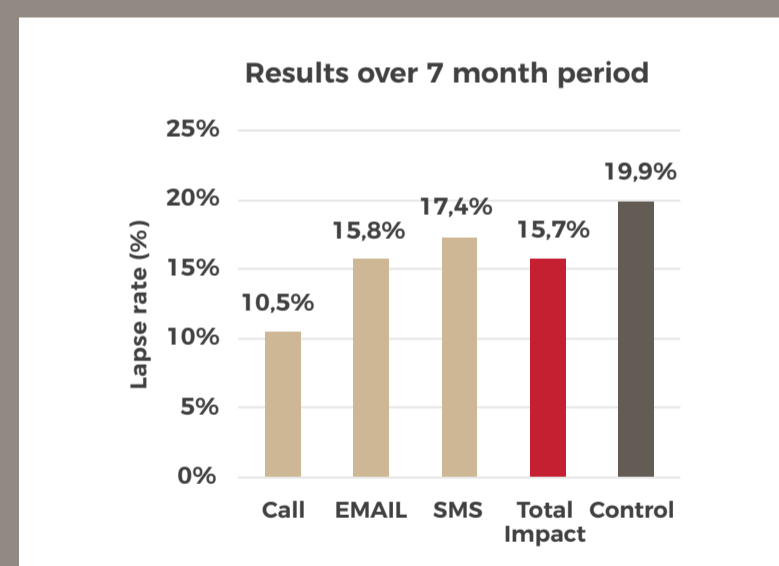

FIGURE 2: Spanish case study – impact of proactive communication over a seven-month period.

may be afflicted by high turnover and, in certain instances, sub-optimal preparation and little customer focus. Significant improvements can often be made by equipping call centre agents with behavioral economics techniques, to be used in conversations with customers or in revised call scripts. Based on Swiss Re's experience, these techniques can enable a call centre to double its save rate in less than six months.
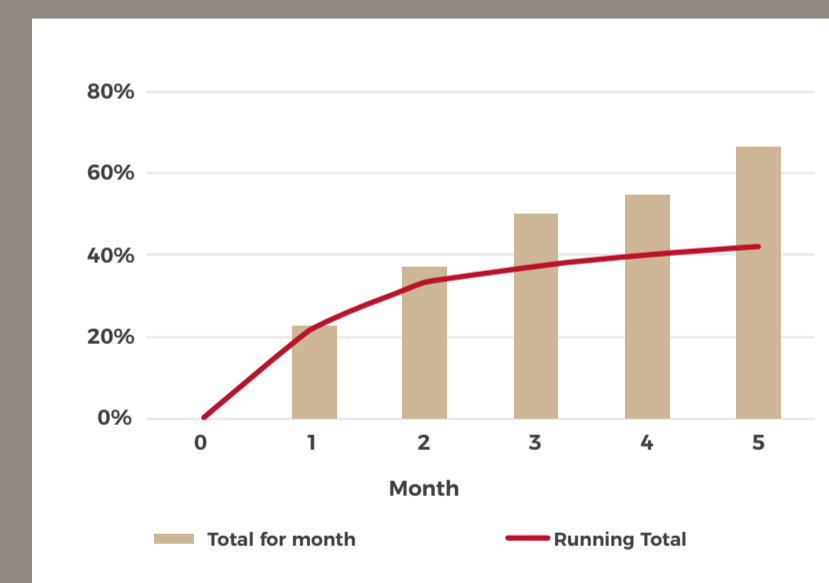
FIGURE 3: UK case study – impact of new call centre script and training over a five-month period.

DATA ANALYTICS

Figure 3 shows a 2019 case study from a UK disability portfolio.

A new script and training for call centre agents, aimed at enhancing policyholders' perception of the value of their insurance, led to an increase in the save rate from 0% to more than 40% in five months.

Similar experience of Swiss Re in the South African market shows significant improvement in the effectiveness displayed by our client-partners in retaining customers who expressed their intention to cancel. There was an approximate 35% increase in retained annual premium income as a result of this.

The ability to leverage data underpins optimal business processes and customer communication. Data enables companies to measure and track progress and establish a virtuous cycle of continuous refinement and improvement. The use and availability of data can vary greatly, from very basic to higher levels of sophistication. Through lapse pattern analytics, data-driven persona definition, and personalized retention and lapse predictions, data can be the key to understanding and anticipating policyholder behavior.

In a 2018 case study from a South African life portfolio, a comprehensive predictive model was developed by leveraging customer demographic, insurance and engagement data and by incorporating a machine-learning component. The model allowed the identification and ranking of more than 20 lapse drivers with 90% precision of prediction, which enabled the company to choose specific and pro-active retention management interventions.

Improvements to persistency can also come indirectly from cross-selling activities. It is well-known that customers with higher product density exhibit lower lapse rate. In that vein, data and analytics can be used to:

- Target profitable customers and minimize acquisition and service costs;
- Cross-sell more effectively and build robust self-service capabilities; and
- Boost retention and loyalty though affinity channels and digital engagement strategies.

When dealing with the end customer, it is important for insurers to uphold integrity and ethics. The use of data and analytics should not infringe on the fair treatment of customers, independently of their risk profile or segment. This is particularly true, for example, when leveraging behavioral economics techniques in order to 'nudge' customers.

WIN-WIN-WIN

The art of customer retention management lies in identifying marginal interventions that enable substantial improvements and incremental value. Based on our experience, by intervening in the three areas mentioned earlier and by ensuring they have the right amount of expertise, insurers can reduce customer lapses by 10-15% in relative terms. This is a win-win-win situation.

First, customer retention management benefits policyholders because it keeps them protected against adverse life events. The three cornerstones of customer retention management are helping existing customers to understand and value the insurance protection they have, reminding them of the risks they could be exposed to without it, and proposing alternative or more suitable options. In most cases, staying protected is a far better outcome for the policyholder than being uninsured.

Second, for the insurer, lower lapsation generally means higher return on the initial investment made to acquire clients. It fuels growth (R1 of saved in-force premium is comparable to achieving up to R7 of new business premium), stabilizes earnings by reducing the risk of deferred acquisition cost write-off, and sustainably protects the portfolio's embedded value. It can also reduce distribution channel leverage. In addition, there are many indirect benefits to understanding lapse drivers, such as feedback loop into product design (right product or pricing for right segment), distribution (improving customer understanding of products through quality sales processes), and claims handling (preventing lapses due to poor customer experience at the claim stage).

Finally, by keeping individuals insured, and thus protected, insurance can alleviate the burden on the state, help close the protection gap, and ultimately help to make society more resilient. Ⓐ

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Originally published by The Actuary, APRIL 2021. © The Institute and Faculty of Actuaries.

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CLIMATE CHANGE

BY **ANDRIES SCHUTTE**

ANOTHER WOLF STALKING OUR ACTUARIAL FLOCK?

Its already too late, some say. It's a problem that our children will have to face, others say. Some, perhaps most, still disagree with the dimensions of what we are facing. Some even question whether what we are facing is natural, or man-made. Many experts with impressive records and many organisations have positioned their opinions about the changing climate. A raft of guidance, position papers, tools, view-points, and other materials have been created, and if anything, is overwhelming in itself.

The World Economic Forum has in its annual survey "Global Risks Report" included climate change for many years, and its assessed significance as a global risk has been climbing on both the likelihood and severity ladders. Extreme weather and Climate action failure now rank number 1 and 2 on likelihood, and number 2 on impact (second only to Infectious diseases, which is perhaps not surprising in the context of the Covid19 virus). What is useful about the WEF analysis, which ranks Climate action failure as the most concerning global risk, is the conceptualisation of the interactions that something as transversal as climate change, has with society, biodiversity, economies and business. Indeed many of the direct nodes of counter-influence, such as the dilemma poor countries are facing in relation to transforming to greener economies while attempting to address structural and other impediments to addressing poverty, rank high in its own right. Last year, the WEF called climate change "a near term planetary emergency". Near term. Emergency. Could that not be said to be a bit dramatic?

Closer to the proverbial "home", the Institute & Faculty of Actuaries (IFoA) issued a risk alert in 2017 saying "Actuaries should ensure they understand, and are clear in communicating, the extent to which they have taken account of climate-related risks in any relevant decisions, calculations or advice." In a series of guidance communications issued by the IFoA to its members in the ensuing years, various practice area committees published papers to assist practitioners in considering how to address climate change and its possible consequences in their various roles.

ASSA under the Enterprise Risk Management committee commenced its own investigations through a working party set up in 2019, with terms of reference broadly covering guidance to our practitioners, disclosure, and an investigation into the production and publication of a South African climate change index. Through this working party, ASSA also has active liaison with the International Actuarial Association's Climate Risk Task Force, which has produced three guidance papers in recent times on climate change. The South African regulatory authorities have also initiated their approach in a number of areas, with the Prudential Authority Supervision Department actively driving various workstreams on this topic. The South African Reserve Bank's (SARBs) biennial common scenario stress test for the first time considers the impact of a drought scenario on the banking industry (large banks). In a separate initiative, a climate survey has been sent out to the insurance industry, in order to gather essential information about the industry's approach and position. Numerous regulations around the globe have been published, and various regulatory activities have built momentum over recent times, with tight deadlines imposed by regulators in some jurisdictions such as the UK and EU.

Many firms, even private ones, are now making climate related disclosures in their financial statements and other disclosures. The Financial Stability Board (FSB) established the Task Force on Climate-related Financial Disclosure (TCFD) to develop a common set of disclosure requirements and standards. The TCFD is gaining global traction as a preferred disclosure framework, and is now compulsory in certain jurisdictions. The South Africa Sustainable Finance Initiative has established several working groups to assist in the development of a sustainable finance framework. These working groups are hosted by the Banking Association of South Africa (BASA) and chaired by National Treasury. One of these working groups is the TCFD working group which will establish minimum disclosure requirements.

Another regulation worth noting is the EU Taxonomy. The Taxonomy is essentially a classification system to determine whether an economic activity is environmentally sustainable. The application of the Taxonomy requires fund managers and banks to classify whether the assets they finance contribute substantially to at least one of six environmental objectives whilst also not doing any harm to the remaining five environmental objectives. The National Treasury recently published a draft for comment, the Green Taxonomy Finance for South Africa. This Taxonomy is largely based on the EU Taxonomy. If adopted in its current form, the Taxonomy will place a significant burden on fund managers and banks to correctly classify their relevant assets as green.

Apart from changing regulations, some firms have also voluntarily subscribed and committed to science-based targets, and many are now managing their own carbon footprints. Science-based targets indicate how aligned a portfolio's decarbonization pathway is with that of a predetermined climate scenario, such as a scenario where the aim is to limit the global average temperature increase to less than 2 degrees.

Innovation has not been left behind, and numerous products around the world have been created in the wake of climate change actions. Unfortunately, a spate of litigation has already taken its course, some of it around misleading disclosures and claims. Not insignificantly, the current US President has reactivated hard initiatives around the Paris agreement, culminating in a wide-spread pick-up in activities on all fronts.

So where does this leave a practicing actuary working in South Africa? Starting from a low base, an organisation may want to create a plan for incorporating climate risk into its business. A changing climate, whether it results in chronic creeping change, or more acute events, or both, can impact a business, and especially insurers and banks, in many ways. Some of the high-level impact areas are:

- The customer, whether these are individuals or organisations
- Operations and business continuity, both through changing technology in the wake of transitioning to a greener economy, and climate related events
- Products, since market norms may change representing both a risk and an opportunity
- Disclosures
- Provisioning and reserving
- Risk management
- Operating model
- Shareholders and other stakeholders
- Employees
- Suppliers
- Regulators and regulations
- Financial soundness and profitability

Climate risk can be broken down into three subcategories as shown in the graphic below.

PHYSICAL RISK

- Changing climate conditions
- Extreme weather events

Direct damage to assets or property
- Lower asset values
- Default on loans
- Increased insurance claims

TRANSITION RISK

- Policy changes
- Technological innovation
- Social adaptation

Disruption from adjustment to low -carbon economy
- Impacts on pricing and demand
- Stranded assets
- Supply chain disruption

LIABILITY RISK

- Stakeholder litigation
- Regulatory enforcement

Not considering or responding to the impacts of climate change
- Business disruption resulting from litigation
- Penalties resulting from litigation

One good way to start a plan, is through the use of scenario analysis. The advantages of creating a plan based on scenario analysis is that the priorities for business may be identified in a manner that is proportional to impact.

Scenario analysis is typically useful if:
- the **effect of a variety of impacts** should be captured that are **interrelated** and can interact positively or negatively with each other
- possible **results are very uncertain**, will have an **impact in the medium to long term**, and the potential disruptive effects are significant
- **historical trends and data sets do not provide a good prediction** of future trends for example rapid or disruptive changes.

Scenario analysis can effectively be used in a number of areas including:
1) Challenge the business model and strategic plans
2) Detect vulnerabilities to physical & transition risks and test resilience of assets
3) Identify business opportunities and/or evaluate investments
4) Early definition of mitigation actions
5) Inform risk appetite
6) Initiation of an appropriate response for the ERM framework, including the management of financial soundness.

Setting out to do an initial scenario analysis requires a focussed effort and commitment by management and the board to contribute its time and available resources, so that a useful baseline of insights can be created. While the outcome of the initial scenario plan will inform the organisational approach to climate risk, it is sensible to have an accountable executive to drive the initiative. A scenario analysis could be conducted as follows:

1. SET THE OBJECTIVES

The scope of the exercise must be clearly articulated up front. The team responsible for the exercise will return to it often, and they should be able to find clarity in the defined scope. Typical scope items would include the sizing of the various risks in terms of key aspects of the business, evaluating the resilience of the corporate strategy, required business model adjustments and their likely proportions, assessment of capital management and the exposure of the firm to assets left stranded from transition initiatives.

2. DEFINE THE SCOPE AND TIME HORIZON

A significant part of scoping for large multinational conglomerates would be deciding whether to include all jurisdictions across all of the group wide entities, or focus at the start only on a few, such as the material ones and those with more

data or less diversified products. A firm may also decide to use only selected climate related perils, and focus on some of the key counterparties and suppliers. The impacts of physical risks are location specific, and it is therefore necessary to have a clear knowledge of the physical location of assets before a detailed bottom up analysis can be conducted. Experienced judgement is required to strike a balance between the size of the project, the amount of time and resources required, and reaching an outcome that is both generally useful and specifically actionable. The term of the assessment also requires careful consideration in terms of alignment to external stakeholder norms, possible regulatory usefulness, and having enough scope to cross-correlate findings with current long-term planning information.

3. CHOICE OF SCENARIOS

Scenarios for both physical and transition risk should be selected. It is common practice, and quite useful to use multiple scenarios. Considerations for selecting the scenarios could be alignment to the common jurisdictional trend, regulatory pronouncements, any disclosure trends, and what is best aligned to the scope and objectives. Scenarios should at least include a central scenario, which is a best estimate according to common agreement, a more optimistic scenario and a less optimistic scenario for both physical and transition risk.

The scenarios that were recently published by the Network for Greening the Financial System (NGFS) aims to incorporate both the impacts of physical and transition risks. It is expected that the NGFS scenarios will be widely adopted in the EU and UK for upcoming stress testing exercises and by banks for informing a climate house view.

4. DERIVE SCENARIO-CONSISTENT CLIMATE PERIL AND TRANSITION RISK VARIABLES

Physical climate risk scenarios are typically articulated in terms of the extent to which temperatures will rise, on average, and the consequential impact on the climate system in the form of floods, droughts, rising sea levels, storms and heat waves amongst others. Rises in

temperatures and changes in climatic conditions will affect society, businesses, and governments. These impacts do not play out in a spatially uniform manner. Some level of spatial definition must, therefore be defined.

Transition risk scenarios are usually defined around a predetermined temperature outcome and the necessary changes to policy and technology that would be required to meet the temperature outcome. The scenarios would include assumptions around energy mix, energy demand, market sentiment and the cost of carbon.

Additionally, the impact of climate risk can be direct or indirect across physical and transition risks, and may not only bring risks, but also opportunities. Since the impacts may well, for some businesses, cause a dramatic change in product suite, and since customer sentiment and preferences interact with the environment, it is important to remain pragmatic while capturing the key features.

5. BUILD RELATIONSHIPS WITH KEY MACRO-ECONOMIC DATA AND MACRO-MICRO LINKAGES

Connecting the climate related variables to the economic variables is not straight forward. The connecting variables should enable the assessment of financial impact, but ideally also be useful in explaining outcomes at a more detailed level in the core portfolios. Understanding the macro-micro linkages first i.e. how the key portfolio variables such as default probabilities in a loan book, are driven by or explained by macro-economic features. A parsimonious set of macro variables can then be selected, and the relationships between the climate scenarios can then be statistically discovered. It may also be necessary, even desirable, to have some relationships based on general reasoning. As always, this part of the work needs to be subjected to the statistical standards deployed generally in terms of models in the organisation. Several alternative methods to econometric analysis exist, such as Continuous General Equilibrium models and Integrated Assessment Models, all with advantages and disadvantages. One of the important considerations, however, is whether internal skills exist in the discipline of the specific approach chosen.

6. CALCULATE IMPACTS

Impacts can now be calculated, aligned to the scope and objectives. A number of aspects should be assessed here before proceeding with the analysis, such as stochastic or deterministic models, which decision variables to use, how to incorporate management actions, bottom-up or top down analysis, and so on. Enough time should be left for logic and output checks, since it typically can consume quite a bit of time. Actuaries are well versed with the various considerations in this area, with the key differences being the extent of judgement required, the term of the analysis, and understanding the links between the various parts of the climate scenarios. A suitable attribution analysis approach should be deployed from the outset, so that changes can be understood and fed back into the modelling decisions going forward.

7. ASSESS AND DEFINE MANAGEMENT ACTIONS AND REPORTING

Management actions should be casted broader than is typically done for the usual actuarial analysis. The scenario team should remind themselves what decisions should be informed by the analysis, for instance, including operating model aspects, product strategy, and identifying corporate vulnerabilities. Reporting is again not usual in the sense that it is likely to be used for various purposes, such as board level decisions, sustainability reports, and informing the actions of operational divisions.

Besides the compelling benefits of using scenario analysis to scope the organisational approach to climate risk, practice has taught a few lessons in terms of the risk management aspects:

1) Just start – it's better to learn lessons and get traction, than seize up in conceptual thinking.
2) Going broad and shallow, or narrow and deep – the scope can be defined narrowly across products or entities or portfolios, enabling a more rigorous or deeper analysis. Alternatively, the scope can be defined broadly, with analysis being more pragmatic. Learnings will differ depending on the option chosen, so it is important to prioritise what learnings are more useful early on.

3) Risk taxonomies and organisational politics – some organisations debate whether to adjust risk taxonomies to separately list climate risk as a principal risk. This approach and the alternative both have merit. Aligning the organisational approach to this philosophy is important, and a dedicated team under the sustainability unit may be useful, provided that the sponsors have sufficient mandate and recourse within the organisation.
4) Data – data requirements are particularly very different to the usual data assembly in organisations. The earlier the organisation starts collecting data, the better. A substantial challenge is for instance the harvesting of data at a spatial resolution that coincides with the format of the other data.
5) The use of current risk management tools – consideration should be given to using the current analytical infrastructure to the maximum extent, provided that it is fit for purpose. This reduces cost and effort, and potentially enhances the alignment to current analysis.
6) Getting the board on board – as usual with projects that could be somewhat controversial, or at least have potential for inspired differences in opinions, it is always a good idea to find board level sponsorship.

Climate change risks are different to risks we have faced in the past. It is relatively easy to argue away its urgency, especially when we are not that well equipped to think about its impact. Postponement is, however not an option. Whether risks materialise early or not, many stakeholders are demanding actions. So it is best to get started and make it count!

Prof Nasim Taleb et al puts it well in a recent publication titled "Climate Models and Precautionary Measures":

"We have only one planet. This fact radically constrains the kinds of risks that are appropriate to take at a large scale. Even a risk with very low probability becomes unacceptable when it affects all of us - there is no reversing mistakes of that magnitude."
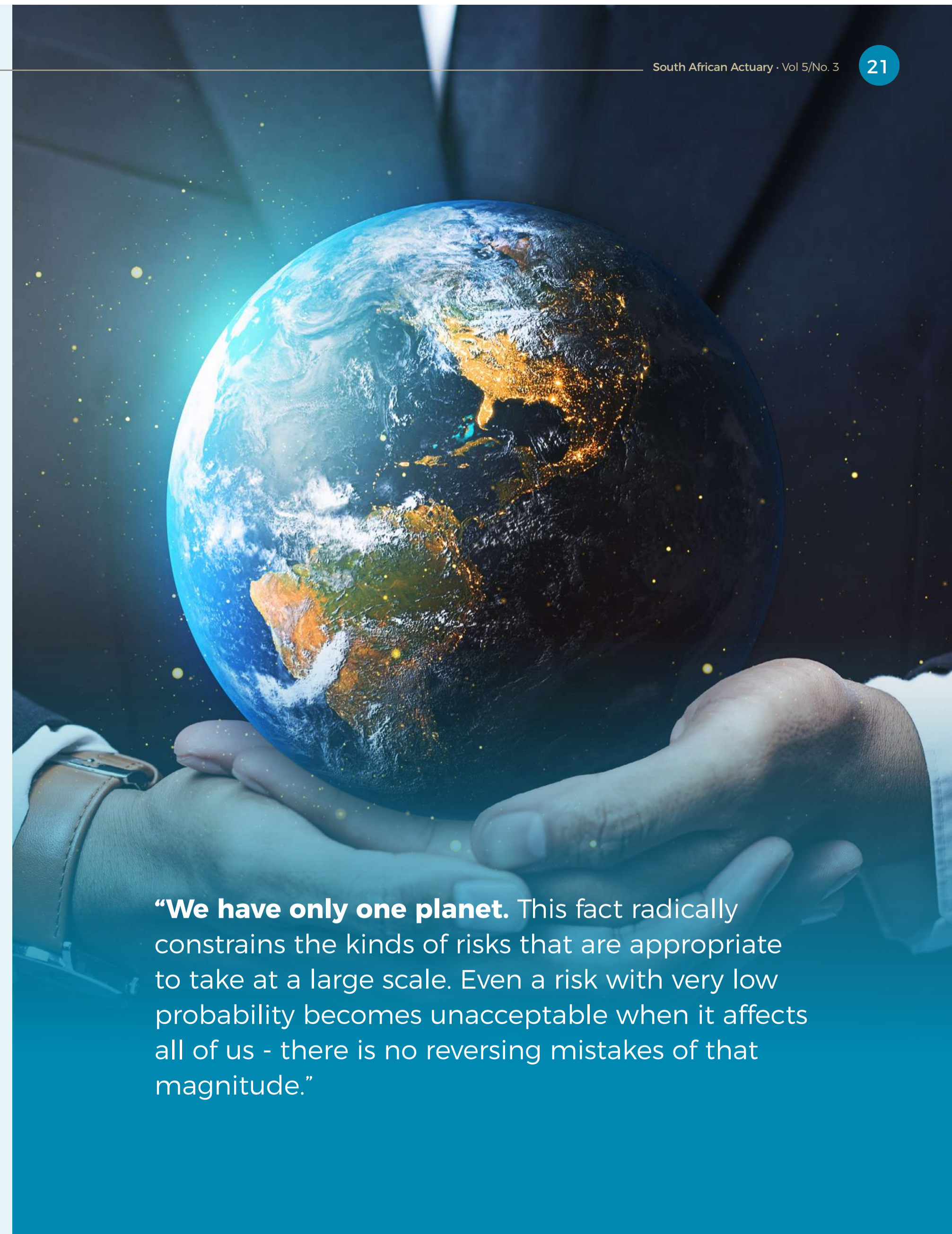
"We have only one planet. This fact radically constrains the kinds of risks that are appropriate to take at a large scale. Even a risk with very low probability becomes unacceptable when it affects all of us - there is no reversing mistakes of that magnitude."

MAKING INFRASTRUCTURE INVESTMENTS WORK
through Actuarial Risk Management Practice

As African economies recover from the pains of Covid-19, countries need to be ready for major infrastructure development in the years to come. This requires countries to develop relevant skills among their people for infrastructure development and financing. Actuaries can play a critical role in this journey. This is an area actuaries cannot ignore, and it is embedded in the Alternative Investments, Banking, Finance, and Enterprise Risk Management (ERM) practice areas as applied to project finance, investment and risk management.

MICHAEL TICHAREVA

The Alternative Investments Forum of the Actuarial Society of South Africa ("ASSA") Chaired by Actuary Malizole Mdlekeza focuses on investments in infrastructure as one of its main thrusts, and ASSA now has an expanded section on infrastructure investments in the Investments Fellowship notes. ASSA is also currently working on a section in the same notes on Impact Investing – investing with the intent to achieve measurable and sustainable social and environmental outcomes whilst making risk adjusted financial returns. As influencers of capital allocation for institutional investors, actuaries should be at the forefront in directing capital where it's most needed, especially towards impact investments. This requires acquiring relevant knowledge.

Over many years of experience on project financing, we have witnessed poor project preparation as one of the main reasons for slow infrastructure rollout in many countries. Project sponsors need to assemble a competent and experienced team to prepare a bankable project. It can easily take several years to prepare a bankable project, and it can cost anywhere between 5% and 10% of total project costs. Actuaries should certainly be in the mix in such teams.

Feasibility studies

A project must be bankable, and for that it must have a solid technical and financial feasibility study prepared by a multi-disciplinary team of engineers, finance experts, risk managers, quantity surveyors, project managers, legal advisors, lawyers and environmental specialists depending on the nature and complexity of the project. Actuaries should be in the mix especially on finance and risk management.

A project feasibility study considers the appropriateness of the project design relative to the needs to be serviced, including social, environmental and legal issues. Issues such as site selection, capacity to implement, phasing of the project, availability of major inputs, project cost, price of the final products to users and market existence must be analysed to assess commercial viability based on current and projected market conditions. Additional factors include the potential for unanticipated delays and the project's operating characteristics such as useful life, reliability, efficiency, required maintenance, and

vulnerability of project technology to innovation.

A good feasibility study should focus on both the "hard" construction costs and an initial estimate of the project financing and development costs. Estimating financing and development costs is a difficult call in the early stages as the interaction between costs and revenues will not have been fully tested yet. However, with experience, a good estimate can be made.

Market, revenue and costs analysis

Analysis of supply and demand, hence the revenue and costs, under various market conditions is an important step in project preparation. Assuming that a project is completed on schedule and within budget, its economic and financial viability will depend primarily on the marketability of the project's output. Off-take agreements with strong counterparties are important to guarantee revenue. In the absence of an off-take agreement, the products would be sold directly to the market on an on-going basis at unknown future prices. The sponsor would, therefore, need to commission a market study of projected demand over the expected life of the project. Such a market study must confirm that, under a reasonable set of economic assumptions, demand will be sufficient to absorb the planned output of the project at a price sufficient to recover the full cost of production, enable the project to service debt, and provide an acceptable return to equity investors.

A market study should generally include a review of competing products and their relative cost of production, an analysis of the expected life cycle for the project output, and an assessment of the potential impact of technological obsolescence. It is also extremely important to assess the impact of potential regulatory decisions on production levels and prices, and ultimately the profitability of the project. For very large projects, it may be important to obtain certain guarantees from the government for a minimum period to ensure the impact of any regulatory decisions during the life of a

project is not adverse. Such guarantees assist in managing regulatory and political risks.

Projects that have a single product whose price may vary widely, such as most commodity based projects, are particularly vulnerable to changes in demand, and may need to hedge against product price risk. Off-take agreements from strong counterparties and certain guarantees become particularly important for hedging. There are also risks on the raw material supply side. Projects whose success or failure relies heavily on the price of one raw material may also require an input supply agreement on guaranteed prices.

Financial modelling

Financial modelling is another particularly important aspect of project preparation, especially when engaging investors. A financial model reflects, in dollars and cents, the provisions made and reached in project agreements. This must include reasonably accurate assumptions with regard to revenue and costs. Metrics such as the internal rate of return, the net present value, pay-back period, debt coverage ratios and their acceptability must be analysed. The financial model often considers, through sensitivity analyses, the impact of construction delays, cost overruns, adverse regulation, inefficiency of the project relative to existing and projected competition, interest rate fluctuations, unavailability of major project inputs, and major unanticipated inflation and volatility in foreign exchange rates.

Risk analysis and management for projects

Actuaries are experts in financial modelling and risk management, but it appears very few are currently applying these in project risk management. Actuaries should be able to assist in undertaking Risk Analysis and Management for Projects ("RAMP") exercises using a well-defined and proven framework developed jointly by the Institute & Faculty of Actuaries and the Institute of Civil Engineers in the UK and is part of the ERM subject syllabus. Since projects are capital-intensive, with many

IT AIMS TO ACHIEVE BETTER FINANCIAL RETURNS FOR SPONSORS, INVESTORS AND LENDERS, AND IMPROVE THE CONSEQUENCES OF PROJECTS FOR THE WIDER COMMUNITY. THE RAMP FRAMEWORK COULD BE APPLIED AT ORGANISATIONAL LEVEL, OR AT INDIVIDUAL PROJECT LEVEL, OR AT BOTH LEVELS.

associated risks in implementing them, the RAMP exercise seeks to provide detailed risk analysis and mitigation strategies to give comfort to investors. This is essentially ERM applied to projects.

RAMP is a well-established framework for analysing and managing the risks involved in projects and any assignment that may be undertaken. It aims to achieve better financial returns for sponsors, investors and lenders, and improve the consequences of projects for the wider community. The RAMP framework could be applied at organisational level, or at individual project level, or at both levels.

The benefits of applying RAMP include:

1. Avoidance of wasted work, because of the iterative nature of the process.
2. Consideration of opportunities as well as threats.
3. Improvement of the credibility of the business case for projects.
4. Consistency with approaches to ERM in the project sponsor's organisation.
5. Greater confidence for those who decide on whether projects should proceed.
6. Recording and communication of "lessons learned".

Despite its benefits, the RAMP model is not commonly applied by many investors as it is a specialist model requiring specific knowledge and expertise. Actuaries, especially those who have attained the CERA designation, can develop that expertise and knowledge from a practical application perspective to apply RAMP for the benefit of institutional investors to achieve optimal and sustainable outcomes. ⓐ

HOW ACTUARIES CAN PROMOTE ACCESS, AFFORDABILITY **AND INCLUSION IN THE HEALTHCARE INDUSTRY** by Shaun Burger

THE SOUTH AFRICAN HEALTHCARE INDUSTRY CHALLENGES

The South African healthcare landscape is known for its complexities, and the COVID-19 pandemic has exacerbated the already fragile state of this sector. It is a continued challenge for many South Africans to be able to afford private healthcare. The medical scheme market only caters for a small portion of the population, leaving many households without an affordable solution.

The provision of funding solutions to solve healthcare needs is arguably one of the most complex environments of all the funding solutions. There are many solutions that consumers use to either insure against, save or borrow for healthcare needs. Even though this landscape remains highly complex and ever-changing, the biggest opportunity for any new entrant is to integrate the different possible solutions and required licenses to adequately meet consumer needs without exposing the underlying complexity involved to clients.

ACTUARIES UP FOR A CHALLENGE

To illustrate some of the innovations in healthcare funding solutions designed by actuaries, let us consider NetcarePlus as a case study. This is a new business within the largest hospital group in South Africa, Netcare, established with the purpose of promoting healthcare access, affordability,

and inclusion. NetcarePlus has a small team of actuaries and other professionals who are committed to address some of the key challenges in the healthcare industry.

Netcare operates the largest healthcare ecosystem in South Africa. In addition to its world class hospital services, the group offers primary healthcare, sub-acute care and day surgery through Medicross, emergency medical services through Netcare 911, renal care through National Renal Care and mental health and psychiatric services through Akeso. With these capabilities across the whole healthcare continuum, Netcare, through NetcarePlus, is ideally placed to promote access and inclusion to quality healthcare in the private sector.

The unified passion of actuaries at NetcarePlus for innovation and truly solving people's healthcare needs gave rise to the following principles as they aim to solve some of the challenges in this industry:

- **Affordability** - Develop solutions that are more affordable and attainable to a large part of the population that has historically not been able to access private healthcare.
- **Simplicity** - Create easy-to-use and understand products with the intent to remove much of the fragmentation experienced in a typical client's healthcare journey.

- **Certainty** - Aim to offer certainty of cost as far as possible through benefit design and clear communication.
- **Access and inclusion** - Aim to eliminate barriers to healthcare by ensuring that the uninsured or under-insured market can use NetcarePlus' affordable products to access private healthcare.

By applying the above principles and using the expanded Netcare ecosystem, NetcarePlus has created products that provide the promise of quality care for everyone. Its products are designed to ensure an integrated healthcare journey for clients, from finding to receiving the best care.

HOW ACTUARIES ARE PLAYING A CRITICAL ROLE AT NETCAREPLUS

Actuaries are well placed to design products that impact society positively through solving structural challenges. Product design and pricing skills that actuaries possess go a long way to solve problems when all the actuaries in the team are aligned to strong principles driven by a passion to make a difference in healthcare. In solving a long standing societal problem. The team of actuaries at NetcarePlus launched innovative healthcare products in 2020 that help more people get access to private healthcare.

The team has developed the following:

- An industry first day-to-day healthcare products in the form of prepaid vouchers that give clients access to a prepaid consultation with a healthcare provider at a time and place that is most convenient to them.
- A standalone insurance product, NetcarePlus Accident and Trauma cover, for the less predictable expenses, typically as a result of an accident.
- All-in affordable prepaid procedures, providing access to private healthcare for certain elective medical procedures at a reduced cost for those who don't have medical aid. These prepaid procedures

Actuaries are well placed to design products **THAT IMPACT SOCIETY POSITIVELY THROUGH SOLVING STRUCTURAL CHALLENGES.**

create certainty of all costs related to the hospital fee, surgeon, anaesthetist, medication, post-operative follow-up and complications. This currently gives access to eye and urological surgeries, with more coming soon.

Innovation, however, does not come without challenges. Actuaries can, therefore, not attempt to approach healthcare in new ways alone. Collaboration with multiple disciplines such as doctors, lawyers and intermediaries to harness the collective wisdom of the team is key to the success of innovative healthcare solutions.

NetcarePlus has built a talented team of skilled individuals across various disciplines to ensure that they achieve the best possible solutions.

Actuaries working alongside other professionals can, therefore, make a sustainable difference in the South African healthcare industry by creating a new and affordable way to get private healthcare. The NetcarePlus story proves the case. Ⓐ

CONVENTION PAPERS:

Beyond theoretical data science: A benchmarking of actuarial departments' practices & proposed recommendations based on industry research *(Dupro, Reacfin, Synpulse)*

VALERIE DU PREEZ FIA - Managing Director, Actuartech & Dupro Advisory (Dupro Ltd)

Valerie has played a key role in the IFoA's journey with data science including:

- Modelling Analytics and Insights Data Science Working Party and the subsequent Practical Applications Papers
- Data Science Member Interest Group and Virtual Conference
- A task force member working on the ethical guidance for practitioners working in data science

Valerie advises insurers and technology providers on the application of data science that incorporates business domain experience and optimal strategies that deliver data driven insights. She launched actuartech.com: an insights page providing thought leadership on the topic of technology and data science, for actuaries.

XAVIER MARECHAL IA|BE qualified actuary; CEO, Reacfin SA

Xavier is an expert in non-life and health pricing and provisioning. For the past few years, he has looked for solutions in traditional actuarial practices (e.g. pricing) which incorporate data science. He is also leading the Prepare and Educate Division of the Data Science Working Group at IA|BE.

ANJA FRIEDRICH Actuary SAV; Manager, Synpulse Management Consulting

Anja is leading the Competence Center for Product and Pricing Management at Synpulse Management Consulting. She focuses on advising insurers about interdisciplinary topics of actuarial know-how and IT. She is also supporting the Swiss Data Science Working Group to generate awareness of the importance of data science for actuaries.

OVERVIEW

Significant changes in technology, regulation, markets, consumer behaviour, the environment, and other global trends are influencing the actuarial department. The increasing availability of big data, the prevalence of technical data science skills, and the application thereof are changing how insights are being derived, thereby shaping the operating model of the actuarial department.

We performed benchmarking exercises using structured interviews with 42 senior first line actuarial function representatives from different British, South African, Belgian, Luxembourgian & Swiss life, non-life, and composite (both life and non-life) insurance organisations to investigate how the insurance industry is utilising data science, with a focus on application and use cases within an actuarial context. Figures 1a and 1b show the distribution of respondents. We investigated the strategies and the operating models within which data science is used, including the types of tools and techniques currently being used by actuarial teams.
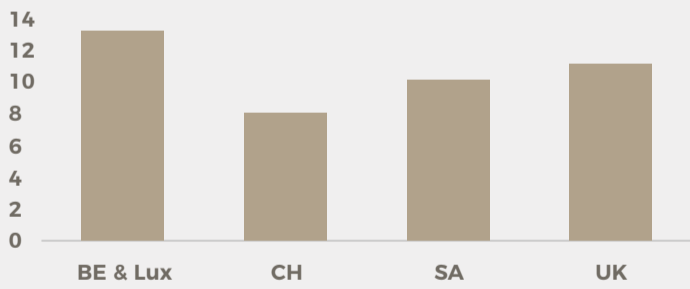

Within our benchmarking exercise we also included themes around the types of data; the technical nature of machine learning techniques and software being used; and wider considerations including risks, risk management, governance, and ethics related to data science.

As Figure 2 indicates, the biggest data science use cases among insurers are those related to core insurance functions such as experience analysis, pricing, underwriting, and reserving. Wider areas such as marketing sales, and claims management have yet to see a similar adoption of data science across respondents. The success and failure of use cases comes down to the interactions between actuarial departments, data science departments, and the wider organisation.

Non-life actuarial functions appear to have the biggest adoption of data science with the most use cases relative to respondents. Pricing related activities were the most popular and claim management use cases such as fraud detection were the most developed. Life functions reported experience analysis (lapse and mortality) as popular use cases for data science activities.

Figure 1a: Number of respondents per country
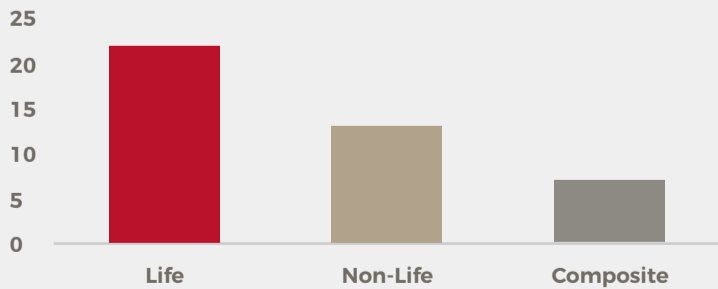
Figure 1b: Number of respondents per line of businesscountry

THE SUCCESS AND FAILURE OF USE CASES COMES DOWN TO THE **INTERACTIONS BETWEEN ACTUARIAL DEPARTMENTS, DATA SCIENCE DEPARTMENTS,** AND THE WIDER ORGANISATION.

We investigated trends in how data is used and the challenges faced getting the right data sources. Departments reported difficulties accessing quality internal data and aggregating multiple sources. External data from sources such as demographics, reinsurers, and financial data is being used readily to enhance internal data - particularly where functions report low quality internal data. Among more mature respondents, we observed an increasing drive towards using behavioural data such as app usage, feedback/complaints filed, telematics, and some degree of wearable data being used.

Departments are shifting more towards open source tools such as Python, R and SQL to perform data science. However, as indicated by Figure 3, SAS and other more traditional software packages are still popular. We observed that this shift is closely linked to the maturity of the department and use cases they are involved in. Respondents do however mainly make use of commercial tools for visualisation and reporting (e.g. Power BI)
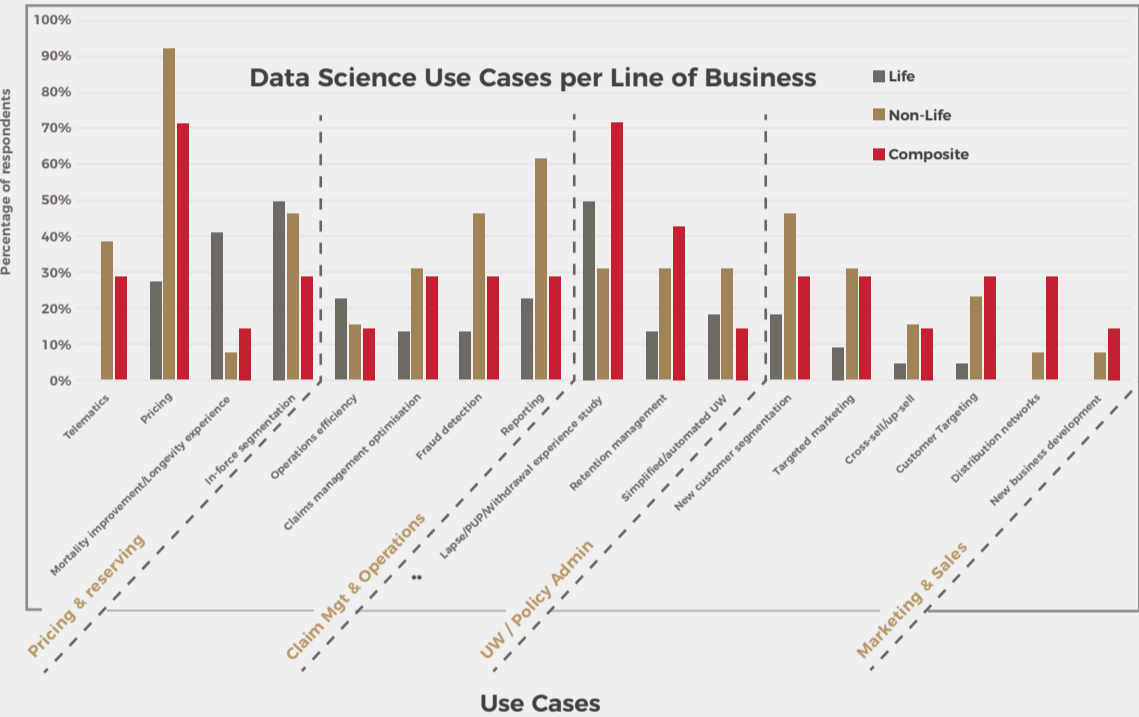

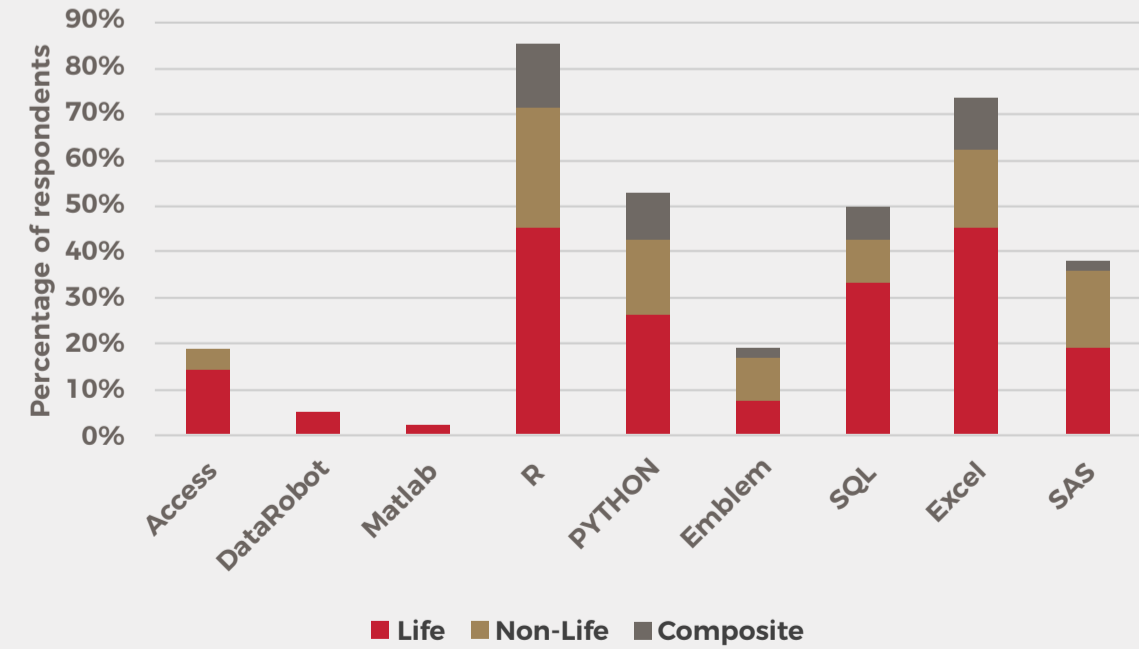**Figure 2:** Key data science use cases identified per business line

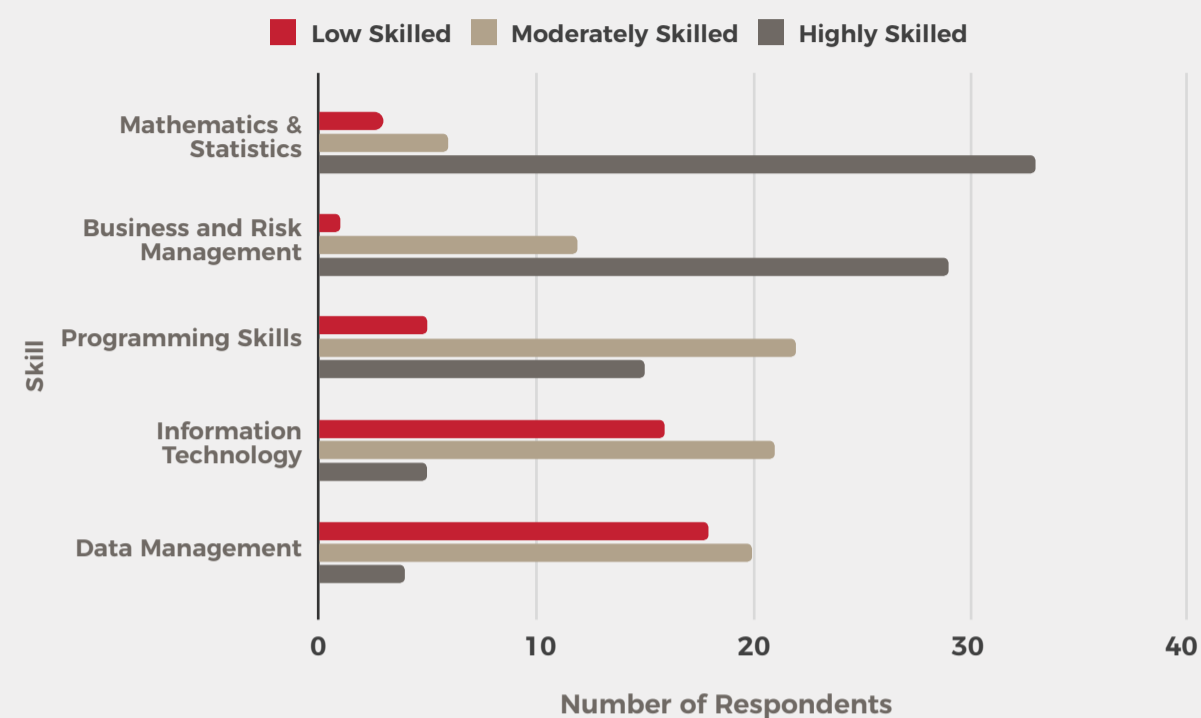**Figure 3:** Software used for model building and validation.

Figure 4: Need copy here Ique se acimus soluptas era porepelles ea qui tem nes voloratur sectur

We investigated trends impacting the skill set required by those working within data science and the barriers to adopting data science. Through this, we were able to identify the skill level and corresponding desire to upskill. The various actuarial departments reported high levels of business domain knowledge with lower programming and data management skills, as shown in Figure 4.
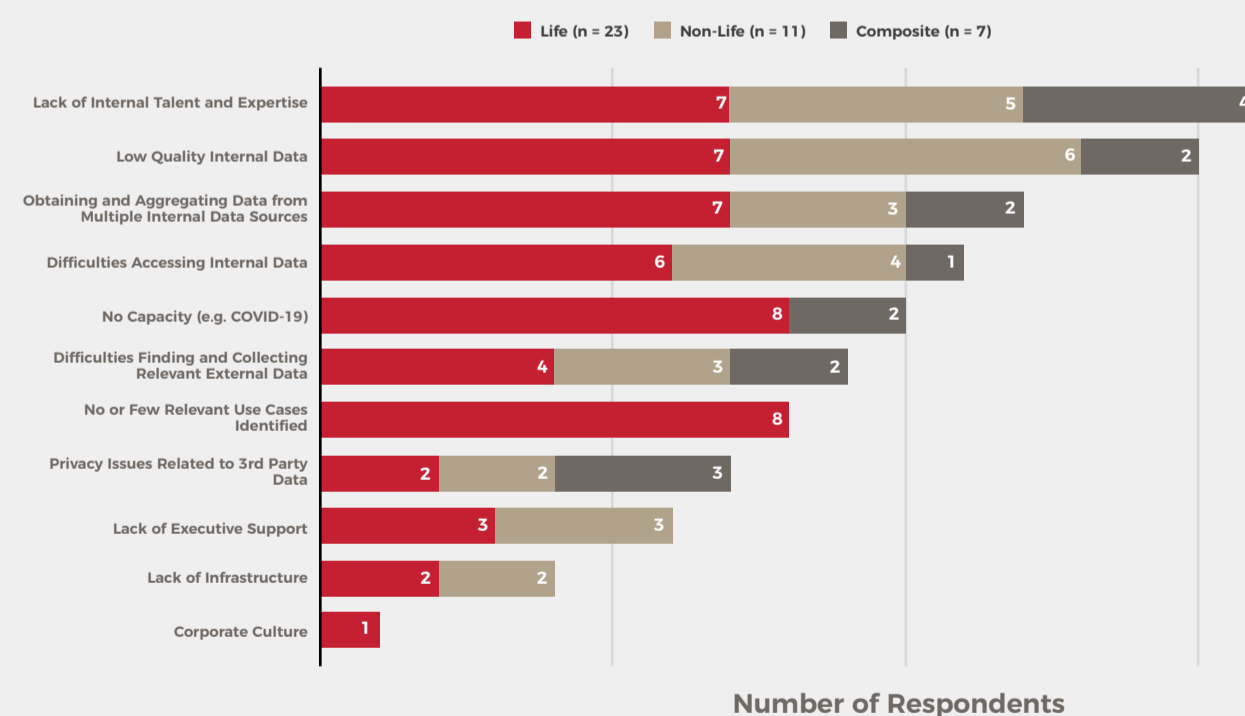

Figure 5: Barriers to entry for adopting data science across business lines

Finally, Figure 5 shows our investigation of the barriers to entry in order to understand why departments are not adopting data science. In addition to lacking internal talent and data quality issues, life departments reported having a limited capacity to apply data science in their team, and a lack of suitable use cases as being their key barriers to entry. Key barriers observed in non-life departments were centred around data and internal talent capable of utilising the data available. Composite departments were mixed across these barriers.

Key findings from the benchmarking exercise were that actuarial departments are tending toward embracing data science as part of their operating model. However, there is much ground to cover in order to reach the level of full collaboration and to support dedicated data science teams. As the more traditional techniques fall out of favour due to improvements in technology and data, departments are changing their way of performing analytics. Actuaries still have the technical domain knowledge to add real business value to data science projects and to have data science improve their own understanding of their business, but barriers around skill levels and data quality issues are preventing them from realising these collaborations. ⓐ

The paper, and subsequent presentation, will offer a deeper look into how departments are embracing data science and new technologies through six parts:

PART 0
Introduction to data science, AI & Machine learning

PART I
Introduction to benchmarking exercise performed

PART II
How do insurers create value using data science?

PART III
What is the level of maturity with regards to data?

PART IV
Which tools & techniques are deployed that enable the application of data science?

PART V
How to ensure optimal team performance when it comes to applying data science?

PART VI What are the main challenges & opportunities in adopting data science?

KEY FINDINGS FROM THE BENCHMARKING EXERCISE WERE THAT **ACTUARIAL DEPARTMENTS ARE TENDING TOWARD EMBRACING DATA SCIENCE AS PART OF THEIR OPERATING MODEL.**

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IFRS 17 WORKSHOP:
Hands-on Introduction to The Standard

Valerie du Preez **FIA** - Managing Director, Actuartech & Dupro Advisory (Dupro Ltd)

Valerie advises insurers and technology providers on the application of data science that incorporates business domain experience and optimal strategies that deliver data driven insights. She launched actuartech.com: an insights page providing thought leadership on the topic of technology and data science, for actuaries.

Nico du Preez **CA** - IFRS 17 Workstream Lead, Beazley; Director, Dupro Ltd

Nico du Preez is an experienced financial reporting accountant with a demonstrated history of working in the insurance industry. He is skilled in International Financial Reporting Standards (IFRS), Lloyd's Regulatory Reporting, Solvency II and auditing.

Patrick Moehrke - Junior Actuarial Consultant, Dupro Ltd

Patrick is a student member of ASSA aspiring to become an actuarial engineer focused on developing efficient software solutions for actuaries and actuarial use. He has assisted on IFRS 17 gap analyses projects for clients and is currently working on IFRS 17 implementation strategies and reporting & software solutions.

Mehul Khandelwal - Junior Actuarial Consultant, Dupro Ltd

Mehul is a student member of the IFoA and aims to become a qualified actuary working in the insurance sector. Mehul has assisted on IFRS 17 gap analyses projects for clients and is currently working on developing IFRS 17 reporting and software solutions.

OVERVIEW

The purpose of this workshop is to equip participants with a strong grasp of the fundamentals underlying the new IFRS insurance contract standard (the Standard) and start utilising it in a workplace context. This workshop assumes an understanding of the standard facilities and functionality in Microsoft Excel, and principles of actuarial and financial reporting. We will be walking through a hands-on example with calculations.

PRACTICAL OUTCOMES:

- A basic understanding of key requirements and changes the new IFRS 17 Standard is bringing
- Hands-on exercise calculating the Contractual Services Margin using the General Measurement Model; including subsequent measurement
- An understanding of differences of key metrics based on different reporting regimes
- An overview of the new disclosure requirements

POINTS TOUCHED ON IN THE WORKSHOP INCLUDE:

- An overview of what the IFRS 17 is
- The background to the IFRS 17
- Important Concepts
- The IFRS 17 Measurement Models
- An overview of data required in the application of the IFRS 17
- Initial considerations when setting actuarial assumptions
- Overview of IFRS 17 calculations
- Applications to discount rates, risk adjustment, statements, and more
- Implementation of IFRS 17 solutions (incl. software solutions)
- Identifying gaps in transition readiness

CONTACT DETAILS

For more information, or any questions you may have, please email info@ actuartech.com, or book a time to speak to a consultant using **https://calendly. com/actuartech/15-minute-meeting**. If you are unable to attend our workshop at ASSA's 2021 convention, but would like to know more about IFRS 17 training and IFRS 17 offerings, please email us on **info@actuartech.com**.

Predictive Machine Learning for Underwriting Life & Health In

Yafei (Patricia) Wang

Patricia is an actuary based in London at Gen Re. She is a Fellow of both the Actuarial Society of South Africa and the Institute and Faculty of Actuaries having a combined ten years of experience in the South African and London markets. Her experience is primarily in financial reporting, financial modelling and machine learning. Patricia completed her undergraduate studies in actuarial science at UCT and more recently completed an MSc (with distinction) at Imperial College London in data analytics and machine learning. She is specifically interested in using machine learning and data analytic tools to resolve business problems in the life and health insurance sector. In 2019, Patricia served as a committee member of the IFoA Asia Conference. She is fluent in English and Chinese (Mandarin).

ABSTRACT

The dominant underwriting approach is a mix between rule-based engines and traditional underwriting. Applications are first assessed by automated rule-based engines which typically are capable of processing only simple applications. The remaining applications are reviewed by underwriters or referred to the reinsurers. This research aims to construct predictive machine learning models for complicated applications that cannot be processed by rule-based engines. Techniques such as natural language processing and clustering analysis are used to process free-text data such as descriptions of impairments and occupations. Various feature selection methods such as mutual information and recursive feature elimination are used to improve prediction accuracies. Machine learning algorithms such as XGB and Random Forest are used to predict underwriting decisions. XGB is the best performer with 94% accuracy on the training set and 71% accuracy on the testing set. Various tools such as word clouds and feature ranking functions are used to give underwriting insights. The paper concludes with data limitations and further researches.

INTRODUCTION

The current dominant underwriting approach for life and health insurance is only partially automated. Life insurers that tried to replicate medical underwriting using automated systems had little success and found that underwriters still need to review many applications (Batty et al. 2010: p.4), and these companies found it challenging to issue more than one-third of policies directly from the system (Batty et al. 2010: p11). The remaining applications that cannot be processed by the rule-based system are typically reviewed by underwriters or passed to reinsurers for review, which is a costly and lengthy process.

This research aims to assess whether predictive machine learning models can be used in the context of life and health insurance policies; in particular, medical underwriting of applications with complicated medical conditions and large sum insured that cannot be processed by the rule-based system.

Desirable outcomes of this research are to build predictive machine learning models that can:

- achieve high accuracy of predictions of underwriting decisions from the machine learning algorithms, given rule-engines can make correct decisions for only a third of the applications (Batty et al. 2010: p.11);
- label applications such that, if the insurer is mainly concerned with high-risk applications, the labels can be used to flag these policies;
- provide underwriting insights that can be used to improve the current process; for example, models can reveal features that have high predictive powers of underwriting decisions.

Data containing free-text descriptions of medical conditions and occupations are preprocessed using machine learning techniques such as natural language processing and k-means clustering analysis.

METHODOLOGY

The methodologies used for this research are illustrated in figure 1.

Several predictive machine learning algorithms are then constructed using processed data. These include Random Forests, Decision Tree, Gradient Boosting, Extreme Gradient boosting, bagging algorithm, AdaBoost, Support Vector Machine, Stochastic Gradient Descent, K Neighbours, and ordinal logistic regression. A broad range of models is constructed to ensure that the best-performing model achieves a high accuracy score.

A secondary objective is to draw insights from the modelling results to make actional business recommendations. For example, the modelling results can rank features by their significances at predicting underwriting decisions, so insurers should capture these variables as accurately as possible. On the contrary, some features have negligible impacts so they could be omitted to reduce the amount of application processing time.

Step 1: Carry out natural language processing and k-means clustering analysis to preprocess free-text variables in the data.

Step 2: Carry out data transformation such that all text variables are transformed into numerical variables.

Step 3: Carry out preliminary data analysis and decides on the treatment of missing data.

Step 4: Carry out PCA and correlation-based filter methods before start modelling. Decide on the suitability of these methods.

Step 5: Use model-dependent feature selection methods.

Step 6: Train models and compare performances.

Step 7: Select the best model and interpret the modelling results.
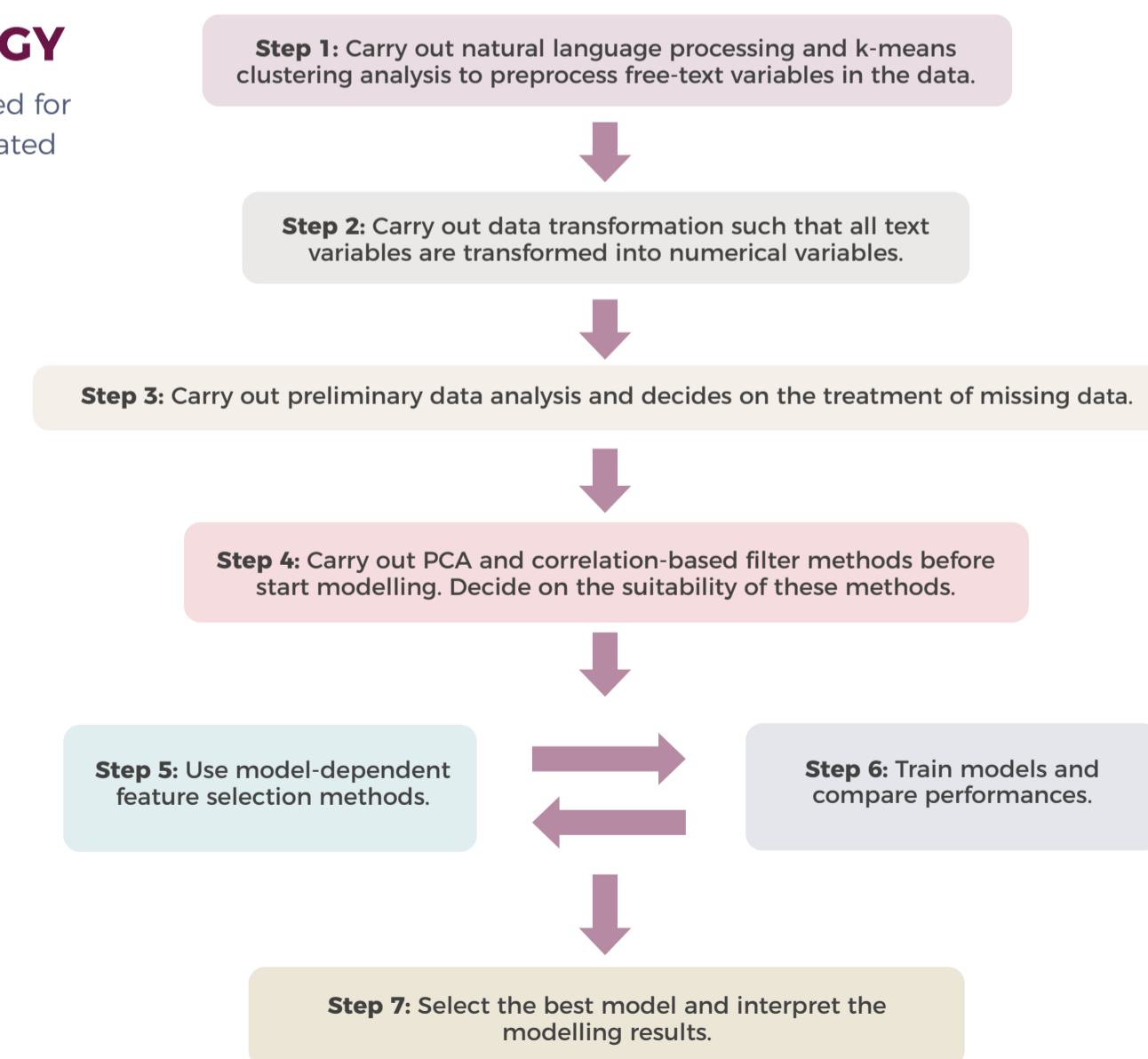
Figure 1: Methodology flowchart

The first step is to process free-text data, in particular, descriptions of impairments and occupations. Free-text data are typically entered into the data-capture system manually by administrators. Such unstructured data contains spelling errors and words of the same meaning but in different variations. Natural language processing is used to eliminate errors and standardize words such that all words appear in lower case and their word origins. Lastly, some descriptions of impairments or occupations do not exist in the medical condition list or occupation list, fizzy match and clustering analysis is applied to imitate the process that underwriters apply judgment to find the appropriate medical condition to apply.

The second step is to transform the text data into numerical data for modelling.

The third step is to look at the missing data and decide on the appropriate treatment of the missing data, as well as carry out preliminary data analysis.

The next two steps are to apply various machine learning techniques for dimension reduction and feature selection. Several feature selection methods are used. The model training will be performed on various subsets of features selected by a combination of these feature selection methods in step 6. Step 5 and step 6 are performed iteratively because some feature selection methods such as Recursive Feature Elimination (RFE) are dependent on the machine learning models.

Ten machine learning algorithms are constructed for this research. The loadings are multiples of 25% and rarely exceed 400%. Applications with loadings greater than 400% are grouped to allow enough data points in this class. As a result, the underwriting decision can be modelled as a multiclass classification problem. Class labels and descriptions are summarised in table 1.

CLASS LABEL	DESCRIPTION
0	loading is 0, the application is accepted on standard terms
1	loading is 1 * 25% = 25%, the application is accepted with loading 25%
2	loading is 2 * 25% = 50%, the application is accepted with loading 50%
3	loading is 3 * 25% = 75%, the application is accepted with loading 75%
4	loading is 4 * 25% = 100%, the application is accepted with loading 100%
5	loading is 5 * 25% = 125%, the application is accepted with loading 125%
6	loading is 6 * 25% = 150%, the application is accepted with loading 150%
7	loading is 7 * 25% = 175%, the application is accepted with loading 175%
8	loading is 8 * 25% = 200%, the application is accepted with loading 200%
9	loading is 9 * 25% = 225%, the application is accepted with loading 225%
10	loading is 10 * 25% = 250%, the application is accepted with loading 250%
11	loading is 11 * 25% = 275%, the application is accepted with loading 275%
12	loading is 12 * 25% = 300%, the application is accepted with loading 300%
13	loading is 13 * 25% = 325%, the application is accepted with loading 325%
14	loading is 14 * 25% = 350%, the application is accepted with loading 350%
15	loading is 15 * 25% = 375%, the application is accepted with loading 375%
16	loading is 16 * 25% = 400%, the application is accepted with loading 400%
20	the application is accepted with loading greater than 400%
100	declined applications

Table 1: Class labels and descriptions

There are several reasons that underwriting decisions, including loadings, could be considered as a multiclass classification problem. Firstly, the natural underwriting decision process resembles a decision tree, so it fits the nature of classification models better, in particular, tree-based models. Even with variable transformation, the output variable, underwriting decision, and the input variables are unlikely only to have linear relationships for which regression models are more appropriate. Secondly, the loadings have discrete values as multiples of 25%, so they are not continuous variables and thus need to be modified to be modelled by classic regression models. As explained above, the loadings are one of 16 possible values, and rarely exceed 400% so they behave more like ordinal variables which can be modelled by classification models. Lastly, underwriting assessment stops when an application is declined, and no loadings would be assigned to declined applications. If loadings were to be modelled using regression models, artificial loadings need to be assigned for the declined applications for modelling. In this case, declined applications are labelled as "100".

Ordinal logistical regression models are included in the research because they are well studied and understood, so they are useful for drawing insights. For this research, all major machine learning algorithms are trained, including logistic regression models and classifiers such as decision tree and random forests.

The prediction accuracies are computed to compare model performances. Micro precision scores, as opposed to macro precision scores, are computed because the dataset is imbalanced.

DATA

Pre-processing

Two columns in the primary dataset are free-text data that require preprocessing: impairment descriptions and occupation descriptions. Typically, underwriters would compare the impairments in the application to the impairments in the medical condition list, each of which is assigned to a medical condition; this medical condition is then used to determine the underwriting decision.

Natural language processor converts all words into lower case, removes all punctuations, and converts all words into their word origins through stemming and lemmatization. This removes spelling errors and word variations of natural language in the application descriptions, so an exact match between impairment descriptions in the application to the impairment description in the medical condition list can be found.

If an exact match is not found, a close-match function is used to return a list of close matches to the word of interest, sorted in descending order of similarity scores. The closest match is used for mapping to a suitable condition.

If neither an exact nor similar impairment is found, clustering analysis is used to find the most appropriate medical condition: all impairments in the condition list are grouped by their corresponding conditions, so 35 clusters are created to represent 35 conditions, each of which contains many impairments all belonging to the cluster. Cluster analysis is then performed on impairments without an exact or a close match, so they are mapped to the most appropriate condition cluster by choosing the smallest distance between impairment description and the cluster centroids.

The occupations in the primary data are processed similarly by natural language processing and clustering analysis, so they are mapped into the correct occupational classes.

Missing Data

There are five variables with missing values, variables with missing data points that are less than 1% of the overall dataset, so they are negligible and deleting these data points would not affect the modelling results.

However, three variables "BMI", "Height" and "Weight" have approximately 40% missing values. It is revealed that the missing values can be entirely attributed to a few companies, possibly as a result of these companies' data capturing issues or their application form designs or chosen market segment. This pattern suggests that the values are not Missing At Random so imputation

is inappropriate here. Again, these data points are removed so only complete data is used for modelling.

FEATURE SELECTION

Principal Component Analysis

PCA aims to transform a high-dimensional dataset into a lower-dimensional dataset with minimal loss of explained variance. With this dataset, PCA cannot reduce dimensions without a large loss of variation or visualise the decision line with a non-obscure interpretation, so PCA is not used.

Feature selection methods

This research uses a combination of correlation-based filter methods, mutual information, and recursive feature elimination. These methods are chosen with the following considerations:

- Practicality: some methods such as wrapper methods are too computationally expensive to be practical for insurance data with large dimensions; the three methods used are relatively computationally efficient.
- Parameter-tuning: recursive method can determine the optimal number of features to be selected; the mutual information method is adapted to do so using the loop described below.
- Accuracy: correlation-based filter methods may eliminate features that are important, and the candidate features are checked before being removed. The other two methods are rather accurate.
- Business applicability: PCA is considered but not used; the rationale is discussed above.

First, correlation-based filters are applied to remove features with constant values.

Next, the correlations between all the input variables are computed. The variables with correlations higher than 0.97 are deemed redundant and candidates for removal. The threshold is set at 0.97 to be conservative to avoid deleting important variables. In addition to the high threshold of 0.97, reasonability checks are used to ensure deleted variables are indeed redundant.

Next, Recursive Feature Elimination with cross-validation is used because this combination has the capability of determining the optimal number of features without user interference. Five-fold cross-validation is used to reduce overfitting. RFE is model-dependent, and XGB is used as the underlying algorithm. Because tree-based models benefit more than other algorithms when used with RFE, and XGB has an in-built penalty to avoid overfitting compared to other tree-based algorithms, it is used as the underlying algorithm. This method retains 67 features.

The mutual information method is then used to eliminate features further. This method requires the modeller to specify the number of features to be selected, but this is unknown, so a loop is used to compute the accuracies of all algorithms on the testing set for k features, where k = {5, 6..., 67}. The performance on the testing data set using the feature selected by each loop is compared, and multiple loops can produce the same maximum accuracy score. The loop that maximises the performances across all models is chosen.

MODELS AND MODEL PERFORMANCES

Models

There are ten machine learning algorithms included: Random Forests, Decision Tree, Gradient Boosting, Extreme Gradient boosting, bagging algorithm, AdaBoost, Support Vector Machine, Stochastic Gradient Descent, K Neighbours, and ordinal logistic regression. Some are classification models; others are regression models.

The parameters are tuned such that the accuracy score is maximised for each classifier. For some parameters, the range can be estimated due to the nature of the problem. For example, for boosting or bagging algorithms, the "max_feature" is set to be no greater than the total number of features selected. Parameter "n_estimators" is the number of trees built for tree-based algorithms. It is set to be 80 initially. This parameter, together with other parameters such as learning rate, are fine-tuned using five-fold randomised search after the optimal subset of features selected. Randomised search of

optimal parameters is done on parameters that may reduce overfitting. For example, eta is the parameter that controls the model complexity of XGB and may reduce overfitting, so it is one of the parameters that are tuned for XGB.

For Adaboost, "SAMME" algorithm is implemented, so the underwriting decision is modelled as a single multiclass classification as opposed to multiple binary classifications.

For SGD algorithm, the loss function is set to "log" so the underlying learner is logistic regression and the penalty term is set to be L1 regularisation. Lasso regression is chosen because it removes noisy features; whereas L2 regularisation reduces the weights on these features.

For the SVM algorithm, Radial Based Function (RBF) is used as the kernel. Insurance underwriting decision is unlikely to have linear or log-linear relationships only with the input variables, due to the complex nature of medical underwriting, so the linear kernel is unlikely to be suitable. As discussed in the literature section, previous studies have found that RBF generally performs better than polynomial, so RBF is chosen.

Default settings are used for other algorithms.

Performances

Table 2 shows the model performances after feature selection and parameter tuning.

	Model_Name	Precision	Recall	Train_Accuracy	Test_Accuracy	F1_Score
7	XGBClassifier	0.71	0.71	0.94	0.71	0.71
1	RandomForestClassifier	0.70	0.70	0.94	0.70	0.70
4	BaggingClassifier	0.70	0.70	0.94	0.70	0.70
5	GradientBoostingClassifier	0.68	0.68	0.94	0.68	0.68
0	DecisionTreeClassifier	0.63	0.63	0.91	0.63	0.63
9	KNeighborsClassifier	0.49	0.49	0.66	0.49	0.49
2	LogisticRegression	0.44	0.44	0.44	0.44	0.44
3	AdaBoostClassifier	0.44	0.44	0.44	0.44	0.44
6	SVC	0.44	0.44	0.44	0.44	0.44
8	SGDClassifier	0.23	0.23	0.24	0.23	0.23

Table 2: Model performances

> NOTICEABLE DIFFERENCES ARE OBSERVED BETWEEN ACCURACIES OF TRAINING AND TEST SETS ACROSS ALL MODELS, INDICATING OVERFITTING

Noticeable differences are observed between accuracies of training and test sets across all models, indicating overfitting. Although feature selection methods and parameter tuning are used to reduce the extent of overfitting, this is often inevitable with real-world data. That said, feature reduction is still useful: the performances of gradient boost and decision tree models improved from 0.66 to 0.68, and 0.60 to 0.63, respectively.

The best performing algorithm is XGB, followed by RF and Bagging. All three algorithms combine the outputs of weak learners into the final output, and the underlying weak learners are decision trees. This is not surprising, because the natural process that human underwriters reach a decision resembles a decision tree.

XGB is the winner of multiple Kaggle challenges (Chen & Guestrin, 2016). Some medical conditions are rare, so there are sparse data for these conditions. The accuracy score stops improving or even decreases a little after the optimal subset of features is selected, so there are features that are noises in the dataset. XGB handles sparse data well and is designed to avoid overfitting by penalising complexity, so it is unsurprisingly the best performer here. Another major advantage of XGB is the in-built penalty term added to the loss function, so the algorithm prefers models with less complexity and thus is less prone to overfitting.

The bagging algorithm indeed outperforms other boosting algorithms, namely AdaBoost and Gradient Boost. The insurance dataset contains noises, so this result echoes Dietterich's research that the bagging algorithm performs better than boosting algorithms on datasets with many noises (Dietterich, 2000).

Not surprisingly, logistic linear regression, SGD with log loss function and SVM with RBF kernel did not perform well. The underwriting decision resembles a decision tree, so the relationships between the outcome variable and input variables are unlikely to be solely logistic linear. Furthermore, regression models typically do not perform well on datasets with many features, which is the case here.

The best performer, XGBoost, achieved 94% accuracy on the training dataset and 71% accuracy on the testing set, which is a rather significant improvement from a random guess for a 19-class classification problem. From a practical point of view, it is also a good improvement to the current rule-engines that found it "challenging to issue more than one-third of policies directly from the system" (Batty et al. 2010). It is worth noting that these scores are achieved despite several limitations which are discussed in **section 6.2**.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The best performing predictive algorithm is XGB, using a combination of correlation-based filter methods, mutual information method, and recursive feature elimination for feature selection. The accuracy score is 94% on the training set and 71% on the test set. Note that this dataset contains entirely applications that the current rule-based engine cannot process.

For insurers concerning the riskiest group of applications with loading larger than 400%, the predictive model produces a label for this group of policies, so this can be used to flag policies for review, should insurers wish to implement the predictive model in parallel to underwriters.

Finally, the output of models can be used to improve the underwriting process in the short term. For example, feature ranking functions embedded in the machine learning models can indicate the variables that the models deem important so insurers aiming to improve underwriting accuracies are encouraged to capture this variable as accurately as possible. The model can be adapted to suit the requirements of more niche insurance products such as microinsurance that typically target low-income groups with simple accept or decline decisions. In these cases, the accuracies of models can be even higher, and the feature rankings are tailored to the product.
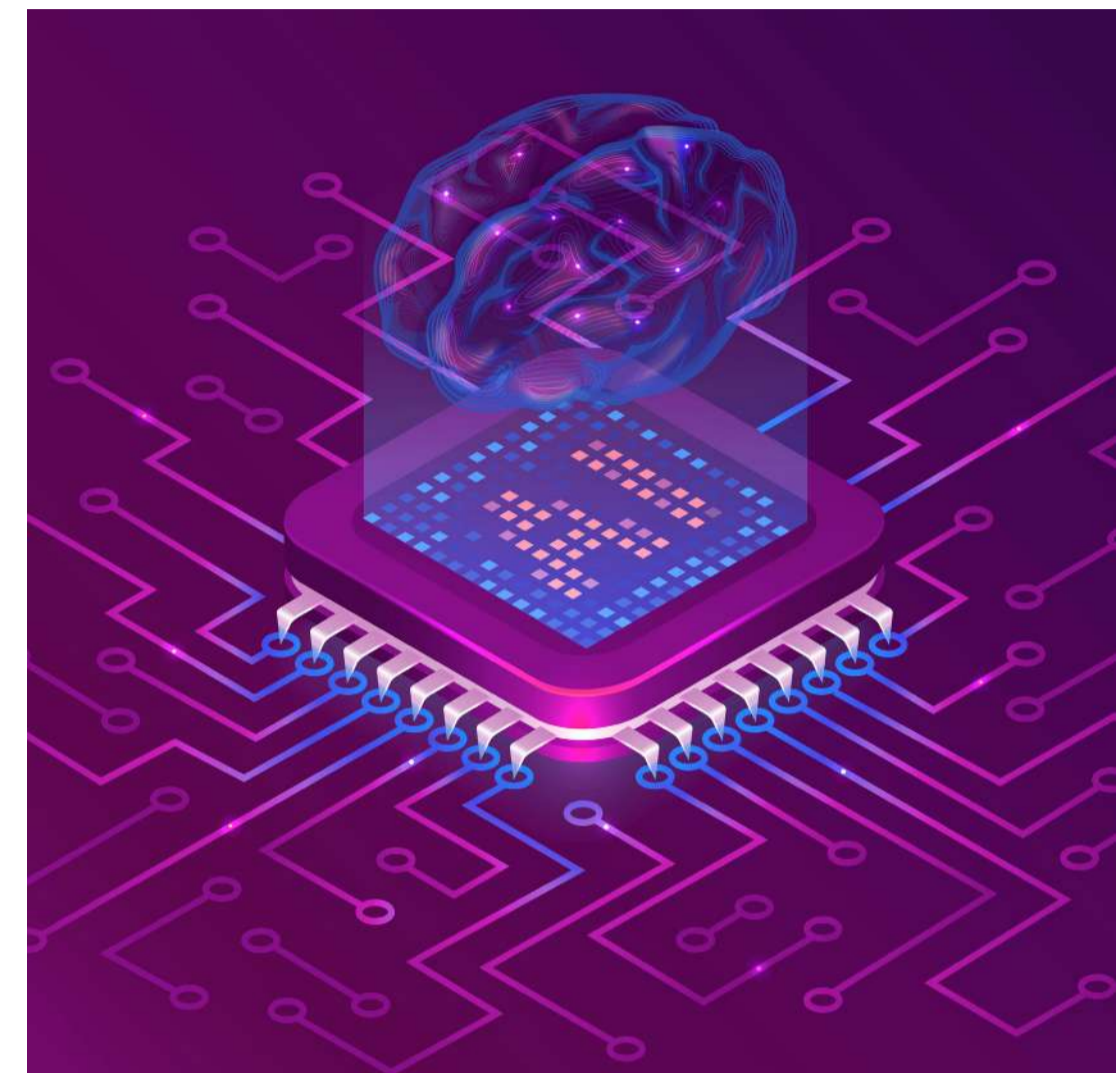
Limitations and future developments

The data used for this research is a reinsurer's dataset containing only referred policies that cannot be processed by the rule-based engines. This is particularly suitable for the aim of this research - assessing the applicability of predictive machine learning models in replicating medical underwriting and for applications with a large sum insured. However, it means that the prediction accuracies would have been higher using a dataset more representative of the general insured population which contains more standard simple applications.

After removing missing data and outliers, the dataset contains only 18182 data points but 118 features. Some machine learning models require a large number of data points for each feature, and 18182 data points are insufficient. This could contribute to the poor performance of some models such as SVM. More data may improve the performances of these models.

Although removing missing data is the most appropriate treatment for this dataset, the missing data points are entirely attributed to a couple of companies' applications. This could result in some biases in the result if these companies have significantly different underwriting practices from the rest of the companies. However, given the competitive pressure in the market, this is unlikely.

Text descriptions in this dataset lack details, which negatively affect the model performances. For example, a diabetic applicant who successfully manages his blood sugar level will get a different loading to another diabetic applicant who is not on any treatment, but this detail is not recorded in the data so the models cannot distinguish these two cases. Another practical limitation is that medical conditions are entered manually, so there are errors in the data; some mandatory checks in the administration system should improve prediction accuracies.

The combination of feature selection methods and underlying algorithms is a design choice that could be further studied. For example, RFE could be tested on other classifiers. The final choice is based on the existing research on various aspects using non-insurance data. All these design choices could be studied to further improve the accuracies or predictive power of machine learning algorithms applied to the underwriting decisions in the context of life and health insurance. ⚠

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RE-EXAMINING RISK
IN ALTERNATIVE REIMBURSEMENT MODELS

by Poonam Doolabh, Lubalethu Dube and Barry Childs

POONAM DOOLABH   LUBALETHU DUBE   BARRY CHILDS

FFS

Healthcare provider reimbursement in the South African private healthcare system is predominantly fee-for-service (FFS). While FFS payment mechanisms have some advantages, such as matching resource use to reimbursement, responsiveness and flexibility, it also causes financial misalignment of incentives between funders and providers of care. Fees charged are aligned with output rather than outcome, with activity rather than improvement of health. There is general acknowledgement that reimbursement models need to move towards an alignment of value between funders and providers of care. The Health Market Inquiry's (HMI) final recommendations concluded that "... a greater uptake of alternative reimbursement models will allow for beneficial patient outcomes...". Such models are often deemed 'Alternative' Reimbursement Models (ARMs), alternative referring to other-than-fee-for-service.

Well-designed ARMs can better align the interests of funders and providers of care. In particular, Ransom et al., (1996) found that the number of surgical procedures performed during the implementation of the capitation reimbursement model decreased

by 15%. Per-diem reimbursement have also been found to significantly reduce length of hospital stays and total medical costs for per-diem payment system participants (Shin et al., 2016). Continued escalation in healthcare costs in the private sector driven at least in part by increasing utilisation for healthcare services is borne fully by medical schemes in the fee-for-service environment. ARMs may help curb excessive increases in utilisation.

Despite the advantages, progress in development and widespread adoption of ARMs has been slow. One of the challenges in designing and implementing ARMs is in contracting between funder and provider. Sometimes, there is an imbalance or asymmetry of information between the parties in the development and understanding of how ARMs work. Some data may not be accessible to a provider seeking to take risk. For example, hospitals do not have full knowledge of the billing data of healthcare professionals treating patients during admissions. Sometimes there is a lack of awareness of the risk management options available to the party taking risk in the ARM. For

these and other reasons, there is mistrust in the industry about ARMs. This paper explores some of the misunderstandings in ARMs and in particular explores stochastic risk of various ARM structures in an effort to demystify the uncertainty and risk that can cause hesitancy for providers unaccustomed to assuming stochastic risk.

The full paper contains a detailed literature review of the financial impact of various ARMs implemented in other countries.

SHARING AND CARING

To help shed some light on risk in ARMs, we consider the distinction between risk transfer and risk sharing arrangements. Risk transfer means that the funder transfers risk over to the provider to manage. If we use a Diagnosis Related Group (DRG) based Fixed Fee ARM as an example, the funder transfers over to the hospital group, the risk of the length of stay (LOS) or level of care (LOC) being higher than the LOS and LOC embedded in the Fixed Fee. The hospital group will be interested in managing LOS and managing patient outcomes to avoid complications to ensure their cost of delivering care does not exceed what is being received under the Fixed Fee ARM. If the hospital improves the management of their patients such that LOS or LOC are lower than that priced in the ARM, the hospital enjoys the savings achieved through this improvement. The funder will monitor LOS to ensure patients aren't being discharged too early, compromising care or resulting in readmissions. Still, they become less concerned with actively managing LOS since this risk has been transferred to the provider.

Under a risk-sharing arrangement, using the same example as above, if savings were to occur, some of this would be shared with the funder. Both the funder and the provider would have a vested interest in the LOS being actively managed and monitored, from the hospital's perspective to manage costs and from the funder's perspective to actively avoid readmissions and ensure the quality of care. The extent of risk-sharing is a function of negotiation between the parties. In our experience, risk-sharing contracts are set up such

that the provider also shares in losses due to higher-than-expected claims.

Risk-sharing contracts can occur in a fee-for-service environment, and many volume-based discount arrangements start in this way. While these are easier to implement from an administrative perspective (because the operational reimbursement structure does not need to change), the disadvantage is that incentives are still misaligned in day-to-day reimbursement transactions and the risk sharing is more abstract to providers on the ground.

AND THAT'S NOT ALL

Whilst utilisation, severity and demographic risks are often considered in ARM contracting, two other risks often do not get sufficient consideration.

The first risk is pricing risk, the risk that utilisation levels or any other assumption used in setting fees is wrong or will not pan out as expected under real-world conditions. This is always a risk when designing a new reimbursement model with imperfectly matched data. Models designed to replace historical reimbursement models, for example, moving to fixed fee per diem ARMs for hospital services to replace historical fee-for-service hospital billing has low pricing risk. Other ARMs designed for new ways of working such as team-based care, value-based contracts with fee modifications for outcomes, or other novel reimbursement models carry higher pricing risk as assumptions are less certain. The estimates derived are typically 'best estimates', set at expected levels and rarely contain explicit margins for pricing uncertainty.

The second is stochastic risk, represented by random variation in underlying claims experience. While most of the systemic variation in claims can be explained by variations in certain risk factors such as demographic profile or case mix, there remains an element of unexplained variation that can only be modelled by a random process. The size of this variation depends in part on volumes of patients, hospital admissions or other ARM specific metrics. ARMs involve taking stochastic risk that can be directly quantified through techniques such as Monte Carlo simulations.

In order to assess the financial risk under an ARM, we need to compare what the risk-taker would have received under the ARM to the risk-taker's cost of delivery of care to determine whether the risk-taker would have made a profit or a loss (or remained cost-neutral). The cost of delivery of care is likely to vary between discipline types and between providers of the same discipline type. Most providers do not share this information externally for obvious reasons and this kind of information was not available to the authors. In the absence of this information, we used FFS claims costs as a proxy for cost of delivery of care. It is widely known that FFS costs already include some margin, therefore, it is important to make an adjustment for this if appropriate. For the purpose of this illustrative exercise, no adjustment was made.

Two variables were allowed to vary within our modelling exercise: ARM structure and population size. Our dataset comprised of annual healthcare claims costs of almost 200 000 medical scheme lives in 2019. The admissions dataset consisted of 45 572 individual admissions. We used the 2019 benefit year so as to not distort the analysis with the impact that COVID-19 had on 2020 claims.

Claims were summarized per family[1] i.e. per policy. We then calculated the amount that would have been received under various ARMs for these real-world families. We performed bootstrapping to randomly sample a subset of these families and compare their aggregated FFS claims costs to the ARM fees. Traditional bootstrapping requires sampling with replacement. However, given the size of our dataset and the purpose of the sampling exercise, we believed that no additional value could be derived from sampling the same family more than once. We, therefore performed sampling without replacement.

When considering the results, the specific provider context should be borne in mind. The provider landscape could be several individual GPs, or a corporate group of GPs, individual hospitals, or hospital group(s), or some intermediary taking Health Management Organisation (HMO) capitation risk. The patients covered by the ARM model in question may only represent a proportion of the provider's total business. The quantities of families or admissions should be interpreted with these issues in mind.

We ran 10 000 samples for each ARM structure and each population size considered. This allowed us to determine the probabilities associated with each of the simulated outcomes. The sections below explore the results from our modelling exercise for various ARM structures.
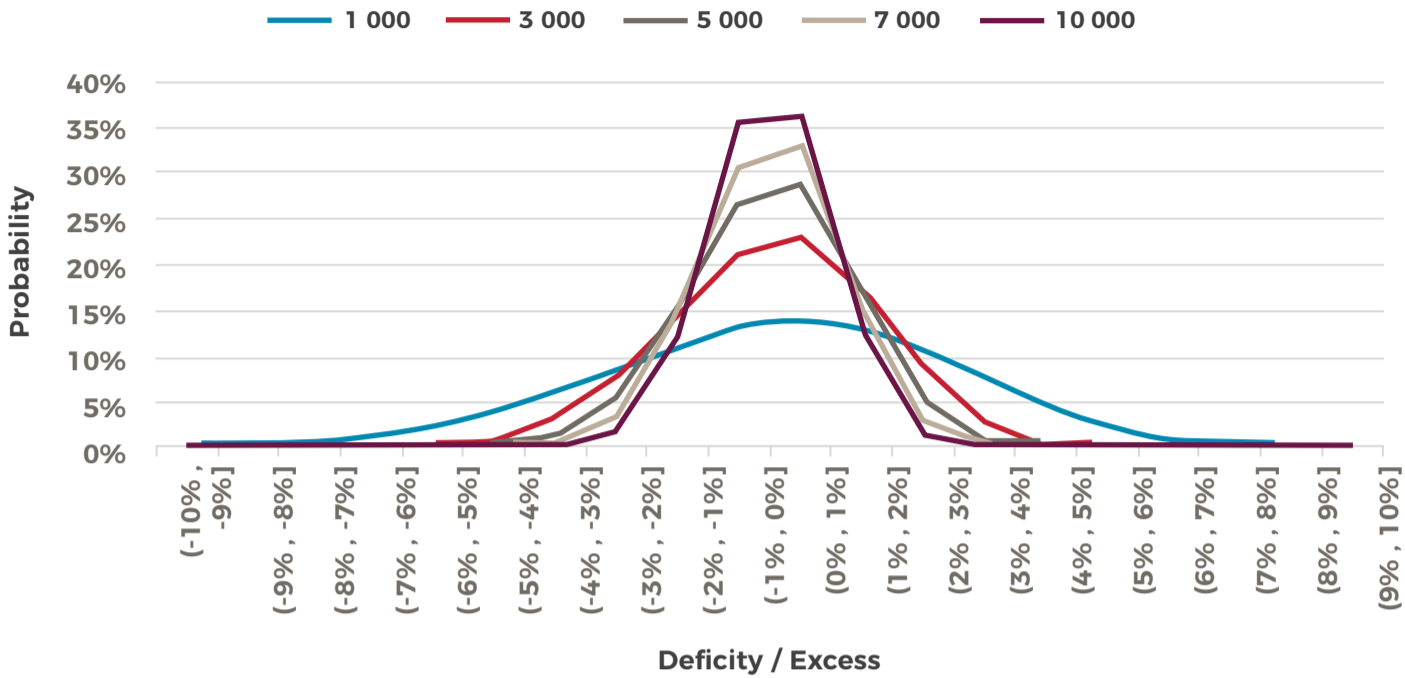
OH CAPITATION, MY CAPITATION

Risk adjustment performed was based on age, gender, chronic status, and benefit option (to allow for different levels of primary care benefits available under different options) to set the risk-adjusted capitation fees. In general, benefit differences between schemes and options will give rise to differences in stochastic risk. Stochastic variation in primary care capitation diminishes quickly as population size grows. A small population under capitation, say 1 000 patients presents wide variation in expected financial performance against a capitation fee set at the expected value. Lager populations of 7 000 - 10 000 patients represent a much smaller risk.

An individual GP in South Africa manages in the range of 3 000 and 5 000 patients[2], some may be larger. This suggests that an individual GP would be exposed to some stochastic variation if their patients were funded according to a capitation model. Currently in South Africa, GPs treat patients from the range of medical scheme benefit options on the market as well as private patients. It is unlikely all patients in a practice would be on a capitation model, so GPs will have a mixed model of reimbursement. Some GP practices are corporatized and operate in groups which have more patients collectively. This may allow for more risk taking via capitation.

Allocations in the modelling approach are randomized. Systemic risk due to say, demographic differences in allocated patients should be mitigated via an appropriate risk adjustment structure. In practice patients would be allocated to a GP practice within geographic areas which may affect the underlying variation in claims behaviour. This could be considered for a future refinement in the work to test the effect that geography has on stochastic risk.

Population size	1 000	3 000	5 000	7 000	10 000
Standard deviation	2.9%	1.7%	1.3%	1.1%	0.9%
Probability of a deficit >= 5%	4.6%	0.3%	0.0%	0.0%	0.0%

A typical GP looking after between 3 000 and 5 000 patients then could take capitation-based payment with little stochastic risk, less than a 0.3% chance of a deficit of more than 5% arising. It may, however not be possible to arrange capitation fees for all a doctors patients given fragmentation on the funder side of the market.

The full paper explores the stochastic risk associated with further ARM structures.

WE ALL STAND TOGETHER

Ongoing cost pressure in the South African private healthcare sector is one reason for renewed interest in alternative reimbursement models. Successful ARMs require mutual agreement between healthcare funder and provider, which in turn requires informed decision-making facilitated through the quantification of risks. This helps parties better understand risks, which in turn supports good risk management and mitigation. Our analysis shows that, subject to an appropriate minimum volume of patients or admissions, as well as considerations for appropriate risk premium, it is acceptable for healthcare providers to take on stochastic risk. While the models shown above are simplifications of reality, they nonetheless provide guidance on the nature and magnitude of the risks under such ARM contracts. Each contract between funder and providers has its own nuances, benefit design considerations, risk appetites and risk mitigation mechanisms to consider.

Entering the right ARM design for the right contract structure helps ensure that each party holds appropriate risk and can better align the interests of the parties. Wider adoption of ARMs is an important area of improvement for the South African healthcare system.

Additionally, regular performance measurement is required as this is key for tracking performance against expected outcomes. Data sharing between funders and providers is thus a key component of sustainable ARM models. ARMs provide a means to improve the health system by aligning risk and incentives between parties, but on their own they are not a silver bullet. They need careful context specific design, and ongoing monitoring and adjustment to ensure improvement is ongoing. ▲

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[1] The average family size for this cohort of lives is 2.8.
[2] Obtained from telephonic discussions with several GPs in practice and Independent Practitioner Association managers.

'WHERE ANGELS FEAR TO TREAD'

Reflections on the Role of an Actuary as Expert Witness in the Land Claims Court by Mickey Lowther

MICKEY LOWTHER is a well-known independent South African actuary whose experience includes acting as expert witness in damages, maintenance and land restitution matters. He has also been a scheme actuary and retirement fund trustee.

Mickey has researched professional education, development and conduct for actuaries. In a decade long collaboration with the late Prof Wendy McMillan, he conceptualised modern and dynamic approaches to areas such as professional conduct, normative education and continuing professional development. These have been implemented with success in South Africa, and in some cases, internationally.

Mickey has addressed conferences and seminars of the International Actuarial Association in Paris, Washington and Berlin, the Actuarial Society of South Africa, the Institute of Retirement Funds, the Pension Lawyers Association, the Principal Officers Association, Professional Practice, Education and Learning (ProPEL, Scotland), Organisational Learning, Knowledge and Capabilities (OLKC, Milan), as well as commercially sponsored conferences. Topics include pension fund governance and risk management, pension reform, assessment of quantum of damages and matters of professional conduct, practice and training.

As one can see from his profile picture, Mickey likes to think through his upcoming projects in the mountains!

In the paper, Mickey reflects on his experiences of giving expert actuarial witness in the Land Claims Court regarding financial compensation as an alternative to the restoration of dispossessed land. As no specific formula for compensation has been legislated in South Africa's land reform programme, relevant case histories are examined in which the common law has been developed. The technical, ethical and professional inputs which an actuary can provide are reviewed.

Mickey reports that some years ago he was approached to give input into a novel matter for actuaries – the calculation of compensation as equitable redress for land dispossessed in the previous century as a result of unfair racial practices. So little precedent existed that the claimants engaged three actuaries to give their opinions on methodology! Since then, he has been involved in a number of similar matters.

Mickey considers that actuaries are ideally placed to serve the public interest in these matters, not just for the calculations (which are mainly straightforward) but also because our services are delivered in terms of our 'professional promise' to be technically correct and up-to-date, ethical, and subject to professional oversight. Discussion of the paper at the Actuarial Convention will address the third strand of the professional promise – members of the profession gathered to examine these and other potential approaches to compensation.

The tricky path that angels might fear to tread, alluded to in the title of this paper, arises because this is a new field in which other professions also play – including lawyers and judges and property valuers. Should actuaries 'stick to their knitting' (as

ACTUARIES ARE IDEALLY PLACED TO SERVE THE PUBLIC INTEREST IN THESE MATTERS, not just for the calculations (which are mainly straightforward) but also because our services are delivered in terms of our 'professional promise' to be technically correct and up-to-date, ethical, and subject to professional oversight.

a leading lawyer suggested while trying to work through the complexities of the 2001 Pension Funds Amendment Act which he felt actuaries were responsible for)? In other words, just be a super-calculator and produce answers to sums as requested. Or should they use their broader ability to make financial sense of the world in the public interest, especially since the land reform programme is clearly in the public interest?

In 2012, Parliament re-opened the window for making land claims – but the window was temporarily shut by the Constitutional Court, which invalidated the legislation due to lack of consultation. If and when Parliament adequately repairs the 2012 amendment to the Land Restitution Act, another 160 000 land claims may fall to be decided. Mickey concludes that actuaries' technical, ethical and professional inputs make them well suited to assist the Land Claims Court to resolve the potentially large number of claims, in the public interest. Ⓐ

Mickey would welcome your preliminary thoughts or queries at **actuary@mweb.co.za**

The Actuary and IBNR Techniques. A machine learning approach.

by Caesar Balona and Ronald Richman

Caesar Balona is an Actuarial Manager at QED Actuaries and Consultants

Many techniques for estimating IBNR reserves are currently available for application in a reserving analysis, and, usually, each of these techniques has several variations that can be applied. Often, reserving techniques are selected using judgment by the actuary in a subjective manner. Thus, to an outside observer, the process of IBNR reserving can appear as more art than science. Nonetheless, it is difficult to assess the contribution of each of these judgments to the predictive accuracy of the reserving exercise, and actuaries auditing or reviewing reserves may require different approaches to be applied. Judgement is certainly required in actuarial calculations, but this leads to a question: what should be left to judgement, and what can be determined in a scientific manner? We addressed this question in a recent paper (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3697256). In this article, we briefly summarize our approach, discuss some new ideas, and introduce our open-source repository that implements the methods.

TOO MANY CHOICES

When applying a chosen reserving method, we often have many parameters to set. For example, even before the choice of an IBNR projection methodology, we must select from a plethora of approaches to deriving loss development factors: simple or weighted averages? How many origin periods to include when calculating the average? Should high or low factors be excluded?

Ronald Richman is the Chief Actuary at Old Mutual Insure.

Then, we turn to the choice of method to estimate the ultimate losses: do we use a basic chain ladder, or rather a Bornhuetter-Ferguson (BF) method? If we use the BF method, what should our apriori loss ratio be or, perhaps, could a Cape-Cod estimate of the loss ratio be more appropriate?

In navigating these choices, there are often well-founded heuristics the actuary can rely upon, for example, to use exposure-based methods on less mature accident years. Nonetheless, it is difficult to guarantee that the judgements made based on these heuristics result in optimal predictive accuracy. Ideally, we would like to have an objective measure of how well a selected reserving method (and selected variation) will perform on unseen data.

MACHINE LEARNING HAS ALREADY SOLVED THESE PROBLEMS

This situation of having many different techniques available for selection brings to mind the situation of selecting a machine learning (ML) technique. Within the discipline of ML, many different techniques have been proposed. For example, to perform regression, one must select a technique from many different categories such as regularized regression, gradient boosted trees, and neural networks. Then, the hyperparameters (which are not inferred directly from the data) that determine how the technique is applied must be chosen, for example, the extent of the regularization of a regression model.

Within ML, the automatic selection of techniques and parameters is done by estimating the expected predictive accuracy of every reasonable combination of techniques and parameters. Within the context of a single class of models, this is called hyperparameter optimisation. Simply put, one tests all combinations and then selects the set of parameters that are shown to be most accurate. How are these tests performed? Several different approaches[1] to estimating the expected predictive accuracy are available. The common thread among many popular versions of these approaches is that the selected model is fit on one subset of the data and tested on another subset. The performance on this unseen data is used as a proxy for the expected predictive accuracy.

The golden standard approach to hyperparameter optimisation is called k-fold cross validation. In this approach, the dataset is split into k separate subsets (each subset is called a 'fold'). Each of the k subsets is used to assess the accuracy obtained after training the model (with its chosen parameters) on the other $k-1$ subsets. The accuracy is then averaged across the k folds. This approach can be extended to time series problems, as we discuss next.

Given that the process of selection of machine learning techniques and hyperparameters is quite mature, actuaries can easily leverage this

for actuarial purposes, and, in our case of reserving, potentially giving us an objective scientific approach to selecting IBNR techniques. In our paper, we use a variation of k-fold cross validation to select the optimal reserving parameters.

APPLYING *K*-FOLD CROSS VALIDATION TO A CLAIMS TRIANGLE

When reserving, an important way of gaining a feel for accuracy is to assess how accurate our claims projections are in the next period. Of course, we are interested in the total IBNR reserve, hence ultimate claims, but we generally re-assess our reserves each subsequent period and base some of our choices of techniques over time on our performance in the most recent period. That is, we perform what is commonly called an actual versus expected (AvE) analysis.

Over time then, our approaches are guided by numerous AvE analyses. Thus, calculating the accuracy of our techniques and a set of parameters using performance on an AvE is a natural way to determine if one set of parameters leads to more accuracy than another. This leads us to the following way of viewing a reserving triangle: we can consider the triangle as a collection of smaller triangles, each with subsequent claims to predict on the next diagonal. This is a natural way to apply k-fold cross validation for a reserving triangle.
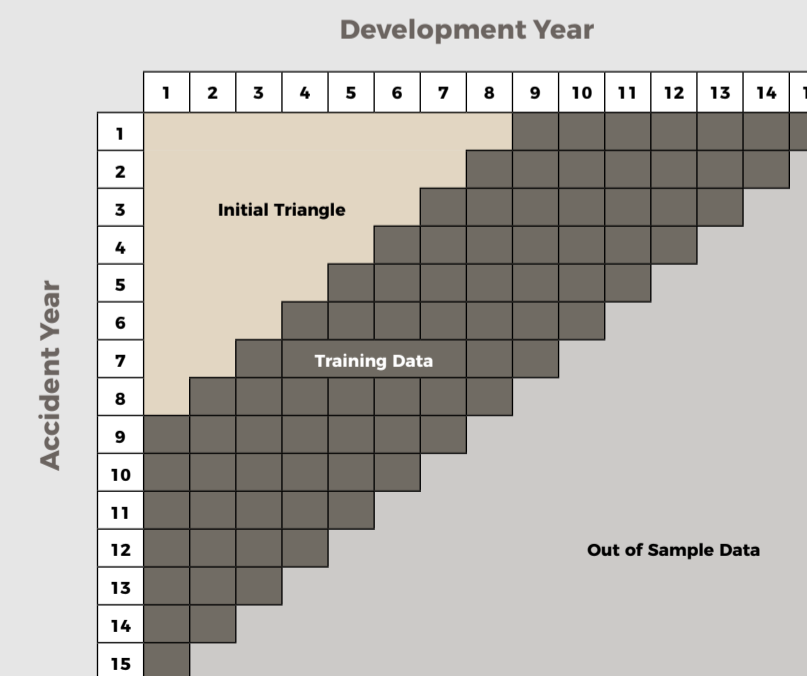
[1] Also worth noting are information criteria approaches, however, these are not available for most commonly used machine learning techniques.

We start by considering a sub-triangle, say, the first 5 calendar periods, shown in blue in the figure above. Given a set of parameters and a chosen methodology, we can determine what our expected claims will be over the next calendar period, shown in green. Using this result, we can calculate an AvE score since we know what the actual claims are in the next calendar period i.e. on the next diagonal.

We can repeat this process for all the remaining calendar periods, until we have reached the final diagonal of the triangle and can no longer calculate an AvE score. Now, we calculate the average AvE score over all the calendar years, to arrive at an average AvE score for our chosen parameters and methodology. If we perform this for all the parameters and methodologies under consideration, we can then simply select the parameter set and methodology that results in the best score. This selection is based on the underlying assumption that good predictive performance in the past will result in good performance in the future; indeed, we discuss later the extent to which we found this to be true empirically.

In practice, it is usually also a requirement to balance accuracy with overall reserve stability. One might imagine that our approach above could prioritise accuracy over stability, and hence our total IBNR might fluctuate unnecessarily. To combat this, we

proposed using the Claims Development Result (CDR) as an alternative scoring metric. The claims development result for calendar year k and accident period i is defined loosely as:

$$CDR_i^k = AvE_i^k + IBNR_i^k - IBNR_i^{k-1}$$

In other words, the CDR adds on to the AvE the change in the IBNR reserve from one calendar period to the next. When using the CDR as a scoring metric, this extra term helps to minimise fluctuations in the IBNR reserve thus achieving more stable IBNR estimates.

HOW DOES THE APPROACH FARE IN PRACTICE?

In our paper, we apply this approach to three triangles. We find that in general our approach leads to a choice of parameters that has improved predictive accuracy over straightforward application of common methods. Even more importantly, we demonstrate that using our approach we can have confidence that our chosen parameters are improving our reserves and provide objective and auditable support for our choice of parameters. The table below compares the actual IBNR (that is, the true development unknown at the time of reserving) against the expected IBNR raised by a baseline Generalized Cape-Cod (GCC) with a 75% decay factor.

	Actual IBNR	Basic GCC	Minimise AvE	Minimise CDR
Swiss Triangle	32 160	37 511	31 414	31 647
	-	+16.6%	-2.3%	-1.6%
Long-Tail Liability	55 162	20 859	44 731	37 155
	-	-62.2%	-18.9%	-32.6%
Short-Tail Property	10 042	2 971	8 226	9 602
	-	-70.4%	-18.1%	-4.4%

From the above table, we see that our approach leads to IBNR reserves much closer to the actual IBNR at the time of reserving. For the case of the Swiss triangle, the GCC over-estimates IBNR by 16.6%. When reviewing the parameters chosen by our approach, we see that it opted to use more recent accident periods to calculate its development factors which reduced overestimation.

On both the Long-Tail Liability and Short-Tail Property the GCC underestimates considerably. When minimising AvE or CDR, our approaches again selected more recent accident periods to calculate LDFs. Interestingly, our approaches also selected the BF method instead of the GCC, gaining extra predictive accuracy by intentionally selecting an optimal apriori loss ratio for each triangle. The impact for the Short-Tail Property triangle is most significant, being within 5% of the actual IBNR.

We refer the reader to the full research paper for an in depth analysis of the results.

MULTIPLE RESERVING METHODS IN AN ENSEMBLE

In our presentation for the 2021 Actuarial Convention, we intend to elaborate on and address four common questions and requested features of our approach. We discuss the most common one here: Our approach selects a single methodology for all accident periods, is there a way to select a different methodology per accident period?

It is common for actuaries to use a Basic Chain-ladder (BCL) for more developed accident periods, and then switch to a BF or GCC for the more recent and less developed accident periods; essentially relying more on data for the older accident periods, and more on judgement for the more recent ones. Our approach did not cater to this requirement because the resulting parameter space will become so large that it will be near impossible to realistically search in a reasonable time.

Thus, to address this hyperdimensional limitation, we developed an alternative approach that we have called the Auto-Ensemble approach. In the basic case of selecting between two reserving methodologies for each accident period (say between BCL or BF, as per the example above) we can think of this as taking the weighted average of the IBNR estimates of each approach where our weights sum to 1. So if we have 5 accident periods, and we selected BF for the most recent two, our resultant weight matrix and ensemble IBNR would look as follows:

BCL Weight	BF Weight	Sum of Weights	BCL IBNR	BF IBNR	Ensemble IBNR
1	0	1	100	500	100
1	0	1	500	750	500
1	0	1	1 000	1 250	1 000
0	1	1	1 500	2 000	2 000
0	1	1	2 500	3 500	3 500

In fact, the weights can be any value between 0 and 1, provided they sum to 1. So, we could take the straight average of the two methods by applying weights of 0.5 to both the BCL and the BF.

THIS GREATLY SIMPLIFIES THE SEARCH SPACE AND MAKES THE PROBLEM ONE OF OPTIMISATION: WE SIMPLY NEED TO FIND THE OPTIMAL WEIGHTS.

This greatly simplifies the search space and makes the problem one of optimisation: we simply need to find the optimal weights. This makes it a trivial problem for a neural network. The approach is thus as follows:

1. Select two or more reserving methodologies you plan to ensemble or select between (possibly using the algorithmic approach we defined in our paper for each of them).
2. Train a neural network using stochastic gradient descent to find the optimal weight matrix that minimises the AvE (or mean squared error) of each accident period.
3. Use the weight matrix to combine the two methodologies.

To most of us not familiar with neural networks or stochastic gradient descent, the above appears unapproachable. However, we have developed an open-source package to make our research practical for all.

TRYANGLE: MACHINE LEARNING TECHNIQUES FOR CHAINLADDER METHODS

Through a research grant graciously provided by the Casualty Actuarial Society, we developed a python package that implements the above approaches and more. Given that the package is open-source, we encourage the reader to contribute to and improve the package as they see fit. This way, we can build a reserving package that is community developed. The table below lists the relevant links for the package:

GitHub Repository	CLICK HERE
Documentation	CLICK HERE
Documentation	CLICK HERE

IS THIS THE "ULTIMATE" RESERVING APPROACH?

Our proposed approach allows for some automation of the process of selecting a reserving technique. Nonetheless, what we are proposing is not to replace the reserving actuary with an algorithm but to assist the actuary by removing the repetitive manual process of selecting parameters by judgement and replace that element with a robust and objective machine learning approach.

In this way, the actuary can spend less time on technique selection and more time applying actuarial judgement by considering external factors not inherent in the data. For example, given the impact COVID-19 has had on the claims experience of insurers, it is unlikely that the result chosen by our algorithm based on experience from 2020 will be optimal. On the other hand, our algorithm could provide a baseline approach based on previous accident years, after which the actuary could spend significantly more time considering on how best to allow for the impact of COVID-19.

LOOKING BACK 4 DECADES

Pointers for the present

by Anthony Asher

In the last email I received from Wim Els, he asked me to write a "looking back" article, to share a few highlights and "give a few pointers to the young ones". Having spent half my career trying to give such pointers, how could I refuse?

Highlights from my teaching were the personally warm interactions with many students and graduates. Professional highlights were the personal interactions with fellow actuaries over the years. The 2010 International convention in Cape Town stands out given the generous welcome I received as an Australian visitor. Other highlights are the long term relationships that have arisen from Church and fellowship groups. But most important has been my family, three sons and now ten grandchildren. The first pointer would thus be to affirm what we all know: close relationships need to be a priority.

My next pointer would be the importance of getting a bigger picture to guide our professional decisions. As a lecturer, I was perhaps a master of deviations from the syllabus. Still, I have often been gratified by emails from graduates telling me that the material I added to their courses proved useful, even when they were unsure of their value at the time. I acknowledge that my deviations sometimes arose from a need to be heard rather than concern for students, but they were based on conviction arising from my own learning experience at university. Reg Munro, Garth Griffin and Roger Grenville-Jones gave the actuarial lectures in my time, and all three contextualised the technical material and gave life to their subjects. They convinced me that the role of the profession was to use actuarial judgement in providing financial security to people.

I have been exceptionally fortunate in being able to follow this conviction and pursue controversial issues at little personal cost. High actuarial salaries, especially in my earlier years, and friendly investment markets have given our family a comfortable lifestyle even though I have spent half my career as an academic. And the academic positions gave me freedom to enter into political and commercial 'battles' where I thought there were institutional failures. Career paths are much slower today (I was given the role of Chief Actuary at the age of 28, with 3 years of post-qualification experience) so today's young actuaries will be somewhat older before having financial independence. They are also likely to take a little longer to get the perspective that comes from being in senior management. My third pointer would be that there is need for patience so as to be equipped and prepared before entering battles.

Fighting battles does not mean spoiling relationships. If you dig into the archives of the ASSA Transactions, you will find a 1990 paper on one of the battles: the "Actuarial Implications of the Liberty/Prudential Merger". It is my explanation

for opposing this merger in court. I lost but remain convinced that the decision was unfair to the Prudential policyholders. I have some regrets about how I conducted the case, but not my decision to try and obtain publicity outside the profession. As my father said at the time: "this town is too small to make enemies". It says much for the graciousness of many of those who disagreed with me, that we remained on good personal terms. Speaking truth to power does not necessarily mean shouting it.

You might argue that it might be better to speak about working together on 'projects' rather than in 'battles'. My view however is coloured by a verse from St Paul: "For our battle is not against flesh and blood, but against the rulers, against the authorities, against the world powers of this darkness, against the spiritual forces of evil." In 1979, I was one of the 5,000 who attended the multiracial South African Christian Leadership Assembly in Pretoria. I was introduced there to the work of Walter Wink, and his interpretation of this verse, which he applied to institutions. It was easy to see Apartheid as a "power of darkness" and a spiritual force of evil. As Desmond Tutu repeated frequently, both white and black people needed deliverance from this evil 'system'.

All the social sciences, particularly sociology and economics, recognise the importance of institutions in determining our behaviour. I have recently published a paper with Tracy Wilcox, a colleague from the School of Management, on risk culture. In it, we recognise three types of institution: culture (narratives and values), organizations (both formal and informal) and law (and regulations). While none are easy to change, they are all the products of different people's inputs – sometimes over generations. We all have a potential role in changing them – and in reducing the corruption and inefficiency that can make them 'evil'.

My small contribution to black empowerment was work I started in 1987 to provide technical advice to black Trade Unions on retirement fund matters, particularly relating to the management of surpluses. I also helped initiate a conference Desmond Tutu (then Archbishop) chaired, which

was held at Wits in January 1990. Its purpose was to discuss how he could help focus economic and social sanctions to maximise pressure on decision makers and reduce the loss of jobs of poorer South Africans. The conferences turned out to be unnecessary, as Nelson Mandela was released in the following month and we began the transition to democracy. Two emotional highlights here were the camaraderie in the queue to vote in 1994, and the rugby world cup final in 1995. When I speak about the possibilities and need for institutional change, people often ask whether it is possible. My answer is that I saw apartheid go, even though it appeared impossible for the first half of my life.

So my last pointer is to keep the faith: to develop personal skills and virtues and corporate institutions that are fair, effective and efficient. As TS Eliot says it so memorably:

THE WORLD TURNS AND THE WORLD CHANGES, BUT ONE THING DOES NOT CHANGE. IN ALL OF MY YEARS, ONE THING DOES NOT CHANGE, HOWEVER YOU DISGUISE IT, THIS THING DOES NOT CHANGE: **THE PERPETUAL STRUGGLE OF GOOD AND EVIL.**
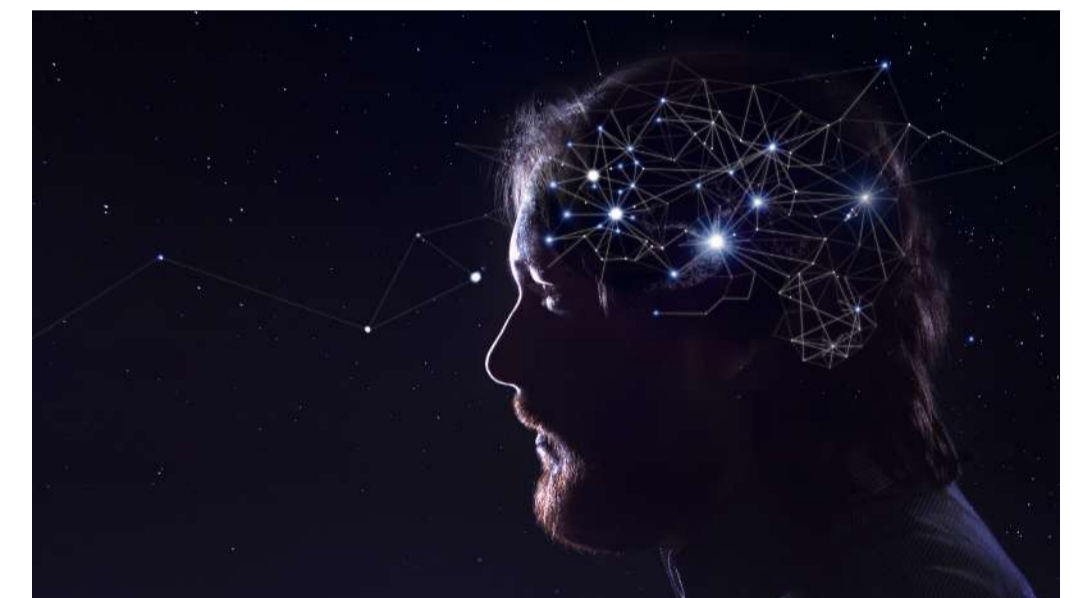
Anthony Asher Ⓐ

AN ASSA FIRST:
A PhD specialising in Machine Learning by Dakalo Mbuvha

The Actuarial Society of South Africa reached a momentous milestone in August 2021! Rendani Mbuvha became the first member of the Actuarial Society to attain a Doctor of Philosophy (PhD) qualification specialising in Machine Learning.

His PhD research work was on Probabilistic Inference in Neural Networks and Gaussian Processes. This line of research is important for understanding the predictive uncertainty around predictions from complex machine learning models. Advances in this area are critical for artificial intelligence (AI) safety and other risk management applications that are of interest to actuarial professionals. Professor Tshilidzi Marwala, one of South Africa's leading AI experts and Vice-Chancellor at the University of Johannesburg (UJ) was one of his research supervisors.

Rendani is passionate about research work and has already contributed a wealth of machine learning research publications. His work has earned him the prestigious Google PhD Fellowship in machine learning from Google Research. The fellowship is awarded globally by Google researchers to the most promising young academics who represent the future of research in their fields.

He has presented his research work at various international conferences including the highly distinguished International Conference on Machine Learning (ICML), the leading international academic conference in machine learning. The paper that he co-authored with Kwanda Ngwenduna, Generative Adversarial Networks for Actuarial Use, won a prize for the best paper award at the 2020 International Association of Consulting Actuaries (IACA).

We spent some time with Rendani to understand his journey in research.

Congratulations Dr Mbuvha on attaining your PhD qualification! Give us a bit of background and a glimpse of your journey so far?

I studied actuarial science at UCT. Thereafter, I worked in corporate roles while completing my actuarial studies. I qualified as a Fellow of the Actuarial Society and a Chartered Enterprise Risk Actuary (CERA) in 2015.

After, qualifying I decided to pursue my passion in research and studied towards a Masters in Computer Science and Engineering at KTH Royal Institute of Technology in Stockholm. When I returned to South Africa, I decided to continue on my route in research by taking up a lecturing position at Wits University while also pursuing my doctoral studies. I have now completed my PhD in Electrical and Electronic Engineering with a focus on Probabilistic Machine Learning at the University of Johannesburg.

So how did you get here? What inspired the move from being a FASSA to now being a FASSA with a PhD in machine learning?

I have always had an inclination towards machine learning and computer science. While I was studying for my undergraduate degree at UCT, I took additional courses in computer science and neuro-fuzzy evolving systems which really piqued my interest in these fields. During my corporate career, I also got heavily involved in analytics-related roles.

You have had the honour of working with the world-renowned UJ Vice-Chancellor Professor Tshilidzi Marwala. What are some of the key lessons you have learned from him and how has this experience shaped you as a researcher?

Professor Marwala's mentorship has been pivotal towards my success as a researcher. One key lesson I have learnt from him is to take a global perspective when doing research work. This has greatly influenced the quality of the work we produce and the network of research collaborators we have worked with. I have, for example had the privilege of collaborating with leading machine learning researchers from the UK and South America which has given me the opportunity to produce global leading research.

What role do you see actuaries playing in Data Science, AI or Machine Learning?

In my view, actuaries have a significant role to play when it comes to managing the additional risks that come with the increased adoption of AI and machine learning. Machine learning and AI also present numerous opportunities for use in actuarial applications. The combination of statistical ability and business acumen remains a unique value

Rendani is a lecturer at Wits University

Rendani with fellow Swedish Institute scholars at the 2017 Diploma Ceremony

proposition for numerous industries, more so in the context of increased data availability. For example, our Wits research group has been looking at using machine learning approaches to Nested Monte Carlo in capital modelling and portfolio optimisation, to name a few. It is encouraging that ASSA is also reviewing its strategy for research.

So, what's next from here? What are some of your plans for the future?

I am continuing with my research and supervising postgraduate students who are interested in working in the nexus of machine learning and actuarial work. Some of the areas we are interested in understanding include issues around climate change, renewable energy and further work on casualty and predictive uncertainty in large scale machine learning models. Outside of that, and probably most important, is to spend more time with my young family and to finally stop procrastinating on taking guitar lessons! Ⓐ

ACTUARIAL WOMEN'S COMMITTEE PAVING THE WAY FOR FEMALE LEADERS THROUGH ITS LEADERSHIP DEVELOPMENT PROGRAMME

by Jodi Christensen and Paballo Makupu

In the modern world, we expect the moniker of "female" actuary or "female" analyst to have been dropped. We expect gender inequality to have been relegated to the past. However, as reality might have it, we are still in a position where only a handful of women hold leadership positions, and according to the Pew Research Centre, most do not even hold these positions for very long. It is clear that we still have some way to go, and there are some questions that remain unanswered. What do we expect to spur on these changes that we are so desperate for? Are our female leaders being kept on the bench despite being ready to take up leadership roles, or does giving them these roles turn them into the leaders we desire?

As women, we have likely all felt a spotlight being shone on us as we enter a room where we are the only woman - which we instinctively take to mean that we are not only representing ourselves, but representing all women in our industry, momentarily becoming a posterchild for "the corporate woman". The Actuarial Women's

Committee ('AWC') has always recognised this, but with the Leadership Development Programme ('LDP'), they aimed to take it a step further than simply recognising the problem. If leadership is the bringing together of people from different spheres of life in support of a common goal, the AWC LDP did exactly that. They brought together female actuarial leaders to discuss the prominent issues that still affect female professionals in the workplace. They aimed to give the knowledge, tools and support to free us of some of these pressures, which are so often self-inflicted. Not an easy feat, but as one of our personal heroes Alexandria Ocasio-Cortez says: "an unprecedented problem requires unprecedented ambition".

Over the past year, we covered a vast range of topics and we're proud to report that we didn't flounder at all, and neither did anyone else. A very human perspective is to view the world as a zero-sum game – one person winning, means the rest lose. One reason this programme has been effective is that it felt like it was inoculated against

that insidious thought. At the risk of sounding like the runner-up of a beauty pageant and proclaiming that we've met the most amazing life-changing group of women (it wasn't always easy - virtual sessions made it far more difficult to get to know everyone than the organisers had probably hoped), a very real sense of respect for one another and one another's opinions was present in each session. This gave people a space to unburden themselves of their own self-limiting views, share their experiences and get concrete advice. Most critically, it's given many of us a network to continue doing that and to assist in doing that for the next cohort of women, and the next, until these sorts of issues and insecurities are no longer the norm.

Another candidate in the programme, well-known for bringing her own authentic brand to the leadership positions she's held, had this to say about it, "I am the person that puts her hand up for opportunities. In more than one case, I found myself in a room full of senior leaders in awe of the depth of these discussions and shift in mindsets compared with individuals who are not in a senior position. Being the person I am, my role is to absorb all this knowledge and implement it in my career journey whilst at the same time sharing these tips and tricks with other young professionals I meet along my journey. I am often an advocate for women in leadership and have spoken on so many local and international panels on this very topic. For me, it is not the content of these women in leadership programs that makes me excited to be a young female professional in pursuit of leadership, but it is the females within the LDP that make me want to be a better leader - they have shown me that I am not alone in this pursuit. Most importantly, they have made me realise that we all have our unique journeys that we have walked to get to where we are today and, ultimately, it is in this network of females, it is in committees like the AWC and programmes like the AWC LDP, that we truly find ourselves and our leadership strength. If

AWC LDP CLASS OF 2021 GRADUATES

Back: Antoinette Nel, Kendyl Renzulli, Thandi Mcizana, Simphiwe Dladla, Cindy Mackay, Karen Muyengwa, Maseeha Rawat
Front: Yashna Chetty, Jodi Christensen, Victoria Vuyeqaba, Nida Ibrahim
Absent: Nokuthula Moyo, Jyotika Nagar, Paballo Makupu, Nabeelah Omar, Teran Neveling, Itumeleng Kgafela

Left: Memory Zimba, President of ASABA
Right: Nabeelah Kolia, Founder of the AWC LDP and President-Elect of ASABA

you are currently wondering "what exactly can I gain from this programme, and what type of individual do I need to be to be accepted into the programme?", I would say stop wondering and apply. The LDP covers various leadership spheres, but at the crux of it all is authenticity, as there is no greater leader than a leader who is brave enough to be themselves while navigating and playing the "corporate game."

Some of the highlights of the programme included managing our own image, dealing with imposter syndrome, building beneficial relationships (and having the strength to change those that are not beneficial), and determining and discussing our business chemistry results. A comment from one of the women in the group that stuck with us is that our perspective already begins to change when we are given the right vocabulary

"TO BE OR NOT TO BE IS NOT THE QUESTION. **THE VITAL QUESTION IS HOW TO BE AND HOW NOT TO BE**".

to process our feelings, fears or shortcomings, and we owe all of the facilitators a huge thank you for giving us that gift. Another highlight of the programme was the graduation event, which not only gave us a chance to connect in person after a year's worth of Zoom calls, but it also gave us an opportunity to celebrate our valiant leader, Nabeelah Kolia, who is to thank for the existence of the LDP.

The environment in which we all operate, tends to be one that relies heavily on reward – be it seeing your name on the pass list after months of studying, or being rewarded with a great performance review, bonus or promotion. This can lead us to expect there to be a measurable degree of validation for our efforts. Our advice to the next cohort of women embarking on this journey is to recognise that looking for that validation in this case is worthless. While there is certainly reason to be proud of completing the programme, and while many will celebrate you for it, your efforts don't end when the programme does. Improving your self-image and outlook, re-assessing your goals and being a support to other women is a never-ending process. The validation should come from noticing how, so gradually as to be imperceptible in the moment, that outlook changes, those goals get bigger and the capacity to be a support increases. This is how we spur on change. We're reminded of the following quote: "To be or not to be is not the question. The vital question is how to be and how not to be". I can't wait to see how the current and future women of the LDP become the remarkable leaders they dream of being. Ⓐ

INSPIRATIONAL 'SUPA PIET' CHASING THE DREAM

To some people **Pieter 'Supa Piet' du Preez** is an athlete who is a recent world and Paralympic champion; to his colleagues he is the face that looks down on them from billboards as they make their way to work; to others he is a reminder about how quickly personal fortunes can change.

It is at work that the 'billboard' presence becomes a reality for his colleagues. He is the person who is most known as a talented actuarial analyst, a team member who puts in the required hours every day. He is a person who has not allowed misfortune to force him to take a 'back seat', or dampen his enthusiasm and passion to achieve in all spheres of his life.

To everyone he meets, whether at work, or at sporting events, Pieter du Preez is simply an incredible athlete and inspiration.

He sits in his wheelchair and his eyes light up as he talks about his ambitions and his most recent victory of reaching a dream that spanned over 35 years of joy, pain, tears, emotions and much more, which is difficult to explain in words...but he is finally an Olympic/Paralympic champion!

As a 'C6' qaudaraplegic, he faces the events he races in with the knowledge that he only has movement of his wrists, biceps and shoulders. Roughly speaking, its less than 15% of that of an able-bodied person. Because of the nature of his disability, he doesn't sweat, so there is a real danger that without a regular watering down, his body will overheat. He also can't get his heart rate up higher than 120bpm, and struggles with low blood pressure, all things that make racing endurance events challenging.

Taking part in the Paralympic games is also a huge process on its own, with having to race in qualification events from 3 years out, to create slots for the event you participate in. Throw in the pandemic, and this became even more of a challenge. On top of this, breaking his shoulder while picking up his son from pre-school a year ago made his dream and journey even more of a battle, but his faith and self-belief made nothing impossible in his mind.

When he talks, it's hard not to be simply overwhelmed when thinking about the planning, logistics, correspondence and plain hard training that are involved in achieving his ambitions. What also has to be factored into the mix is working every day and working as an actuarial analyst at Deloitte in Waterfall, Johannesburg.
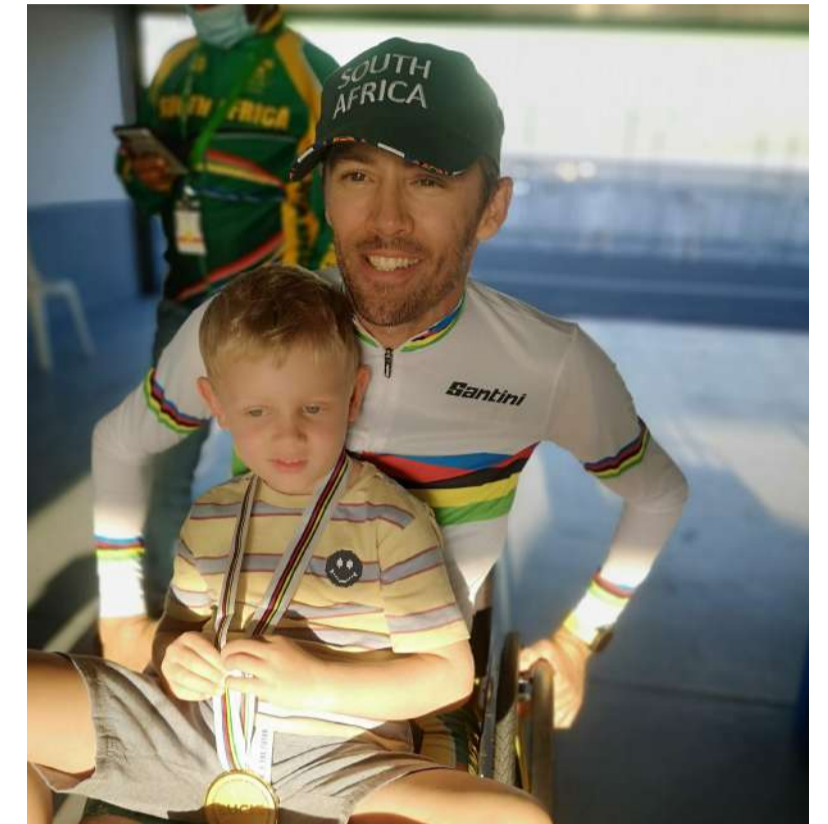
WHY GO THROUGH ALL THIS TO COMPETE IN A RACE?

The answer lies in Pieter's approach to life. He has a strong faith, a competitive spirit, a passion for his sport and simply isn't a person who is prepared to compromise.

"Triathlon, cycling, swimming, wheelchair racing and sport in general for me are lifestyles. I believe that whatever you do, there is at least one person looking up at you. I believed this before my accident and do so now, more than ever before. With this belief in challenges and the strength of the human spirit, goes a similar outlook on life."

"I have been given an opportunity to do what most people would consider are impossible things. By doing them, I believe that I am encouraging others to tackle what they believe is impossible."

Pieter was 23-years-old and contemplating becoming a professional triathlete, when a car turned across his path in Johannesburg, sending him flying from his bike. He knew he was in trouble, he says, when, while lying on the tarmac, he realised that something was wrong with his neck. By the time he reached hospital he was fighting to breathe.

He smiles ruefully as he recalls that he was on his way to the chiropractor when the accident occurred. "I had a hamstring injury and was on my way to get my spine aligned, when the car hit me and put it totally out of alignment," he says.

A medically-induced coma and long rehabilitation followed. Through it all, says Pieter, he knew he was going to be fine. "It was grace from God above," he explains simply, "before the accident; I believed that if my legs didn't work my life would be over."

"After the accident, it was a matter of guess what? I can't move my legs, my fingers or my arms. It was simply never an issue. My body was injured. Pieter du Preez wasn't injured a bit. In fact, I learned such a lot. I got so much stronger in terms of what and who Pieter is. There was no line between my life before the accident and my life after the accident."

"I want a picture done for home, one of all three Triathlon sports. It will show me in the background running, but running into my racing chair. For me, I have been living one continuous life; there is no line saying before and after. I am still running, although in a different way."

Pieter responds to the question about what has changed in his life by appropriately turning to a race analogy. "I used to be always in front," he says. "I made the South African 'under 23' Triathlon team, South African Student's cycling team. When I competed in events after the accident, it was weird to me to be a back-straggler. I learned what it was like to be at the back of the race where people encourage each other - something which doesn't happen at the front of the field all that often. When competing in parasports he, however, is back at the front of the pack".

"When it comes to disability, I have learned a lot. I know that I have to break the ice because people sometimes don't know how to deal with me."

"My knowledge and understanding of the human spirit has increased. I am living a fuller life because I am seeing so much more of life. Material things have no significance."

I AM SEEING SO MUCH MORE OF LIFE. MATERIAL THINGS HAVE NO SIGNIFICANCE."

"In short, I wouldn't change anything for the world."

18 years after the event that had taken just a few seconds, but left him as a C6 quadriplegic, Pieter is known to his friends and colleagues at Deloitte as 'Supa Piet' and even has a t-shirt to prove his claim.

Behind him and supporting her husband all the way is Pieter's wife, Illse, an occupational therapist who met Pieter when she was one of a party of friends who visited him in hospital. Married to Pieter in 2008, and now having added a member to team supapiet in their 4 year old son, Pietman, together they conquer the world.

Pieter also realized on his return to South Africa that the Paralympic gold is not his but rather the country's and he states it is incredibly humbling and a privilege to be part of something that creates excitement and hope to so many others.

But, for the man who has achieved so much, there is still one major challenge ahead. Because of an inherited genetic problem, he is going blind.

His response to this is characteristic of the man. "I will adapt as I always have. In fact, I see it as a super power that makes me live life fully everyday before I can't do things independently anymore."

Follow Pieter's progress as he trains to achieve a world's first on **Twitter @supapiet #Supapiet**

CAREER HIGHLIGHTS:

- SA wheelchair rugby team 2005
- Multiple Africa record holder 800, 1500, 5000, 10000, marathon
- World Record holder 10 000m (2015 -2019)
- Silver and bronze medallist Athletics World Champs 2011
- 7 x Berlin Marathon champion (T51) 2012 – 2018, course record holder
- 5 x Padua International Marathon champion (T51) 2011, 2014 – 2016,2019, course record holder
- 4 x Oita International marathon champion (T51) 2015 – 2019, course record holder
- London 2012 SA Paralympic team, 6th place 100m 2012 Paralympics, London
- Paracycling Paralympic Champion, 5 x World Champion, 11 x World Championship medallist, Multiple World Cup medallist
- World First Quadriplegic in history to finish & current World Record holder of IM70.3 and IM triathlon
- 2016 Laureus World sports award finalist
- Robben Island Swim 7.5km – World first SCI(Quadriplegic) in history

STUDENT SUB-COMMITTEE Profile

The student liaison committee has fallen away and has been replaced by the student sub-committee which reports into the Member Engagement Board. The student sub-committee aims to bridge the gap between the Society and its biggest member population, Students, Technical and newly qualified Associates. It also aims to enhance the value provided to and highlight the important role of the "young members" of ASSA. Some of the initiatives we have on the go include engaging with other student bodies, arranging student networking events and engaging with university students. The committee has also contributed to the ASSA social media strategy and will continue to advise ASSA on the implementation of the strategy.

Please look out for upcoming student sub-committee quiz at the upcoming Winter Chill on the 16th of July.

If you have any queries or suggestions, please get in touch with the student subcommittee liaison Jehaan Abrahams on the following email **jabrahams@actuarialsociety.org.za**

KWANDA NGWENDUNA

MUTETO MUTETO

MUTETO MUTETO

I am a Technical member of the Actuarial Society of South Africa with a proven track record in Life insurance currently working in the Group Capital Management team at Liberty. My current role gives me a holistic view of both Corporate Finance and Actuarial Science which has opened my eyes to how the skills we obtain from our studies can be applied in wider Finance area. I am passionate about enabling the young members of ASSA to realise their potential, who in the long term will use their knowledge to impact the society at large. Being a Zambian national working in South Africa, I also serve as a voice for ASSA Actuarial students who are not of South African origin. When I am not working or studying for exams I grab my guitar to escape to another world as I have always had an interest in music. I believe that in another Life I would be a Jazz guitarist.

DAVID NG

I am a member of the Actuarial Society of South Africa with 5 years of experience specialising in short-term insurance commercial pricing and portfolio management at Hollard. Before the student sub-committee, I was Hollard's student representative, where I was able to develop my understanding of actuarial student's experiences and struggles from various backgrounds and circumstances. I have a passion for enabling others to drive positive, sustainable change and reach their potential, which has motivated me to take on the role of Deputy Chairman of the Student sub-committee. In my spare time, I enjoy playing the piano, playing golf, and jogging to keep fit.

KWANDA NGWENDUNA

"Kwanda is an Associate Member of the Actuarial Society of South Africa, with only a fellowship exam still outstanding. His interests in statistics and machine learning has enabled him to pursue double honours in actuarial science and mathematical statistics as well as an MSc in Data Science. Kwanda is enrolled for a PhD in Actuarial Science. He has over 9 years experience mostly in life reinsurance, predictive analytics and crop insurance having worked for Munich Re of Africa, Vodacom, ABSA Life and currently at Land Bank Insurance SOC Ltd managing the actuarial function for both the short-term and long-term insurance entities. He is a past Treasurer for ASABA. He is the current Student Representative in the ASSA Council, advocating for the voice of students and transformation in the profession. He is an avid football fanatic with a passionate support for Bafana BaStyle and takes part in the Wits Choirs participating in concerts, graduations, university events and other choral events. He is passionate about research and development and is a published researcher. In his spare time, he provides tutorship to postgraduate students on statistics and machine learning. He is passionate about giving giving out to others and seeing the actuarial profession transforming, especially on adequate representation and contribution of women, black Africans and younger population."

OYAMA MBALIGONTSI

I am a member of the Actuarial Society of South Africa, with 6 years' work experience in the short term insurance industry. Most of my professional work has been around Solvency capital calculations, risk management, product design and pricing. I have a couple off exams left, so my weekends are pretty much spent studying. However during "off exam season periods", I enjoy cooking and trying out new healthy recipes. I also make my own fruit juices and smoothies. I love conspiracy theories, anything technology related, non-traditional actuarial fields. I am chairperson of the communications subcommittee of the short term insurance committee (STIC). I am also a member of the STIC's CPD subcommittee and STIC's legislative subcommittee. In my spare time, I love reading up on start-ups, innovation, AI, technology and stem cells. I believe in giving back to the community – hence my involvement in ASSA's membership engagement board and student subcommittee.

Book Review

"GRIT"

by Angela Duckworth

- Maseeha Rawat

Only a small proportion of actuarial students pass every university course and professional exam on their first attempt. One of the most common experiences that aspiring actuaries face early in their academic journeys is exam failure. I've had many discussions with actuarial students about the "mental block" towards studying that can develop after failing. Even those who manage to escape academic failure, eventually experience career-related challenges in other shapes and forms: coping with demanding work environments, resolving conflict in the workplace, and struggling to achieve career progression to name a few possibilities.

In facing these challenges, some bounce back extremely quickly with lessons learned, while others become demotivated and stay in that space for longer. A person may also display differing levels of resilience based on the nature of the situation, and over time. These observations, together with a general interest in the science of high-performance, led to my curiosity about one of the buzzwords in organisation psychology over the last few years: grit.

The term was made famous by neuroscientist Angela Duckworth through her book of the same title. The book is a fascinating read about why talented people often fail to reach their full potential, and far less gifted people often go on to achieve great success. Duckworth argues that the secret to success, grit, is about perseverance and passion and for a long-term goal. This starts with having a single, clear, "top-level" goal, and organising other (mid- and lower-level) goals in a structured and aligned way. Thereafter, it's about really sticking to the top-level goal over the long term, without even dreaming of giving up when things get difficult. It's not just about staying on the treadmill, but about getting back on the treadmill the next day with an eagerness to try again.

So, what if you don't have a clear hierarchy of goals, and you aren't very gritty? The good news is that grit can grow, both through internal personal development and through external factors. If you'd like to get a deep understanding of how to develop grit, I recommend that you read the book. To give a quick teaser, the book outlines four "psychological assets" that you can build to develop grit from the inside out: interest, practice, purpose, and hope. The final few chapters discuss how you can grow grit from the outside in, i.e. to leverage the external environment yourself, and to create such environments to help others build grit.

What I loved about the style of the book in the combination of scientific reasoning with a very human, personal touch. A large part of the book discusses the results of long-term studies, the findings of which gradually build the author's case. This is interspersed with experiences from her own life, as well as anecdotes from successful and gritty people. It is a great example of technical results presented in an insightful way - something that actuaries strive to do on a daily basis.

ACTUARIAL SKILLS

critical in assessing the risks of global climate change

The role of the actuary is to quantify and manage future risk to ensure that organisations are prepared to manage potential challenges.

Environmental and social risks and their potential effect on a company's bottom line are no exception. For example, global climate change affects life assurers because it influences mortality rates through an accompanying increase in extreme weather events, with resulting effects on vector-driven diseases, water, air and food qualities, migration and civil conflict.

Actuarial skills are therefore increasingly recognised as critical in assessing the risks of global climate change, with actuaries becoming involved in a number of critical projects. In the United States and Canada, for example, the actuarial profession has recently launched the Actuarial Climate Index to measure variability in climate. Work on the extension of this index to cover Europe is already underway.

In the UK, the Institute and Faculty of Actuaries (IFoA) has addressed the issue of claims for damages caused by contributors to climate change. The IFoA has also signed a statement by the Overseas Development Institute (ODI) urging the G20 Governments to honour their long-standing commitment to phase out fossil-fuel subsidies.

A working group of the International Actuarial Association (IAA) is currently researching the effects of global climate change on mortality. A member of this working group has further been selected as part of an expert panel advising the European Commission on policies targeting sustainable finance, specifically within the context of the Capital Markets Union.

The IAA is also involved in the Warsaw International Mechanism, tasked by the United Nations Framework Convention on Climate Change (UNFCCC) with risk-management approaches to loss and damage associated with the adverse effects of climate change, including slow-onset impacts such as sea-level rises.

Both the IAA and the IFoA have submitted responses to the Task Force on Climate-Related Financial Disclosures established by the Financial Stability Board, an international body that monitors and makes recommendations about the global financial system.

Furthermore, the IAA is working on the regulation and pricing of carbon emissions, the effects of climate change on government budgets, and the usefulness and limitations of insurance as it relates to the effects of climate change on vulnerable populations. In light of the Paris Agreement, the IAA has already drafted a paper on the monitoring of progress towards the stabilisation of CO_2 concentration in the atmosphere.

The IAA is additionally collaborating with the United Nations Environmental Programme's Principles for Sustainable Insurance and with the Organisation for Economic Co-operation and Development on disaster recovery.

It is clear that the actuarial profession sees the need to embrace all three domains of the triple bottom line - environmental (or ecological), social and economic. In recognising this, the IAA is also extending its knowledge on ecological economics and on formulating measures that can be used for environmental, social and economic accountability by entities in both the public and private sectors.

ACTUARIAL SOCIETY OF SOUTH AFRICA

LET'S ALL BE SAFE

SPREAD THE WORD, NOT THE VIRUS.

www.sacoronavirus.co.za