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Presidential PERSPECTIVE

Lusani Mulaudzi President, 2020-21

The best of times, the worst of times

For many of us in the actuarial profession work continued as normal and for some, working from home provided more advantages than disadvantages. There was less pressure on what to wear, more time saved due to not having to deal with traffic and spending more time with family. All this while our incomes were unaffected. For most of our fellow countrymen, this was the worst of times. Many depend on high volumes of people travelling to and from the airport, travelling to and from work and frequenting shopping centres and restaurants. Even without the stringent lockdowns, many would have been impacted by precautionary actions by South Africans.

It was therefore necessary for safety nets to be set up to help alleviate the suffering caused by COVID-19. The solidarity fund was set up to assist businesses, government extended social grants and many individuals and non-governmental organisations (NGOs) stepped up to distribute food in impoverished communities. Some of these efforts should not stop, they should continue post lockdown. Our highly unequal society requires these types of efforts continuously.

The Public Interest Seminar kicked off on 10 June with a focus on social investments and obligations. The government spends roughly 60% of the annual budget on social services. This includes the health, education, social development, and community development budgets. South Africa is very much a welfare state and more needs to be done to enhance the capability of the state to deliver maximum returns on this massive investment. Investing to build social capital is important for an unequal society as South Africa, however, this must be balanced with improving our productivity as a nation.

Our modelling team worked under pressure to produce the first version of our COVID-19 model in 45 days. Roughly 400 members of the society attended the COVID-19 sessional and the discussion was lively. The model will be updated based on technical feedback received, emerging data on progression of the disease in South Africa and emerging literature from around the world. I recently signed up for an online course on complexity because of COVID-19, I am on a quest to understand how to deal with complexity.

FA Hayek wrote a chapter on the 'The Theory of Complex Phenomena' that was published in Readings in the Philosophy of Social Science, MIT Press, 1964. Hayek discussed the challenge of pattern recognition and pattern prediction in complex phenomena. COVID-19 is a complex phenomenon due to the number of variables that are interacting with each other with no central control and this makes it difficult to predict exactly how it will progress and the impact it will have on societies across the globe. Models are still important, but their limitations must be communicated with an extra degree of clarity in times like these.

Our student members were given an opportunity to write online examinations due to COVID-19 and subsequent lockdowns. Although many have done so successfully, this has been stressful for many. I acknowledge that some students may have done better under normal circumstances and I would like to encourage those students for whom this did not work out to not give up. There should be more options available for the students in the next session but no guarantee that the situation will be back to normal.

In times like these, driving recklessly through crowded streets as the abusive Marquis St. Evrémonde did in Charles Dickens' Tale of Two Cities, has the potential of driving our nation over the cliff. When the history books are written let it be said of this generation that we made the best decisions given all resources at our disposal. The Actuarial Society has an important role to play in this regard. 🚧

Presidential PERSPECTIVE

Actuaries and the SA Inc balance sheet

PUBLIC INTEREST

SEMINAR | 10 JUNE 2020 | PRETORIA

THEME: Unpacking the Assets & Liabilities on the SA Inc. Balance Sheet



CALL FOR PAPERS AND SPEAKERS

The Actuarial Society of South Africa will be hosting the first Public Interest Seminar which will explore and unpack the Assets and Liabilities of South Africa Incorporated. Attendees will gain a deeper understanding of key policy issues through discussions with public interest policy experts/ makers as they unpack them using the balance sheet approach.

This will be an open engagement between actuaries, policymakers and government officials from a wide range of government departments and agencies. The theme will be covered during the seminar include the following:

- **The government's social investments and obligations:** Health, Education and Social security
- **Growth strategy:** Job creation, Economic development, Small business development and Infrastructure development
- **Management of resources:** Energy, Water, Agriculture, Minerals and Land
- **Management of risks:** Crime, Corruption and Natural disasters

The Actuarial Society of South Africa has set out to develop practical tools to demonstrate the future impact of current decisions on the balance sheet of South Africa Incorporated (a representation of the assets and liabilities of the South African government).

If you are currently doing research in any of the topics listed or interested to do so, please send as an abstract of not more than 250 words, no later than 28 February 2020 to the following email address: gshawker@actuarialsociety.org.za.

The Organising Committee will make the final decision on the format allocation to presenters, considering the number of presenters, the range of topics, and programme time constraints.

KEY DEADLINES

Deliverable	Due date
Abstract submission deadline	28 February
Initial selection	6 March
Feedback to shortlisted candidates	13 March
Final paper submission deadline	15 May
Final presentation submission	1 June
Public Interest Seminar	10 June

FURTHER INFORMATION

For further information, please contact Niel Fourie on nfourie@actuarialsociety.org.za

PRESENTATION STRUCTURE

Panel discussions: Consisting of 3 – 4 speakers, each speaking for a maximum of 20 minutes followed by Q&A sessions.



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This framework considers questions such as **what needs to be done to address inequality efficiently, effectively and sustainably in South Africa.**

The inaugural public interest seminar of the Actuarial Society of South Africa was held virtually on 10,17 and 23 June 2020. Looking back, it is clear to see how difficult it would have been to handle the information overload in a one-day seminar as originally planned. The public interest portfolio of the Actuarial Society of South Africa aims to build a bridge between the actuarial profession and policymakers. In preparing for this inaugural seminar, we needed to find a relatable framework for both groups, and we decided to use the concept of the SA Inc balance sheet. This framework considers questions such as what needs to be done to address inequality efficiently, effectively and sustainably in South Africa.

This framework enabled us to develop topics focused on how actuarial skills can enhance planning and resource allocation in social services (including health and education) and economic development. COVID-19 became a reality after we had made plans to organise the seminar, but it made the seminar more relevant. COVID-19 has placed a huge strain on the country's finances, the Minister of Finance announced that our debt to GDP ratio is now projected to reach 87.4% in 2023-24 and if government fails to manage its finances this can reach 140% by

2029. The need to focus more on resource allocation was echoed at the seminar by GTAC's Emmanuelle Gille.

Some of the emerging themes from the seminar are as follows:

- To reduce the dependency ratio in retirement, there is a need to focus on finding a workable solution to encourage informal sector workers to save for retirement. Lack of progress in the National Social Security Framework (NSSF) discussions is a big challenge but stakeholders have an opportunity to work collaboratively to solve some of the problems the NSSF seeks to address.
- Developing reliable population projections for a period up to 7 years can enable better planning and should be prioritised.
- The basic income grant debate is important, and the cost associated with this is a public interest matter.
- Given the strain on the country's finances exacerbated by COVID-19, actuarial skills can be applied to assist in rationing or more incisive resource allocation. This was illustrated by the modelling work that was done by a team led by an actuary to determine projected supply gaps in various medical specialities. The Actuarial Society is working with the HSRC to determine the cost implications of an education policy to reduce classroom sizes in foundation phase in public schools in South Africa.
- Our efforts to reduce inequality can easily be undone by disasters and our failure to manage growing liabilities against the state. The seminar identified the need to manage the physical and transitional risk due to climate change as well the need to manage the risk posed by the growing Road Accident Fund (RAF) liability and

the medical negligence claims against the health departments. A novel concept of a Civic Engagement Catastrophe (CECAT) bond was introduced, and refinements of this concept will continue.

- Actuaries have a role to play in unpacking the role of private equity and venture capital as channels to spur the growth of the economy and job creation. Understanding the riskiness of these investments compared to traditional asset classes is important for pension fund trustees amongst other stakeholders and actuaries as trusted advisors have a significant role to play. Regulatory changes are necessary in this space and need to be developed.

These themes need to be taken forward and I sense the need for bold activism by actuaries to move these issues forward. This requires thorough research, mobilisation of funds and resources and consistent engagement with policymakers. The inaugural public interest seminar has helped the profession to identify these themes and for the policymakers to be exposed to how actuaries can assist in resolving some of South Africa's most pressing issues. As Samora Machel used to say, "Aluta continua." 

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Editorial



Mike McDougall (Chief Executive)

In March this year, South Africa followed the lead of many countries around the world and confined most citizens to their homes with severe restrictions on movement as a previously unknown virus began its expected rampage through the country. As we head into the second half of the year, the curtailment on personal freedom has been relaxed but not lifted. Across the world there are debates raging on the need for lockdowns from the start, whether they have served their purpose or any purpose, what that purpose might have been, whether they are being relaxed too quickly or not quickly enough, which gatherings increase the risk of the virus spreading and which don't and many other nuanced arguments. This is a time that requires both flexible and resolute leadership that is guided by wise advice.

Unsurprisingly, within the actuarial profession we hold a range of views on the progress of the pandemic and the appropriateness and effectiveness of different interventions. However, the value of our advice comes not from sharing our opinions and preferences but from analysing data and developing models that can be used to project the advance of the pandemic and

its consequences. For actuaries and other modelers these are challenging times – the only certainties being that the models will all be wrong and some will be useful. This is not the time for glamorous show modelling (that may, like a stopped watch, happen to be right once) but for the gruelling and often tedious task of analysing incomplete and often contradictory datasets, looking for correlations and causal relationships between factors and codifying it in a model that can be reviewed and reproduced by others. Such models will go through many iterations and run numerous scenarios before a best estimate scenario can be developed. In a world of social media and headline grabbing journalists the nuances of scenario and sensitivity testing can be lost in drive for the next sensational headline, gotcha moment or search for a result to support a previously established conclusion.

While the pressure cooker environment of social media and instantly available information and opinion adds a new intensity, South African actuaries have previously led the world in the modelling of a new pandemic that was sowing fear and mayhem through the world. In this edition we talk to Peter Doyle who led the world in the development of actuarial models of the AIDS pandemic. Although a very different disease with a longer incubation period and less easily spread without close physical contact, today's modelers can learn from the wisdom and experience of Peter and his team. While the initial Doyle model has evolved into the ASSA model, the model brought clarity and process into an issue that could easily have been overrun by either panic and prejudice or disregard.

In a world that craves certainty, actuarial models are an anomaly with the focus on what might happen and not what will happen. This is both the limitation and the strength of actuarial influence. Limitation in that we cannot meet the hunger for certainty but strength in that we can increase the understanding of sensitivities and consequences thus leading to more robust decision making. Our challenge is not to develop models that are always right but models that are useful and then to advise on how these models can be applied to optimize decisions. 

COVID-19

Considerations and Conundrums

- Barry Childs



The novel Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which is the causative agent of Coronavirus Disease 2019 (Covid-19) has been a pandemic of several kinds. First the epidemiological kind, as declared by the WHO on 11 March 2020, but also a pandemic of data visualisation dashboards, projection models, news and opinion. It has been a polarising wedge in politics, society, and even the actuarial profession.

The world watched in morbid fascination as China locked down the Wuhan district. Being classified as a novel virus is what drove a lot of the concern. Novelty in virology terms means no inherent immunity, no treatment, and no vaccine. These characteristics placed Covid-19 in the sweet spot of danger – moderate infection reproduction rate, short serial interval, a long enough incubation period to spread widely before the onset of symptoms, and a low to moderate fatality rate so that it did not kill all its hosts. The ongoing uncertainty caused unprecedented policy reactions with mixed success. Countries experienced vastly different disease progression, some having no fatalities (Vietnam, for instance) while others have experienced sharp excess mortality (the UK, for instance). Some, like Italy and Spain, were hit early and hard. Other countries got a late start but nonetheless are showing high levels of mortality (the USA). Yet other countries show a slow and steady rise, including several South American countries and also, it seems, South Africa.

Much remains unknown about the nature of the virus, even though so many new pre-peer review academic papers appear daily. The disease disproportionately affects the elderly and largely leaves children alone, which is unusual for a respiratory disease. People with certain comorbidities also experience more severe outcomes and increased fatality risk, especially diabetes and hypertension. The overall infection fatality rate remains unknown as the disease presents many conundrums such as the relatively high proportion of individuals who exhibit no or only very mild symptoms and so go untested and untreated. Low-side estimates are around 0.2%, while high-side estimates are 1% or above. Comparing across countries, simple case fatality rates are unreliable as they depend on each country's testing penetration and protocols which have varied widely. Even if testing penetration is similar in different countries and regions, there can be different testing protocols as to who is tested and when they are tested, making comparisons difficult.

The ASSA Covid-19 modelling group was pulled together in March 2020 from a small group of volunteers who wished to contribute to the profession's dialogue on the emerging pandemic. The group's first modelling effort was released for public comment on 28 April 2020. Much feedback was received, some related to form and some on more substantive matters. At the time of writing this article, the second model release is being discussed and finalised. Views within the modelling group are wide, and it has not been possible to reach consensus on some fundamental disease dynamics that affect spread. The most contentious debate is where the disease's attack rate (the proportion of the population infected) will end, and the factors that drive that rate. Is the epidemic over for countries who have "turned the corner"? This despite antibody testing studies in many of those

countries being below 20%, or even below 10% – far below the level implied by the (often misunderstood) herd immunity threshold? Are these antibody test results because of social and governmental actions, the so-called non pharmaceutical intervention (NPI) effects of social distancing, mask wearing, and general increase in hand and surface sanitising? Or are the effects due to some innate immunity that varies widely across the world and within communities?

The ASSA modelling group presently uses a compartmental model. One clear implicit assumption of such a model is the implicit assumption of homogeneity. While we have allowed for age-based disease severity and mortality once infected, there is no allowance for heterogeneity in the infection process. This heterogeneity may arise from different sources – variations in contact rates, variations in susceptibility, and variations in infectivity. Variation in contact rates is a known and widely accepted phenomenon, while the available literature is unclear on the other two components. Medical experts seem to disagree on whether natural immunity responses, such as those at a cellular level, would affect disease severity, or whether these could shield certain individuals from becoming infected at all. This is not a binary question, as viral loads vary and affect immune response and testing accuracy. Time and more study will tell.

Notwithstanding this uncertainty, we have adopted the approach of incorporating this effect without ascribing such heterogeneity to any specific driver. Allowing for greater heterogeneity changes the progression of infection and lowers the herd immunity threshold as well as the final population attack rate. Conceptually, those at higher risk of becoming infected are captured earlier and, once removed from the susceptible reservoir, leave behind a less susceptible group. This

results in higher rates of transmission early on, followed by slower disease spread trailing off. Could this effect explain what has been observed in other countries with varying levels of NPI intervention? With no conclusive scientific evidence on innate immunity, and the observed variation in country mortality rates, this remains a difficult case to make. Alternatively, are government interventions and stringent policy steps like lockdowns responsible for saving hundreds of thousands of lives worldwide? Given the observed variations in country mortality rates for countries that have adopted similar interventions, this is also a difficult case to make. It seems more likely that the observed variation in country experience arises from a combination of factors.

The Diamond Princess cruise ship presented an early real-world experiment of disease spread in a confined environment, which topped out around 20% of the passengers and crew being infected. While viral exposure is likely to have been high, a cruise ship is also perfectly designed for natural self-isolation. On the other hand, antibody testing at Marion Correctional Institution, Ohio, showed prison wide population prevalence of 78%, where we might expect much less contact heterogeneity. There remains much confounding information at a macro and micro level. Socio-economically poorer communities within countries do comparatively worse, but low- and middle-income countries have generally performed better in international comparisons. Fortunately, the medical community is fast at work seeking out effective treatments to improve outcomes and at the time of writing this article, a commonly used steroid showed promise in significantly reducing mortality in severe cases.

It is tempting to take comfort from observed attack rates and age-based mortality rates in other countries when considering where South Africa may end up. However, our own outlier experience with HIV/AIDS should be an effective counterbalance to such views and leave room for at least some uncertainty.

Whenever I have the opportunity to present on the issue of Covid-19 modelling I take time to stress that the effect of the disease should be seen in context. South Africa has relatively high premature mortality due to our high burden of HIV/AIDS, TB, NCDs, violent deaths and other causes. Close to 500,000 South Africans will die in 2020, or approximately 1 300 a day. The Thembisa model outputs suggest over 60,000 deaths from HIV/AIDS in 2020. We do not report on these deaths daily to the country on websites and social media. The economics of healthcare are unavoidably cruel as apportionment of limited funds means that rationing is inevitable. The interventions taken to reduce the number of Covid-19 deaths may make these the most expensive lives we have ever saved.

Aside from the technical elements of disease modelling, the Covid-19 pandemic has presented a textbook for study on some of the fundamental behavioural science tenants – priming, framing, overconfidence, availability heuristics, and anchoring. Without going into each of these items, I encourage you all to be personally aware of their presence in your own engagements and arguments. Exploring opposing theories and indulging challenging hypotheses are important parts of discovery amidst uncertainty, which makes us better actuaries. 

Business joins hands to support the national fight against COVID-19

- Ashleigh Theophanides



South Africa's fight against the Novel Coronavirus (COVID-19) is a national one – it is as much the fight of businesses and individuals, as it is of Government.

The spread of the pandemic since March 2020 has seen the nation come to a grinding halt in many aspects, as Government has sought to delay the peak of infections and minimise the loss of lives, while protecting livelihoods.

The announcement of a national state of disaster by President Cyril Ramaphosa and subsequent consequences on the economy and individuals in some circumstances has been devastating.

It is however worth reflecting on how this pandemic has created a platform for South Africans to rise and join hands across the private and public sectors, in the fight against a common, invisible enemy.

In March, Business Unity South Africa (BUSA) and the Black Business Council (BBC) mobilised a collaboration between South African organisations to support Government. Known as Business for South Africa (B4SA), this private-public collaboration effort draws on volunteered

business resources and capacity, and actively collaborates with Government to support both public and private sector initiatives.

B4SA has mobilised diverse skillsets from across South African business bodies and organisations, large and small member companies, professional services firms as well as communication and legal specialists, to form focused working groups that are driving a coordinated and proactive programme to mitigate the economic, social and health impacts of COVID-19 on South Africa.

B4SA is organised within work groups with a specific focus on Health, Economic Interventions, Labour, Civil Society and Communications. Supporting each of these main work groups are cross-cutting functions such as Analytics and Automation, Innovation, Legal and Risk.

The B4SA construct has and continues to support Government in multiple ways. In the spirit of collaboration, some of the initiatives in recent months have included the procurement of Personal Protective Equipment (PPE), Epidemic Modelling, Hospital and Location Spatial Planning, and Safe Transport Modelling.

PROCUREMENT OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

A key concern for the country in fighting this pandemic has been to ensure that healthcare and frontline workers have access to quality and adequate PPE such as masks, gloves and aprons. Similarly, funding committed by South Africans for the procurement of PPE through organisations such as the Solidarity Fund, Naspers and the Motsepe Foundation required a channel for procuring the right products, and in turn distributing these to users most critically in need.

B4SA established a procurement strategy, processes and technology solutions in early April 2020 to allow suppliers of PPE to register products and provide their stock and manufacturing capacity levels, culminating in the *B4SA Supplier Portal*. The supplier portal has allowed funders to ensure the right product category with the correct levels of accreditation.

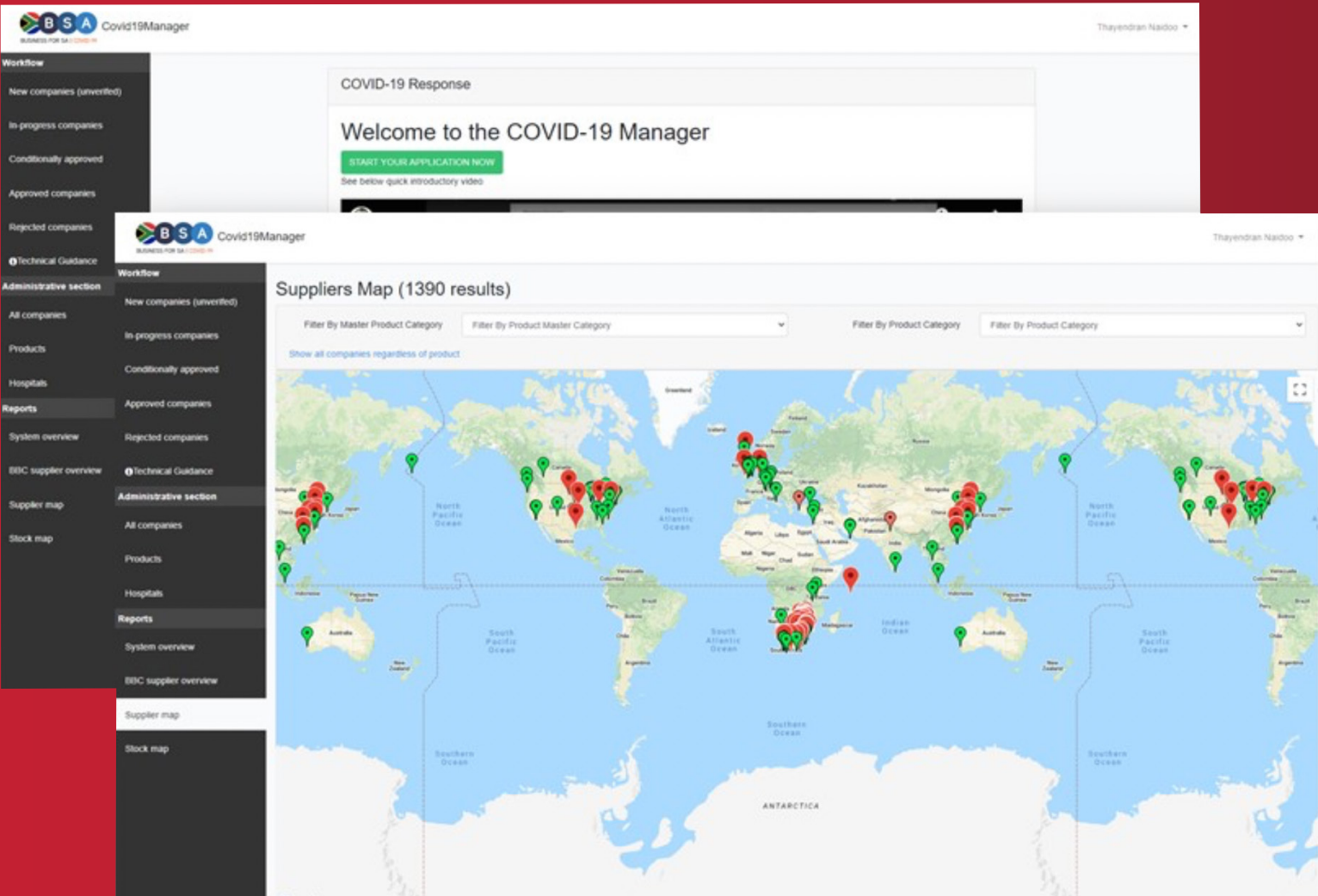


Figure 1: B4SA COVID-19 Supplier Portal

Further to this, B4SA facilitated the collection of supply chain data from stock on hand, to deliveries of PPE, such that PPE can be purchased at the best price and channelled to healthcare and frontline workers most critically in need. Through the *B4SA PPE Platform* the data are currently being used by B4SA to manage purchases, while at the same time providing visibility to funders on how donations have helped to relieve the shortages faced by healthcare facilities requiring quality PPE.

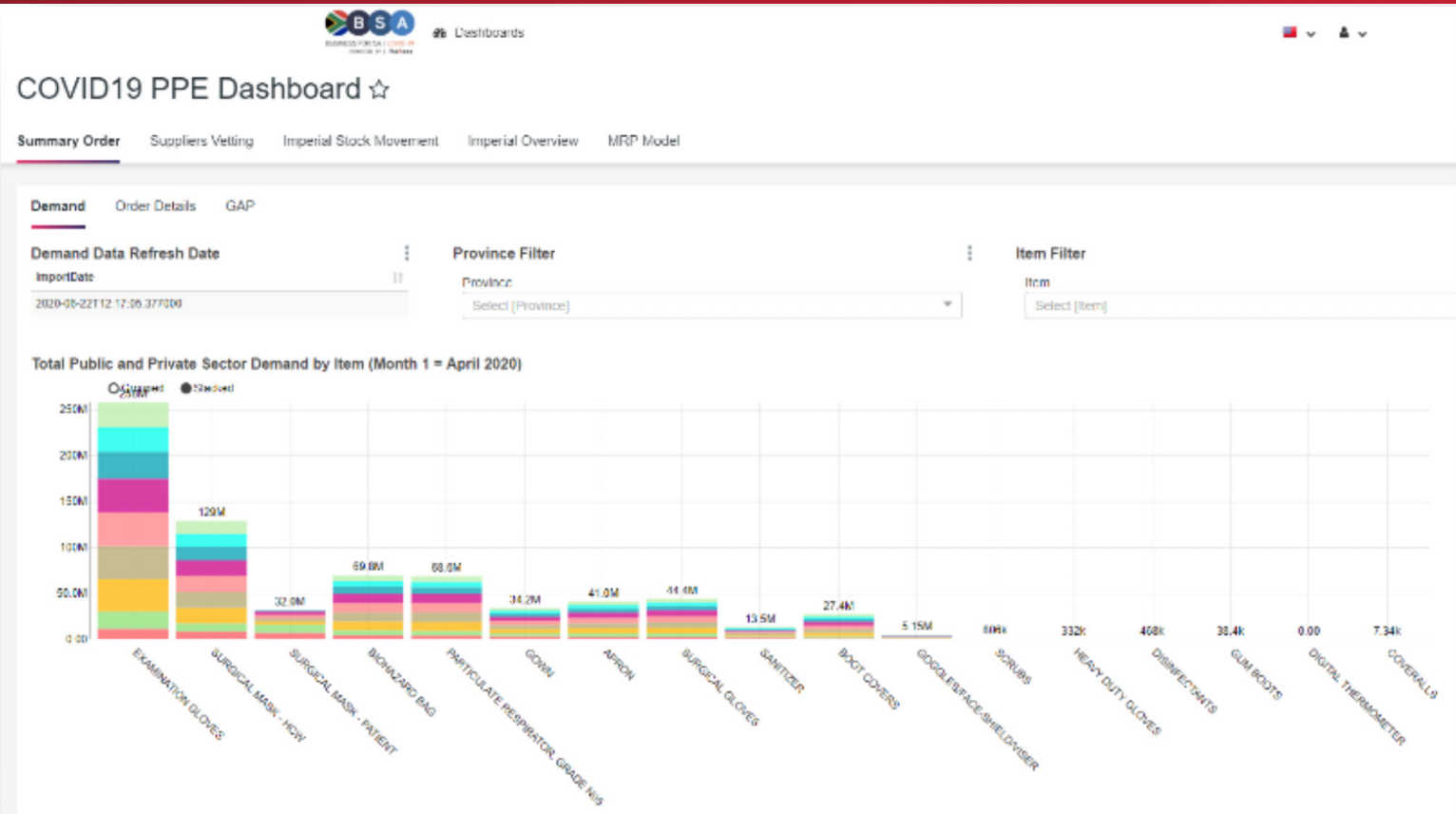


Figure 2: Sample B4SA PPE dashboard view Supplier Portal

As at 30 June 2020, the donations received from South African companies and individuals have resulted in over 1.49 million pieces of PPE being procured through the B4SA PPE Platform. The PPE has been donated to public sector doctors, nurses and community health care workers at the frontlines of the country's fight against the pandemic. The focus of these donations has been across all provinces and is targeted at hotspots. Donated products include 940 300 pairs of examination gloves, 269 500 surgical masks, 133 870 N95 respirators, 134 027 face shields, 9 729 litres of sanitiser, 1 100 coveralls and 1 100 surgical aprons.

EPIDEMIC MODELLING

In March, B4SA established a forum for the ongoing collaboration between various modellers to provide a robust view of infection rates and thereby deduce demand for hospital beds, medicines and PPE over the coming months. This forum allowed for modellers from different groups, including

universities, public sector health, private sector companies, and the Actuarial Society of South Africa to come together and stress-test the model results.

These collaborative efforts have brought together local and global researchers to predict how the pandemic may spread in South Africa, providing insights into South Africa's possible requirements of hospital beds, PPE, and medicines.

The results of three models (led respectively by the National Department of Health (NDOH), the Actuarial Society of South Africa, and B4SA) have been presented to Government health officials, who have requested continued support for the national fight against the COVID-19 pandemic, by collaborating and giving a best estimate of the infection rate.

The models include population density and geo-spatial factors and take into account demographics of the country. The models also



B4SA, together with the support of ESRI South Africa, has been able to provide spatial views of South Africa overlaid with various data.

include assumptions about the effectiveness of lockdown measures taken by Government as well as certain factors such as comorbidities, asymptomatic rates, and infection rates.

HOSPITAL AND LOCATION SPATIAL PLANNING

As part of the B4SA response, geospatial mapping has been a crucial element of the analysis conducted by various teams. B4SA, together with the support of ESRI South Africa, has been able to provide spatial views of South Africa overlaid with various data. For example,

such spatial views and analyses directly relate to the need to identify potential locations as temporary facilities to house overflow patients from hospitals in the form of isolation and quarantine locations. This furthermore assists in spatial planning such as the repurposing of facilities to house medical staff.

The views are deployed in an interactive dashboard allowing the user to navigate across South Africa and switch between the various layers available. These layers include population density, hospital locations, stadiums, shopping centres, education facilities, field hospitals and hotels at a municipal level. The interactive dashboard may also be used going forward to assist the B4SA Food Distribution Project – mapping existing supply chains for the distribution of food coupons for those in desperate need.

SAFE TRANSPORT MODELLING

Given the pressure on Government to relax lockdown restrictions, it was imperative to understand how the public transport sector would need to respond, given the regulatory changes and prevention procedures under the risk-adjusted approach. Hence providing a holistic view of the public transport sectors' readiness to manage health risks and modelling the number of daily commuters as well as their requirements for masks and hand sanitisers as the economy gradually opens was critical.

In order to facilitate the accelerated opening of the economy in a way that manages the associated health exposure, preserves lives and minimises the long-term adverse impact on the economy and livelihoods, a model was developed to predict the number of daily commuters. This was broken up by taxi, bus and rail and included formal and informal transport. Based on the model results, B4SA proposed initiatives to practically implement actions that supported the opening of the public transport sector in a safe and sustainable manner.

"While the pandemic is one of the worst events to happen to our country, it has also shown us that it brings out the very best of humanity..."

As much as we hope and wish that a crisis such as this global pandemic never faces us as South Africans again, it is worth noting how South Africans have rallied together during this time to support Government and the most vulnerable groups. The provision of volunteer resources and technology as

part of B4SA has enabled the 400-strong group of individuals to contribute meaningfully to the country's fight against COVID-19.

B4SA's Health Work Group leader, Stavros Nicolaou, said in a recent media statement: "While the pandemic is one of the worst events to happen to our country, it has also shown us that it brings out the very best of humanity, not only in donating much needed PPE at a critical time in the pandemic, but it also shows us that we are a resilient, inventive and industrious nation that will rise to the challenges presented to us."

This is to acknowledge every individual and organisation that has contributed to our country's response to fight this pandemic. Let it be an encouragement to us all that South Africans can work together, and in some ways become stronger as a nation beyond this most challenging time.

Ashleigh Theophanides is the Analytics and Automation cross-functional work group leader for B4SA. Ashleigh is also a senior partner at Deloitte. 

IMPORTANT RESOURCES:

B4SA's procurement portal:

<https://covid19manager.co.za/>

Requests for medical PPE email to:

Covid19requests@businessresponsecovid19.co.za

ProudlySA's cloth mask marketplace:

https://www.proudlysa.co.za/covid_19/covid_19.php#

Business for South Africa (B4SA) website:

<https://www.businessforsa.org>

Tools and guidelines to expedite a safe return to work: <https://www.return2work.co.za/>

Government COVID-19 resource portal:

<https://sacoronavirus.co.za>



Peter Doyle

DISEASE MODELLING: SOUTH AFRICA'S "GIFT TO THE ACTUARIAL PROFESSION"

In 1983, AIDS was diagnosed for the first time in two patients in South Africa. The first recorded AIDS-related death occurred in the same year. According to UNAIDS, there were 7.7 million people living with HIV in the country in 2018.

The leading role played by South African actuaries in modelling this epidemic has been described as South Africa's gift to the actuarial profession. South African Actuary talked to Peter Doyle, who did pioneering work in this regard. Peter is working on a Convention paper about his experience, which includes key insights he had taken from it, and on modelling epidemics in real time. In this interview, he talks about the background to the AIDS model, his reasons for becoming involved and how the model was developed.

South African Actuary: Most members of the Society are too young to remember the 1980s, and some others can probably use a reminder. Can you tell us a bit about the period, to provide context, please?

Peter Doyle: It is easy to misunderstand history without the context, so I need to just touch briefly on that context and how it influenced the AIDS epidemic itself and therefore the AIDS model. The origins of the AIDS epidemic and my work on the AIDS model happened during the last decade of apartheid in South Africa. This was a time characterised by social upheaval, civil and border wars, sanctions, misinformation ("fake news" is definitely not a new phenomenon), distrust, political change, fear and hope (but sometimes only a very little hope) for the future.

Inevitably, HIV and the AIDS epidemic rapidly became politicised. Rumours abounded. One theme was that the white government was responsible for spreading HIV, intent on reducing the black majority. While white alarmists pointed to the rampant HIV infection

in Africa as evidence of the need to keep apartheid in place. These were the extreme views, similar to the conspiracy theories of today. And everybody used "statistics" to prove their point. It did not help that HIV was primarily a sexually transmitted disease and so racial, sexual and religious stigmatisation was the order of the day.

Another not insignificant problem at the time was sanctions. In the 1980s this was becoming a real issue in South Africa and clearly one of the pressure points that eventually forced change. It was difficult to travel to some parts of Africa on a South African passport. The Southern African borders to our north were closed to most travellers, which in itself had a complex impact on the spread of HIV infection in South Africa. Even further afield one did not always feel welcome. UNAIDS did not come into South Africa until after 1994 and I had to travel to Zimbabwe and later to Switzerland to meet with them.

Modelling the HIV epidemic and presenting the scenarios was therefore fraught with political

danger and potential misrepresentation, to say the very least. Several people tried to warn me off our "foolish" endeavour for those very reasons. One of the ways that we managed to navigate in part these complex issues was to consult very widely and, later on, to present our findings very widely, both to the old establishment and to the incoming leaders of the new ANC government; both business and labour; and, quite frankly, to anybody who would listen.

SAA: So what prompted you to become and stay involved?

PD: When asked about my experiences, I usually say something about being just in the right place at the wrong time. But there were two other main reasons.

Metropolitan Homes Trust Life, where I worked at the time, was one of the most forward thinking and socio-politically aware businesses in South Africa. We had a very large book of insured lives, probably covering the widest spectrum of people in Southern Africa of any life insurer, and needed mortality rates to price and reserve for these lives sustainably into the future.

The industry body, the Life Offices Association (LOA), had decided to exclude AIDS claims. Most insurers had already introduced exclusion clauses into their policy wording and were trying to introduce it even into existing policy wordings. There were some bizarre discussions about claims still being payable should the claimant have been HIV infected through no fault of their own. How could they ever tell?

Like many others at Metropolitan, I took exception to the use of exclusion clauses. They were discriminatory, difficult to enforce and unlikely to be effective. We had two primary objections to the use of exclusion clauses: the first was the principle of fairness and equity; the second was that they would be futile and the financial consequences of misestimating our claims experience would be devastating in the light of a possible epidemic. Many of our products were community rated.

With our funeral and industrial style business, quick claims processing, often within 24 hours, were essential for the families' financial security. AIDS deaths would almost certainly be under-reported, especially if the attending doctor knew that an associated insurance claim would be repudiated. Besides, most death certificates simply stated "natural causes" as the cause of death.

I therefore proposed to our board that if we could not reply on AIDS exclusion clauses, we needed to be able to project extra AIDS mortality and include that in our pricing and reserving bases. This became the compelling business reason to develop a model. I had made an undertaking to the board that I had no idea how to fulfil.

Apart from this business driven issue, the other reason was a quasi-scientific, actuarial, curiosity. I had become frustrated by the obvious and speculative nonsense being published at the time about the AIDS epidemic; mostly pseudo-science and most of it sensationalist. Some of it was even based on "models". I could be writing about Covid-19, too, for that matter.

Two well-known authors forecast a "doomsday" in Africa and predicted that HIV would infect at least 50% of the entire African population. What they did not explain was that their models used simple exponential doubling times of HIV infection, until it reached the 50% level. Knowing full well that nobody would believe a forecast of an infection rate of 100% in the following year, they conveniently stopped their models at 50%.

One author even went so far as to state categorically that 50% of the population in Africa would be "dead or dying by the year 2000". A notorious TV documentary, from the BBC no less, suggested that Africa was becoming depopulated and showed aerial images of empty rural villages. Although never proven, these villages were probably empty as the result of war or famine, or both; but certainly not HIV.

These blatant intellectual dishonesties, or inaccuracies, were a serious challenge to a young actuary seeking for truth.

SAA: Any other major challenges in modelling the epidemic?

PD: Many! 😊 Remember that a smaller AIDS epidemic unfolded in South Africa before the larger HIV epidemic, in the sense that AIDS cases were being seen worldwide long before anybody realised that this was a viral epidemic of HIV infection, or before medical science even knew HIV existed. (By the way, it was also this chronology that sowed some of the seeds of doubt among the so-called “AIDS dissidents”).

There were many issues to be understood, even long after the HIV virus itself was discovered. These included testing protocols, modality, causality, susceptibility, co-factors, definitions, etc. As a result, I spent many days just trying to get to grips with the science of epidemiology, let alone the epidemic itself. The amount of misinformation was huge; both caused by a simple lack of knowledge, worldwide as well as locally, but also due to the malicious stigmatisation of HIV and AIDS.

This presented many problems for modelling the epidemic. Most people, including actuaries in the UK and US, had published models based on reported AIDS cases. Virtually all of them simply fitted an exponential s-curve to the reported AIDS cases. It was obvious to me that was a futile approach, which posed just too many problems, not least due to the known under-reporting of AIDS cases.

Under-reporting of AIDS was multifaceted: AIDS presented clinically as other diseases; AIDS was a syndrome and not a single disease; reporting an AIDS death required knowledge of the patient’s immune system and a laboratory test which was often not practical; there could be a stigma related to reporting an AIDS death; there could be adverse consequences of reporting an AIDS death, e.g. a repudiated life insurance claim; the data collection and method of reporting up to national data level had many inconsistencies; many deaths are

classified as “natural causes” without further detail; etc.

One of the other problems that arose from relying on reported AIDS cases, was that there was no data on when AIDS patients had become HIV infected. While some anecdotal evidence may have existed, it still did not explain how many other people were out there carrying HIV. And what did the pattern of disease progression look like? The early AIDS cases gave no idea of the long tail of other possible AIDS cases from people already infected by asymptomatic.

There was also the not insignificant matter of the morbidity and mortality of AIDS patients. However, we knew that we had access to large books of life insurance business, and hoped that, once we knew more about HIV infection, we could eventually back-solve some of those questions based on our emerging morbidity and mortality data.

This was a classic case of looking in the rear-view mirror to see what was coming on ahead. We therefore decided to model the spread of HIV infection and I devoted myself first and foremost to finding data on HIV infection. This was probably the best decision I made about the model. The real epidemic was HIV infection, but nobody had tried to model that yet.

SAA: How did it come together, then?

PD: Collaboration was the modelling glue: other actuaries, other people, other disciplines. Very little that happened with respect to modelling the AIDS epidemic was my work alone; it was always a highly collaborative undertaking.

It may be hard to believe now, but in the early years of working on the model, there was no Internet, no mobile phones, no Google. I relied on medical journals, print media, fax machines and the aeroplane. Virtually all of my contact with people was face-to-face and I travelled to see them, in their offices or hospitals or laboratories. Many of these were remarkable meetings, etched in my memory still today.

I engaged with many people and a few actuaries in the life insurance industry. Most people wanted to talk about underwriting and exclusion clauses. One actuary who stood out to me, and was the first to get me to see the matter of public interest, was Paul Truyens. He had an exceptionally good insight into the role of the actuary, the role of business and the public interest at large. Paul was also technically very strong and is the one who would often challenge my thinking the most in the early days of grappling with a model.

My original idea was only to model life insurance mortality and exposure. Several of the large life insurers had large books of business in other East and Southern African countries, where the HIV epidemic was significantly ahead of that in South Africa. I suggested that we extend the ASSA’s CMI (Continuous Mortality Investigation) into a prospective model of data, using claims data from other neighbouring countries. We came very close to doing this, but eventually all of the life offices declined to submit data.

That was the point at which I took the idea back into Metropolitan to develop a first principles model of the epidemic. The single person that helped me the most at that stage was Douglas Keir, the country head of Swiss Reinsurance in South Africa and later president of the Actuarial Society. Doug introduced me to a number of people, all outside of the actuarial profession, who were working in the medical and scientific field. We collaborated with many of these people for many years; particularly as later our modelling work started to become useful to them as well.

To recount all of these meetings would take many pages; but my learning curve became exponential at that point; and I learned something, or many things, new from each meeting. Many of these people were at the forefront of the scientific research effort in Southern Africa. After every meeting I always asked two questions. Who else should I talk to? And everybody gave me at least one new contact; and so a powerful network came about. Did they think it was possible to model the epidemic? Everybody said, “No”.

After I had spent over a year researching on HIV and AIDS quite intensively, I was nowhere near to producing a model, which I had promised to do.

A breakthrough in my thinking came from a meeting with Prof Barry Schoub. As head of the National Institute of Virology, he was the preeminent epidemiologist in South Africa at that time. In our meeting, he told me that there was not enough knowledge yet to produce any type of epidemiological model; besides, we were still trying to understand the clinical dimensions of this disease.

Two key points came out of that meeting with Prof Schoub, though. The first was confirmation that HIV was primarily a sexually transmitted epidemic in SA that caused AIDS sickness. Bear in mind that this was still an open question in many minds at that time. The second was a “light bulb” moment for me in my understanding, because Prof Schoub took the time to explain to me how an epidemic works and especially how it proceeds through a population via difference in susceptibility among risk groups. He pointed me to an academic paper that he had written on the topic. It then became blindingly obvious how I should approach the model, both when I saw the chain of connection epidemiologically, but, more importantly, when I also understood the connection to the data that I was gathering.

Not long after that, in early December when our office was quiet, I closed my office door one morning and set out to design the AIDS model. Pencil and paper. The first version did not fit onto an A4 page, so I took a card folder and opened it out to an A3 size, and in about two hours I drew up the model design. I acutely remember the process and being rather astonished that what I had put down on paper had not been fully formulated in my head before I started that morning. I still have a copy of that drawing today (the original is framed and on the wall of the ASSA office). That creative process has happened a couple of times in my life and works well for me.

SAA: How did you develop that further?

PD: Remember what I said about the Internet, Google and so on. As I was a senior manager at the time, I did not have a PC. Every piece of information came to me as a hard copy, even valuation reports and management information. In retrospect, I am also really happy that Donald Millar and I decided to programme the model in Basic and so we did not end up with a nightmare set of spreadsheets!

Getting access to sufficient computing power was an issue; this was not high priority project at the time. But my excellent secretary, Janine, had a PC on her desk to use the word processing capability; that was pretty much all one could do on a desktop PC; I doubt that we even had email at that time. So Donald and I decided to run the model on Janine's PC because it had a 10MB hard drive. The problem was that one single run of the model (one scenario) took about 10 minutes per year and so it ran for anything up to four hours for a 20-year scenario. PCs then could not multi-task, so we could only run it at night.

Our ritual was that in the late afternoon Donald would load up any coding improvements to the model, we agreed the parameters for the next scenario and hit "Run". Next morning first thing I would grab the printout and see what we had got. The worst times were when there had been a glitch in the software and it had bombed out during the night; so we would have to redo it again the next night.

Why is this relevant other than being a nice story? Because it made us very disciplined. We put a lot of thought into the next run and the next set of parameters. Often we wanted to test the model's sensitivity to a single parameter change and we needed to be sure of the order of magnitude change that was reasonable. In the morning after scanning the results, either we felt we had hit the jackpot or it was back to the drawing board. We had to be careful, though, because some results were counter-intuitive, because we were still trying to understand the model, let alone the epidemic.

A good example of this was the incubation period from HIV infection to AIDS sickness, discussed elsewhere. Initially we thought, foolishly with the benefit of hindsight, that a shorter incubation period would mean a more severe epidemic. Not so! Obviously a more rapid onset of AIDS sickness reduces the pool of HIV infected lives quicker and so leads to lower incidence of new HIV infections and a smaller overall epidemic. It would have been easy to discard that as a random result the first time we saw it, but the discipline of only daily runs force us to think through the logic every time and we learnt a lot in the process.

The scenario set we first published were scenarios numbered 62 to 65. That was literally our run count. Over the approximately 8 months of development of the model, we had been able to get it to run 65 times and every run we had scrutinized the parameters and output in some detail.

SAA: What was the response when you presented your results to the Society?

PD: The Actuarial Society AIDS Committee decided to host a special one-day seminar on the AIDS epidemic. Donald Millar and I decided to publish our results of the modelling for the first time at this seminar. We quickly settled on publishing a specific set of scenarios, numbered 62 to 65. Then began the work of documenting how the model worked and why we were confident in our results.

One of the key problems was that several of the datasets against which we had calibrated the model were not yet published data; and we could definitely not publish that data. Nevertheless, there was sufficient data in the public domain to make sense of our model.

After we wrote the first draft of our paper, I gave it to one of the most senior actuaries I knew, in many ways one of my mentors. His feedback was that the paper was interesting, but that we should not publish it "because the results may be wrong" and what would be a setback to my career. However, we were

already committed to the ASSA seminar, and so we decided to take our chances.

As the time for the seminar approached, the event seemed to get bigger and bigger. It was a one-day seminar to be held the day after the ASSA annual convention. Many people outside the profession, including the media, were invited to attend the seminar.

The presentation at the seminar went well, but it generated a storm of interest beyond what we had expected. The difficult responses were to the media, who mostly wanted to know what we thought of the other projections out there at the time, asking for certainty that we could not really provide.

The other very positive responses were from others working in the field of AIDS and HIV infection. My network of contacts grew significantly and as a result we ended up in many other fruitful debates and collaborations. New sources of data and other technical papers were brought to our attention. We had entered a much more intense phase, both technically and publicly, that has carried on for years.

SAA: How did the international actuarial community respond?

PD: Every four years, Metropolitan sent one actuary to the International Congress of Actuaries (ICA). In 1992, the ICA was held in Montreal, Canada, and I was the actuary designated to attend.

Since I was going anyway, I decided to submit our paper on the HIV model as one of the scientific papers at the ICA. Getting the paper together in the format set out for publication was a bit of a rush, because it had to be submitted so long before the Congress to allow for papers to be printed for the Congress. In between the time we submitted the paper and the Congress itself, the first published studies of HIV infection among antenatal women came out in South Africa and so I took along graphs of these results in case anybody was interested.

At that time, each day at the Congress had a plenary session in the morning devoted to one of the practice areas for technical papers. I expected nothing to come of our paper, as there were many other excellent papers in the section. I was wrong on many counts.

There were too many papers for presentation each day, so the practice was that the Chair of the particular scientific section would summarise one or two papers and discuss the overall quality of papers received. The day dawned for our section.

To my amazement, and later shock, the Chair, before what seemed like several thousand actuaries, started off discussing our paper. However, he literally tore it apart as an example of the sort of work actuaries should not be doing. There was not sufficient actuarial content. There was not sufficient data. It was not in a traditional field of actuarial practice. Besides, actuaries in the US and the UK had already tried unsuccessfully to model the epidemic, and so it was futile for actuaries in an emerging market like South Africa to think they could do any better!

The other practice at this ICA was that a couple of authors of papers were chosen at random to come up and talk at the plenary. We had been given strict instructions to watch the screen, as the names of speakers would be put up on the screen. As the Chair finished tearing our paper apart, the shock was seeing my name up on screen as the first author to speak. Armed only with my slides of data, I marched up to the podium and I think gave a relatively credible response to the Chair's criticisms. Many people came to talk to me afterwards and seemed genuinely interested in our work. Welcome to the world of the international actuary!

Note: As indicated in the introduction, Peter is working on a paper for this year's Convention, in which he will share more, including key insights from his experience. Don't miss it! 

AIDS: Doomsday Scenarios and Scientific Modelling at A Glance

The pioneering research work Peter Doyle had done on AIDS, which raised the profile of the Actuarial Society and the actuarial profession in South Africa, led to Council awarding the Murray Medal to him in 1992.

Under Doyle's convenership from 1991 to 1997, the Society's AIDS Committee produced a professional guidance note for actuarial practice in South Africa in the face of an HIV epidemic. Because the Committee was earlier not convinced that there was enough data to develop a model and due to differences in suggested approaches, Doyle developed a model at Metropolitan Life.

Simplistic models, based on limited sets of assumptions, had been produced in South Africa at the time. The interpretation of these models led to doomsday scenarios, e.g. that schools in South Africa would run empty after the year 2000. Although some commentators regarded the results of the model developed by Doyle as conservative, it became one of the most widely accepted and longest surviving predictive models in South Africa. It was a proprietary model, however, and a team led by Alan Whitelock-Jones and in collaboration with actuaries at Metropolitan developed an open source version of the Metropolitan model, which became the ASSA500 AIDS Model. This was presented to the profession in 1996. In 1998, Rob Dorrington presented an updated version, ASSA600, at the Society's annual Convention. This was a combined AIDS and demographic model for the country as a whole. Modelling both together not only produced better demographic projections but also provided more to check the model against, to ensure that it produced realistic and measurable demographic outputs.

The ASSA2000 suite of models was developed in 2000. Major improvements on ASSA600 included adjustments to incorporate updated empirical data and understanding of the epidemic. In particular, the ASSA2000 version represented a significant advance on earlier versions in that it attempted to model sexual activity. This enhanced the usefulness of the model as a tool to assess the impact of various behavioural changes and intervention strategies.

The ASSA2002 Model, released in 2004, was a landmark achievement in understanding the South African HIV/AIDS epidemic and improving the accuracy of demographic estimates. Apart from improved estimates of the extent of the epidemic, the main development in ASSA2002 was to incorporate the impact of interventions. Five interventions were modelled: information and education campaigns, improved treatment of sexually transmitted diseases, voluntary counselling and testing, mother-to-child transmission prevention and antiretroviral treatment. In addition, the model produced estimates of the number of HIV-infected people in the different stages of disease, which was useful in assessing the extent of the morbidity associated with the epidemic. This made the model much more relevant at a time when both the public and private sectors are rolling out various interventions.

ASSA2003, released in 2005, was the first AIDS and demographic model to take the government's Comprehensive Plan for HIV and AIDS into account at a provincial level. ASSA2002 was the first South African model to take the various government and private sector interventions at a national level into account. ASSA2003 allowed for government and private sector interventions at a provincial level and can project provincial HIV and AIDS statistics. It was the first version to model the epidemic in the provinces in a way that was consistent with the model for the country as a whole.

The ASSA2003 AIDS model became a valuable tool for the various provincial health departments in the implementation of the national Comprehensive HIV and AIDS plan. The model provided estimates of the expected numbers of South Africans entering the AIDS sick phase and who will be requiring antiretroviral treatment in the future.

Soon after the turn of the century, some critics of the model and AIDS modelling in general suggested that, inter alia, mathematical modelling used in the assessment of long-term AIDS prevalence and death estimates lacked scientific rigour.

In response, the Actuarial Society's AIDS Committee pointed out that new research into behaviour changes, the effects of Voluntary Counselling and Testing, STD management by public health facilities and antiretroviral therapy had all been built into the ASSA2002 model, which was the latest version at the time. The downward revision of the Society's historic estimates accordingly reflected both refined understanding of epidemiological dynamics (for example how antenatal clinic data differs from population data) and actual changes that are occurring in the world as a result of interventions which previously did not exist.

Leigh Johnson and Rob Dorrington developed an ASSA'ndaba (public education document) on AIDS Modelling, which was received favourably by various audiences, including a parliamentary delegation preparing a document for the Pan-African Parliament.

ASSA2008 was released in 2011. The most significant changes to the previous version of the model are greater estimates of the impact of antiretroviral treatment in recent years, as well as significant increases in levels in condom usage over the last decade.

The model is provided in the public domain, and in open source code, so that users are free to download it, review it and question its structure and methodologies. As Rob Dorrington pointed out, it is hoped that in so doing, the Society can further research and improve the modelling of the epidemic. 

NOW IS THE TIME for the inclusive Digital Insurance Pioneers to step up

- Jeremy Leach



As we are all impacted by Covid 19, it has made me reflect further around the role of insurance and why I chose to focus on this area. It was early on in Inclusivity Solutions life when I experienced one of the most moving moments of my career. It was at the launch of our second product, Ingoboka Cash, in Rwanda, when I was approached by 24-year-old Theoneste Nizeyimana. Overcome by emotion, Theoneste quite literally threw his arms around me explaining that were it not for the money he had received from his insurance claim following a horrific accident, he would not have been able to recover from his surgeries as quickly as he had, and would not have been able to afford to repay a financial loan he'd been forced to take out to cover his lost earnings.

[YOU CAN READ THEONESTE'S STORY, CLICK HERE](#)

How insurance makes a difference

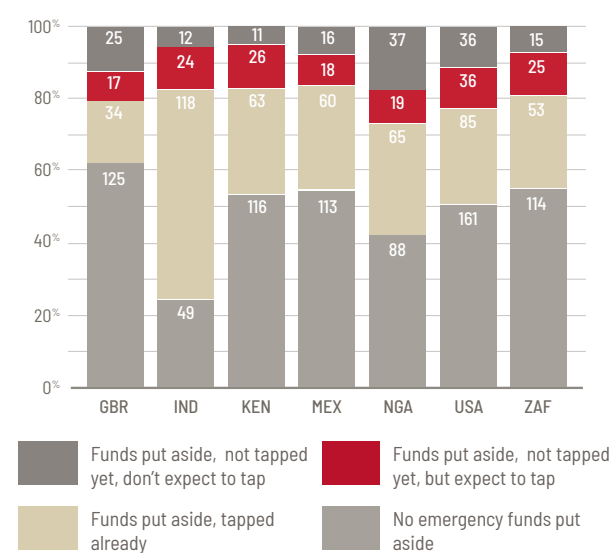
Theoneste's story was a reminder of what drove my career change from 'high finance' to focus on financial inclusion and later inclusive insurance. It was a reminder of the material impact that the most basic insurance can have on a person's life in emerging markets, if designed well, and the reason why I started Inclusivity Solutions. Sadly, however, stories like Theoneste's are few and far between, the heart-breaking reality is the vast majority of the young adults in the markets that we serve have no safety net at all. They simply cannot afford it or cannot access it.



Financial resilience

50% of the respondents have no emergency funds, and another 15-30% already tapped into those funds, except India, where ratios are reversed.

Have you put money aside as emergency funds, to see you through a difficult time when you might lose most or all of your income



Losing it all in a heartbeat

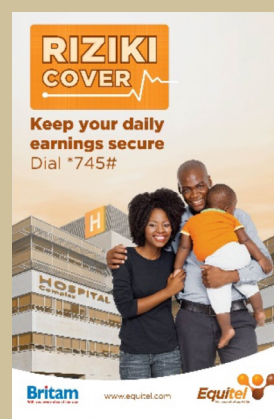
Now consider the potential impact of COVID-19 on these people. These are smart, hard-working, ambitious individuals who are all striving for a better life for themselves and their dependents. Whilst they are often more financially savvy than most of us, because they have to be, they are also heavily reliant on their daily incomes to carry them from one day to the next. If they get sick and are unable to work, they risk losing everything. And what is worse, as C19 is affecting their broader family networks simultaneously, their previous safety net of remittances is at breaking point. The cruelty of this scenario is unthinkable, especially when like me, you've spent time listening to their stories and meeting their families.

My former employer, BFA Global, underscored the severity of financial resiliency in times of crisis in a recent study when they found that as many as 50% of people in the UK, Mexico and Kenya said they did not have a way of coping financially if they should lose their income. In many countries it is much more than that. And C19 makes this worse as it is a death by a thousand cuts as we don't know when the economy can be resuscitated, and emergency basic income grants or transfers can only go so far.

Providers of insurance have the leverage

Whilst it is little comfort, it is at least good to know that we designed our products to ensure that our + 700,000 clients in Kenya, Rwanda and Cote d' Ivoire will be covered for loss of income from hospitalisation and/or death from the likes of C19 - with no exceptions. Unfortunately, this is not the norm in this industry as many people who thought they would have cover have found out they haven't.

Whilst the industry still has a long way to go, it is times like these when inclusive insurance offers distribution partners the opportunity



I have always held a deep conviction that insurance can address the real risks that matter for the most vulnerable people, people like Theoneste.

to add real value to their customers and demonstrate social responsibility. And with a little fine-tuning I believe we can increase its effectiveness even more:

1. We need to ensure that every product is designed in such a way to meet the needs of our clients and remove typical exclusions, including pandemics as we are experiencing now. In our case, every product that we take to market is supported by rigorous Human Centred Design research and co-creation workshops to ensure that products are aligned to customers real pain points, are simple to understand and easy to navigate. Our obsession is for all products to address the risks that really matter and can play a real role in adding value to clients, as demonstrated by Theoneste's testimonial above.
2. We need distribution partners and insurers to recognise that, if well designed and efficiently implemented, we can expand access to the 92% - 95% of

the adult population that do not have access to insurance in many emerging markets. On our side we are committed to delighting customers by ensuring a simple and easy client journey from sign up right through to claims processing in hours rather than months and this is needed to reach the majority.

Realising the dream of meeting the needs of our clients

Ironically, shock events such as COVID-19 often serve as the tipping point to awaken customers to the true value of insurance, where present bias otherwise may have prevented them from considering it. When typhoon Hyan hit the Philippines in 2014, **Pioneer Insurance** had to pay out a large number of claims. So positive was the customer experience, that Pioneer benefited from three consecutive years of exponential revenue growth following the event.

I have always held a deep conviction that insurance can address the real risks that matter for the most vulnerable people, people like Theoneste. It is the reason why our mission statement at Inclusivity Solutions is "to protect and enhance the quality of life of vulnerable people through digital insurance solutions" and, to be clear, we are ALL vulnerable to C19 whatever walk of life we are in.

Whilst the humanitarian and economic devastation of the COVID-19 pandemic is undeniable, it is my firm belief that if we focus on designing products that meet the actual risks that matter and work with distribution partners that have the foresight to include insurance into their financial services portfolio we can rapidly extend the safety net of insurance to the majority. We are all in this together. ⚠️



Kelefilwe Kungwane: HELPING OTHERS TACKLE OBSTACLES

Kelefilwe Kungwane qualified as a Fellow of the Actuarial Society and Chartered Enterprise Risk Actuary in 2019. She served on the organising committee for the Society's first public interest seminar. And she is about to complete a term as president of Actuaries' Lekgotla.

South African Actuary: Please give us a quick background sketch: where you went to school, grew up and so on.

Kelefilwe Kungwane: I was born in Mabopane, a township situated in the north of Pretoria. I am the second of six children. Having been raised by a community of teachers (my parents, aunts and uncles), the

importance of education was deeply ingrained in me from a very young age. I believed that a good education would provide me with opportunities that the previous generations in my family did not have access to. This led me to do very well throughout school – I was the Dux Scholar at Hoërskool Gerrit Maritz and matriculated top of my class in 2011. I went on to study actuarial science at the University of Pretoria and I completed my honours in 2015, having obtained all exemptions from the professional exams. I qualified as an actuary in 2019 and obtained the CERA designation in the same year. (Editorial note: Kelefilwe's research project on National Health Insurance, a collaborative effort with Mudanalo Shavhani, was featured in South African Actuary, October 2019 – Volume 3, Number 3).

SAA: Tell us about your current job, please. Where you work and what the work entails.

KK: I joined Liberty in 2016, fresh out of varsity. I spent my first few years doing SAM valuations, capital modelling and risk quantification. My current role as Lead Specialist in the Insurance Risk Insights team focuses on assumption setting and using insights derived from experience investigations, and research to engage with the business and drive decisions relating to Liberty's Retail Book.

SAA: How did you become aware of, and what attracted you to, the actuarial profession?

KK: I first found out about the actuarial career path in Grade 11 through the UP with Science programme, a science enrichment programme for secondary school learners presented by the University of Pretoria. I subsequently did lots of research and was determined to pursue a career in actuarial science, no matter how difficult a lot of people made it seem. It was not only my love for maths, but also the ability to apply actuarial skills to solve complex problems in a broad range of industries that mainly drew me to the career path.

SAA: What are some of the things that have helped you on your journey towards qualifying as an actuary?

KK: Varsity was in no doubt challenging; remembering my "Why" always helped me push through and I also had an incredible support system around me which enabled me to do well. The SAADP also played a key role in my success throughout university. The programme provided me with financial and academic support and mentorship. Our programme manager, Mrs Refilwe Lehobo, was basically our "campus mom" who provided us psychological support.

As a working student, I made use of the resources available to assist me in passing the exams (past papers, sessionals, ASET notes and revision booklets). I also learnt a LOT through asking for help from various people. My experience is that people are generally open to help; you just need to ask. I passed my Fellowship exam on the third attempt, after having sessions with various subject matter experts at Liberty and doing past papers on Saturday mornings through a study group system formed within Actuaries' Lekgotla. The marking of each other's papers improved my exam technique substantially!

SAA: Tell us more about Actuaries' Lekgotla, please. What is the organisation about? What are its objectives?

KK: Actuaries' Lekgotla (AL) was created to address the challenges faced by Black actuarial professionals and has since evolved into an organisation whose vision is to empower, celebrate and encourage Black actuaries in South Africa. AL aims to be at the forefront of speaking truth to power regarding transformation and advocating for the interests of Black actuarial professionals while increasing the number of Black qualified actuaries who are at the intersection of technical competence and social awareness. The initiatives to date (such as study interventions, submission to Parliament and sessionals) have mainly been

Separating your self-worth from what you do, allows you to embrace failure when it happens, as failing does not feel like a personal attack, but rather something to learn from.

member-driven and we draw strength from having a community of people with the same drive and determination.

SAA: What do you regard as the main challenge or challenges the actuarial profession faces in South Africa?

KK: I think a challenge is being relevant in spaces where actuaries do not traditionally play in. And I think that this may be because the awareness of our profession, compared to others, isn't that great, so people do not quite understand what our skill set enables us to do. Some people think that actuaries are just statisticians who are just expensive to hire. With more awareness and more actuaries breaking into different fields, this perception is likely to change.

Transformation remains a challenge that the profession faces. The influential roles that actuaries play in various sectors in society require us to have diversity in experiences and way of thinking in order to better serve the interests of our stakeholders.

SAA: If you had to give one piece of advice to students, what would that be?

KK: It is important not to anchor your self-worth on your ability to pass exams and ultimately qualify as an actuary. This journey towards qualifying (and I suppose your career in general) is only part of your story and should not define you. Separating your self-worth from what you do, allows you to embrace failure when it happens, as failing does not feel like a personal attack, but rather something to learn from. You're also able to enjoy other pleasures of life along the way .

Using Generative Adversarial Networks TO ADDRESS CLASS IMBALANCE

Kwanda Ngwenduna^{1*}, Rendani Mbuva²

Abstract

Gaining an advantage in competitive markets through offerings of suitable tailored products to customers relies on adequate predictive models. To build these models, a substantial amount of data is desirable. However, when expanding to new or unexplored territories, this required level of information is rarely always available. To build such models, actuaries often have to; procure data from local providers, use limited unsuitable industry and public research or rely from extrapolations from other better known markets. Another common pathology when applying machine learning techniques in actuarial domains is the prevalence of imbalanced classes where risk events of interest such as mortality, accidents and fraud are under represented in data. In this work, we show how an implicit model using the Generative Adversarial Network (GAN) can alleviate these problems through the generation of adequate quality data from very limited or highly imbalanced samples. Through the paper, we provide an introduction to GANs and how they can be used to synthesize data that accurately enhance the data resolution of very infrequent events and improve model robustness. Overall, we show a significant superiority of GANs for predictive models and stochastic simulations when compared to competing approaches on benchmark data sets. This work offers numerous contributions to actuaries with applications to inter alia new sample creation, data augmentation, boosting predictive models, anomaly detection and missing data imputation.

Keywords

Generative models — Generative Adversarial Network — SMOTE — Wasserstein GAN — Class Imbalance

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1. Introduction

Gaining an advantage in competitive markets through offerings of suitable tailored products on customers relies on building and maintaining adequate predictive models. To build these models, a substantial amount of data and a sizeable number of records is desirable. However, when expanding to new or unexplored markets, that level of information is rarely always available. To build such models, actuarial firms often have to procure data from local providers, use limited unsuitable industry and public research or rely from extrapolations from other better known markets.

In this work, we show how an implicit model using the Generative Adversarial Network (GAN) [1] can alleviate this problem through the generation of adequate quality data even from very limited small samples, from difficult domains or without alignment and thus handling class imbalance.

A GAN is an example of a generative model that is used to create new samples from a latent noise space. A generative model describes how a data set is generated in terms of a probabilistic model. This generative model p_{model} mimics the training data distribution p_{data} as close as possible. If this is achieved, then we can sample from p_{model} to generate realistic samples that appear to have been drawn from p_{data} . We are

satisfied if our model can also generate diverse samples that are suitable different from the training data. In some cases, the model can be estimated explicitly and sometimes it can generate samples implicitly. Other models are capable of doing both.

GANs are useful for learning the structure of the data and can generate new samples without explicitly postulating the model. GANs were invented in 2014 and have generated more interest since then. They are known to be better than other generative models due to the quality of samples they generate. GANs have been highly successful in computer vision, e-commerce, medicine, video generation, music generation, text generation, missing data imputation, time series and new sample creation in tabular data sets, with remarkable results, but their application to the actuarial discipline remains largely still unexplored [2].

In this paper, we explain what GANs are and how they can be used to synthesize data in order to accurately enhance very infrequent events, alleviate class imbalance and create better prediction models. This work also provides theoretical and practical applications of GANs. We demonstrate a popular GAN architecture to a typical problem resembling an actuarial use on benchmark data sets using Python.

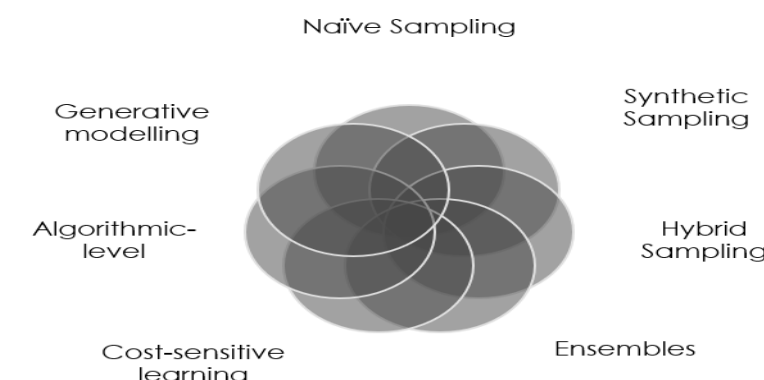
2. Class Imbalance

Whilst Machine Learning (ML) has gained significant prevalence in the past few decades, class imbalance, limited data sets and missing data remain pervasive problems [3]. These issues occur due to the nature of the data space, data collection costs, data limitations, new markets and absolute rarity. These issues create problems for building models as they lead to inadequate data, leading to inaccurate or misleading models, biased accuracy measures and subjective uncertainty margins which create further model risk.

In binary classification problems, class imbalance occurs when one of the classes has overwhelmingly more instances than others. ML classifiers tend to have skewed accuracy towards the majority class when the data is imbalanced [2]. This results in giving a false sense of performance, thereby under-estimating the most important class of interest (usually the minority class containing far fewer instances). This is problematic as misclassifying a minority class can result in significant misclassification costs than for the majority case [4]. Class imbalance also arises because ML classifiers do not necessarily take into account unequal class distributions. This problem causes a significant and an unexpected performance behaviour for most classifiers.

Techniques as shown in Figure 1 exist to alleviate class imbalance and these techniques include re-sampling, algorithmic-level solutions, cost-sensitive learning, ensembles and generative models. Re-sampling techniques modify the training data such that the distribution of the classes is evenly balanced where the majority or minority class is either under-sampled or over-sampled. Over-sampling has been the most frequently used technique than under-sampling since under-sampling eliminates important information in the majority class.

Figure 1. Taxonomy of solutions to tackle class imbalance



A pioneering and popular method to alleviate class imbalance has been the Synthetic Minority Over-sampling TEchnique (SMOTE) method [4]. However, SMOTE suffers from over-fitting, over-lapping classes, noisy examples, is less reliant on the true probability distribution, alters the original distribution of the minority classes and this may not be desirable [3].

There have been few empirical reviews which compare and synthesise SMOTE and its density-based variants. There

have been few approaches which create synthetic samples by sampling implicitly from the minority class distribution. Current density-based approaches may be subjective as they need to pre-specify the format and structure of the minority class distribution.

Generative models offer a significant alternative yet these models have not been thoroughly explored in imbalanced learning. In this work, we show how a popular implicit generative model can be used to handle class imbalance and rival SMOTE.

“... in the process of training generative models, we will endow the computer with the understanding of the world and what is made up of.”

— OpenAI

3. Generative Models

This research is concerned with handling class imbalance through generative modelling. Other approaches exist such as synthetic sampling, however, these approaches do not take into account the underlying structure of the data distribution and often lead to over-fitting and over-lapping cases.

Generative models are flexible models capable of learning the data distribution and sampling from this data distribution, thereby creating new synthetic cases. In this section, we review generative models and explain why GANs are of better quality than other deep generative models.

3.1 Definition

Given a data set with observations X , we assume that X has been generated from an unknown true probability distribution p_{data} . A generative model p_{model} mimics p_{data} as close as possible. If this is achieved, then we can sample from p_{model} to generate realistic samples that appear to have been drawn from p_{data} .

We are satisfied if our model can also generate diverse samples that are suitable different from X . In some cases, the model can be estimated explicitly and sometimes it can generate samples implicitly. Other models are capable of doing both. GANs provide no estimate of the model but are capable of generating new data without estimating p_{model} . Deep generative models are divided into implicit and explicit models.

3.2 Explicit models

Explicit models specify or approximate a parameterised log-likelihood representation of the data. Parameters are then estimated and learned from the data and this requires a maximum likelihood estimation which integrates over the entire data space and this may be intractable. These approximation techniques may not always yield the best results as some of them rely on Markov chains which are time-consuming [1].

Other methods such as Variational Autoencoder (VAE) [5] which learn by approximate inference can only approach a lower bound of the objective function instead of learning the

objective function directly. As a result, these models have a problem of computational tractability and often lead to blurry samples.

3.3 Implicit models

Implicit models train and learn to model the true distribution indirectly and define a stochastic procedure to directly generate new data from a latent space without an explicit hypothesis. Some of these models involve Markov chains which impose greater computational cost and often fail to scale to higher dimensional spaces.

A GAN is one of the few implicit probabilistic models capable of sampling in parallel and in a single step. GANs were designed to remedy most of the issues with explicit and some implicit models. GANs are known to parallelize sample generation, have fewer restrictions, subjectively thought to produce better samples, make no use of Markov chain or maximum likelihood estimation, assume no variational bounds and no distributional assumptions [6, 7]. As a result, GANs have generated a lot of interest since 2014, with wide applications in many areas.

3.4 Generative Adversarial Networks

GANs were originally invented in a landmark paper by Ian Goodfellow in 2014. The setup of the framework uses an adversarial process to estimate the parameters of two artificial neural network (ANN) models by iteratively and concomitantly training a discriminator (D) and a generator (G), as shown in Figure 2.

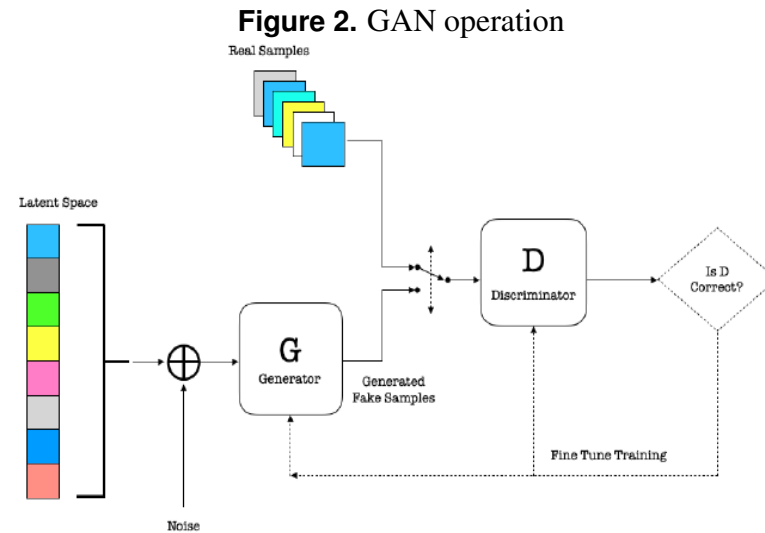
Through multiple cycles of generation and discrimination, both networks train each other, while simultaneously trying to outwit each other. GANs have two adversarial ANNs:

- G picks a random vector z from the prior latent space Z and then generates samples from this distribution using ANN;
- D receives generated samples from G and the true data examples, and must distinguish between the two for authenticity.

Both D and G are ANNs which play a zero-sum game, where G learns to produce realistic-looking samples and D learns to get better at discriminating between the generated samples and the true data. Once G is trained to optimality, it can create new samples and augment the training data set. GANs can sample in parallel better than other generative models, have fewer restrictions on the generator function, assume no use of Markov Chains, no variational bounds unlike VAE, produce subjectively better quality samples than other generative models and are flexible, both regarding their loss functions and their topology of models [1, 6, 8].

Whilst GANs are gaining popularity in many applications, they have notable issues. GANs are notoriously difficult to train properly, difficult to evaluate, the likelihood cannot be easily computed, suffer from the vanishing gradient problem, mode collapse, boundary distortion and over-fitting [6].

Mode collapse is when many latent noise values z are mapped to the same data point x , leading to a lack of diver-



sity in the samples that are created i.e. under-fitting. The vanishing gradient problem occurs when D becomes perfect in its training without giving G the chance to improve. As a result, GANs may fail to converge and thereby leading to poor generated samples.

[9] look at ways to improve GANs (called hacks) while other authors propose variants to the vanilla GAN by changing the loss function, adding gradient penalties (GPs), adding labels, avoiding over-fitting and finding better ways of optimizing GANs. There are many GAN papers and its representative variants.¹ The reader is pointed to comprehensive papers by [2], [10], [11] and [12]. In this work, we are interested in exploring GAN applications and showing their potential to actuaries, especially for alleviating class imbalance, data augmentation and improving the predictive ability of actuarial models.

“... GANs and their variants..the most interesting idea in the last 10 years in machine learning...”

— Facebook’s AI research director, Yann LeCun

4. Applications of GANs

There are a number of deep generative models for synthetic sample generation. Some of the models are explicit with an intractable likelihood and inference. Some models are only approximate and generate blurry samples. Other methods do not sample in parallel, are complex and rely on Markov chains which are time-consuming. GANs are attractive as they remedy most of these issues and have generated extremely good examples in many domains.

GANs are powerful generative models which generate realistic-looking samples with a random vector z . We do not know the format and the structure of the model nor do we make any mathematical assumptions. This allows GANs to be widely applied in many areas. Table 1 provides a summary of various areas where GANs have been applied. The most

¹<https://github.com/hindupuravinash/the-gan-zoo>

successful applications of GANs are in computer vision but there has been wider applications in other domains. We have provided some interesting applications for actuarial adoption in a bold text in Table 1.

To our knowledge, there has been limited applications of GANs in traditional actuarial areas such as life insurance or non-life insurance. This is compounded by the fact that GANs have been highly successful in computer vision, with less emphasis on tabular data sets although in the past few years this focus has been shifting.

GANs can equally be adopted for tabular data sets to boost limited data sets and improve actuarial models, especially in areas where models are needed to make business decisions. In particular, GANs could allow some less reliance on using stochastic simulations that are based on subjective distributions and err less on margins used. Effectively, GANs can be used to boost the predictive ability of actuarial models.

The availability of sufficient data in many domains is a necessity, especially where predictive models are needed to make business decisions. In this work, we are interested in adopting GANs for new sample creation and data augmentation in order to boost predictive models by supplementing training data sets with new samples that are learned from the real data distribution in an adversarial manner. Data augmentation is a procedure to create synthetic cases to augment the training data set and increase its size, especially for those data points that are lacking. This is where GAN shines - the ability to create new samples and thereby creating adequate data sets, which can lead to better models.

There are two main strategies to check if this augmentation really helped something: we can train our model on fake data and check how well it performs on real samples. We can also train our model on real data to do some classification task and only after check how well it performs on generated data. If it works well in both cases — we can feel free to add samples from the generative model to our real data and retrain it again — we should expect a gain of performance.

Recently, a number of papers have applied GANs to augment various data sets, with remarkable results on the performance of the predictive models applied after [13, 14, 15]. Similarly, GANs can be used to augment actuarial data sets and boost actuarial models, making them more accurate and less biased. In this work, we demonstrate how this can be done for a number of data sets, described in Section 7.

5. SMOTE

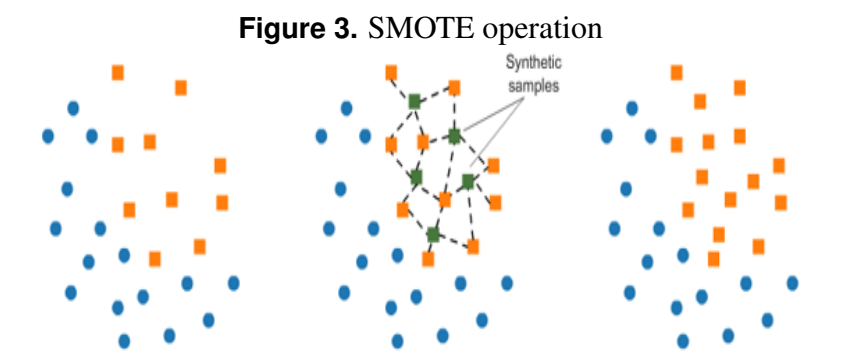
This section describes the theoretical operation of SMOTE, shown in Figure 3, for comparative purposes with the GAN applied in this work. SMOTE creates new synthetic cases by linearly interpolating between two nearest neighbour instances of the minority class. [4] show that SMOTE improved the effectiveness of ML classifiers compared to random over-sampling and under-sampling approaches. Over time, SMOTE has become the default method for synthetic sample generation

and has proven to be popular among researchers, becoming a pioneer in imbalanced learning [3].

Considering a random minority instance x , a new instance s is generated by considering its k -nearest neighbors (k -NNs). These k -NNs are found by using the Euclidean distance metric. Initially, an instance y is generated at random from the k -NNs. Then a new synthetic minority instance s is generated as follows:

$$s = x + \alpha(y - x) \quad (1)$$

where α is randomly generated from the Uniform distribution $[0, 1]$.



SMOTE parameters are the value of k -NNs and the number of minority cases to generate. The number of k -NNs can be varied such that an optimal metric is found, whilst restricting the number of generated instances to ensure a balanced class distribution. SMOTE is the benchmark method for addressing class imbalance in binary classification problems.

6. GAN Theory

This section describes in detail the theoretical operation of GANs, their challenges and tricks to improve their training.

6.1 Vanilla GAN

This section describes the original GAN formulation, called MiniMax GAN (MM-GAN). This is the baseline model over which all other variants are based.

6.1.1 The Discriminator

The discriminator (D) receives generated samples from a generator G and the true data examples from $p_{data}(x)$, and must distinguish between the two for authenticity through a deep ANN [1]. The resulting output $D_{\theta_d}(x)$ for an input x is the probability of x being sampled from $p_{data}(x)$ instead of p_g , where p_g is the implicit distribution defined by G . The vector θ_d represents learned parameters from D .

The discriminator’s goal is to yield $D(x)$ near 1 for $x \sim p_{data}$ and $D(G(z))$ closer to 0 for $p_z(z)$ using the sigmoid function in the output layer. This is achieved by maximising D ’s loss over θ_d :

$$\mathbb{E}_{x \sim p_{data}(x)} [\log D_{\theta_d}(x)] + \mathbb{E}_{z \sim p_z(z)} [\log(1 - D_{\theta_d}(G_{\theta_g}(z)))] \quad (2)$$

Table 1. Taxonomy of GANs applied in various topics

Application	Description and Method
Image translation	Convert an image from one domain to another using CycleGAN, DiscoGAN or Pix2Pix.
Super resolution	Increase the resolution and texture information of an image using SRGAN, ESRGAN etc.
Image synthesis	Generate realistic new images using DCGAN, BigGAN, ProGAN, SAGAN and Style GANs.
Object detection	Detect objects in a video or image using MTGAN/Perceptual GAN for semantic segmentation.
Joint image generation	Learn joint distribution of images and create images from different domains e.g. DualGANs.
Video generation	Predict the next frame in a video or create new videos using VGAN or MoCoGAN.
Text to images	Convert a text into an image using StackGAN, AttnGAN, TACGAN etc.
Music generation	Create new music or notes using MuseGAN or MidiNet.
Text generation	Predict or create new texts using RankGAN.
Speech enhancement	Speech synthesis and enhancement using SpecGAN or SEGAN.
Medicine	Medical segmentation; increase resolution of images and drug discovery using ChemGAN.
Entertainment	Create art from scratch using GauGAN, content creation, anime characters, games etc.
Data Augmentation	Create new samples, boost the training data set and get better predictive models.
Joint Distribution Learning	Learn joint distribution of different data domains using DiscoGAN/CoupledGAN.
Time Series Generation	Recurrent Conditional GANs useful for stochastic simulations and time series prediction.
Domain Adaptation	Learn transfers between different data domains using DANN or CyCADA.
Semi-supervised Learning	Train D into a classifier which achieves superior accuracy from few labelled examples.
Missing Data Imputation	Train a generator to impute missing cases. GAIN/MisGAN are better than multiple imputation.
Privacy Preservation	Using the generator, one can share salient features and make data publicly available.
Anomaly Detection	GANomaly, Doping and AnoGAN can learn anomalies in the data better than other techniques.
Other Domains	e-Commerce, Data manipulation, Attention prediction, Continual learning and Steganography.

6.1.2 The Generator

The generator (G) randomly picks a sample z from the prior latent space defined by $p(z)$ and then generates samples from this distribution using an ANN. This deep ANN must learn the parameters Θ_g given an input $z \sim p_z(z)$, that will give the output $G_{\theta_g}(z)$. G is trained to fool D i.e. to make D 's output for fake/generated sample $D(G(z))$ closer to 1. The parameters of G are learned by minimising G 's loss over Θ_g :

$$\mathbb{E}_{Z \sim p_z(z)} [\log(1 - D_{\theta_d}(G_{\theta_g}(z)))] \quad (3)$$

6.1.3 GAN Loss

Combining the losses for D and G , GANs solve the following minimax game in alternate steps through gradient descent (GD), minimised over Θ_g and maximised over Θ_d :

$$\mathbb{E}_{X \sim p_{data}(x)} [\log D_{\theta_d}(x)] + \mathbb{E}_{Z \sim p_z(z)} [\log(1 - D_{\theta_d}(G_{\theta_g}(z)))] \quad (4)$$

The above losses for D and G are the original formulation proposed by Goodfellow in 2014, called minimax GAN (MM-GAN). Since we are minimising over θ_g and maximising over θ_d , training of GANs alternate between gradient descent (GD) on G and gradient ascent on D [7]. GD is the method of solving the parameters of the ANN in both G and D . Typically, for every training of G , D is trained k times although an optimal choice is debatable among researchers. The original algorithm for training GANs is shown in Algorithm 1.

Remark 1. *Gradient based updates on the ANN can be accomplished using any of the common GD optimisers. Typically, Stochastic GD (SGD) with Momentum [16] for D , Root Mean Square propagation (RMSProp) [17] or Adaptive moment estimation (Adam) [18] for G tend to work well in practise [1].*

6.1.4 Non-Saturating GAN

While the above loss function is useful for theoretical results, unfortunately it does not work well in practise and there are challenges getting the GAN to convergence, stabilise its training and getting diverse samples. In practice, rather than training the above loss function for G , to provide better gradients in earlier training, [1] suggest to maximise the following objective function for G instead:

$$J_G^{LS-GAN} = \mathbb{E}_{Z \sim p_z(z)} \log(D_{\theta_d}(G_{\theta_g}(z))) \quad (5)$$

This version of GAN is called non-saturating GAN (NS-GAN) and is typically used as the benchmark in most studies and in practise. This leads to the following NS-GAN loss function:

$$\max_{\theta_g} \max_{\theta_d} \mathbb{E}_{X \sim p_{data}(x)} [\log D_{\theta_d}(x)] + \mathbb{E}_{Z \sim p_z(z)} \log(D_{\theta_d}(G_{\theta_g}(z))) \quad (6)$$

With this new loss function, we alternate between gradient ascent on D and gradient ascent on G . The algorithm

presented in Algorithm 1 is based on the original MM-GAN formulation, however, it can easily be tweaked to represent NS-GAN.

Algorithm 1 Mini-batch SG ascent of GANs with the original objective for MM-GAN. The number of steps to apply to D , k , is a hyper-parameter. For every training of G , we train D k times. [1] used $k = 1$.

```

1: for number of epochs do
2:   update the discriminator
3:   for  $k$  steps do
4:     • Sample mini-batch of  $m$  noise samples  $\{z^{(1)}, \dots, z^{(m)}\}$  from the noise prior  $p_g(z)$ .
     • Sample mini-batch of  $m$  true examples  $\{x^{(1)}, \dots, x^{(m)}\}$  from the training data distribution  $p_{data}(x)$ .
     • Update the discriminator  $D$  by ascending its stochastic gradient on these mini-batches:

$$\Delta_{\theta_d} \frac{1}{m} \sum_{i=1}^m [\log D(x^i) + \log(1 - D(G(z^i)))]$$

5:   end for
6:   update the generator
7:   • Sample mini-batch of  $m$  noise samples  $\{z^{(1)}, \dots, z^{(m)}\}$  from the noise prior  $p_g(z)$ .
     • Update the generator by descending its stochastic gradient computed on this mini-batch:

$$\Delta_{\theta_g} \frac{1}{m} \sum_{i=1}^m \log(1 - D(G(z^i)))$$

8: end for

```

6.1.5 Optimal Solution

Theoretically, it can be shown that for $p_g = p_{data}$, the GAN zero-sum game in Equation 6 has a global optima. Given enough capacity for both networks and D is trained to optimality for a fixed G , convergence of the GAN algorithm is guaranteed [1]. The optimal discriminator $D_G^*(x)$ for a fixed G is:

$$D_G^*(x) = \frac{p_{data}(x)}{p_{data}(x) + p_g(x)} \quad (7)$$

Assuming that D is perfectly trained and if we substitute $D_G^*(x)$ into Equation 6 for G 's loss, this gives rise to the Jensen-Shannon (JS) divergence [19]. The JS divergence can be written as a function of the Kullback-Leibler (KL) divergence [20].

The KL divergence between two probability distributions p_{data} and p_g is defined as $\int p_{data}(x) \log\left(\frac{p_{data}(x)}{p_g(x)}\right) dx$. We denote the KL divergence as $D_{KL}(p_{data}||p_g)$.

The JS divergence between two probability distributions p_{data} and p_g is defined as the sum of two KL divergences

stated as $D_{KL}\left(p_{data}||\frac{p_{data}+p_g}{2}\right) + D_{KL}\left(p_g||\frac{p_{data}+p_g}{2}\right)$. We denote the JS divergence as $D_{JS}(p_{data}||p_g)$.

If we substitute $D_G^*(x)$ into Equation 6, the minimum loss for G is reached if and only if $p_g = p_{data}$, thus one can show that:

$$J_G = -\log 4 + 2D_{JS}(p_{data}||p_g) \quad (8)$$

This equation tells us that when D has no capacity limitation and is optimal, the GAN loss function measures the similarity between p_{data} and p_g using JS divergence. However, although the above results provide a nice theoretical result, in practise, D is rarely ever fully optimal when optimising G [1].

Thus alternative GAN architectures have been proposed to fix this issue and to get closer to optimality. Below we describe what causes this failure to convergence and how to fix it.

6.2 Challenges with GANs

GANs are notoriously difficult to train properly, difficult to evaluate, the likelihood cannot be easily be computed, suffer from the vanishing gradient problem, mode collapse, boundary distortion and over-fitting. This section describes key challenges on GAN training.

6.2.1 Mode collapse

Mode collapse is when many latent noise values z are mapped to the same data point x , leading to a lack of diversity in the samples that are created i.e. under-fitting. This is regarded as the most significant problem with GANs. Many studies have spent lots of time in varied contexts to fix this.

6.2.2 Vanishing gradient

This occurs when D becomes perfect in its training without giving G the chance to improve. As a result, GANs may fail to converge and thereby leading to poor generated samples.

6.3 Improved GAN Training

There are many GAN architectures which avoid the problems that come with the vanilla GAN. We briefly describe some of the most common and popular GAN solutions. Given the vast number of taxonomies, we are not able to cover all of them but only discuss the most popular and those subsequently used in this work.

6.3.1 Conditional GANs

The first extension of GAN was the Conditional GAN (cGAN) which gave the generator the label Y in the latent space, making them class conditional [21]. Most of the GAN variants can be modified to include cGAN. cGAN allows to create diversified samples and forcing G to create specific samples and thereby fixing the mode collapse problem.

6.3.2 Deep Convolutional GAN

Given that Deep Convolutional GANs (DCGANs) [22] use Convolutional Neural Networks (CNNs) which are typically for images, we do not review this architecture in detail as our

7.1 Data Sets

We considered 5 publicly available imbalanced data sets from the Machine Learning Repository UCI. The data sets are shown in Table 2. ML models are usually trained and tested on unseen data. Two approaches to split the data are cross-validation (CV) and train-test split. This work adopts 75% training data and 25% testing data. CV is used to optimise parameters of a classifier.

7.2 SMOTE Implementation

Over-sampling is performed on the 75% training data using the R *imbalace* library. The R imbalace library contains functions for performing SMOTE and other variants.² The two parameters to tune are the number of neighbors and the over-sampling rate. We optimised the value of K-NN for SMOTE for each data set. We kept the over-sampling rate the same to ensure balanced class distributions within each data set. Using SMOTE, we create additional synthetic cases to augment the above training data sets.

7.3 GAN Implementation

Given its popularity and wide use, WGAN is adopted for an alternative synthetic sample generation. Specifically, we adopt the conditional version of WGAN with GP, thus we use WCGAN-GP. GANs can be implemented in a number of open-source neural-network libraries in Python. Due to its simplicity and faster computations, the high-level Keras library with Tensorflow back-end is chosen to implement WCGAN-GP.³ This is trained using all minority cases of each data set with 3 layers in each ANN for both *G* and *D*, trained using default Adam parameters in Keras; with 128 units in the first layer, 256 units in the second layer and 512 units in the third layer for *G* and vice versa for *D*, correspondingly.

Figure 4 presents the experiments of training WCGAN-GP. For comparative purposes, using similar parameters, we show the quality of samples generated for WCGAN-GP, WGAN, cGAN and non-saturating GAN on the credit card fraud data. We consider this for two combinations of the features for illustrative purposes up to 5000 epochs.

The results show the superiority of samples generated by WCGAN-GP. There is a clear mode collapse problem on the vanilla GAN and cGAN. WGAN and WCGAN-GP show better samples. There is also clear damped oscillations and unstable losses for GAN and cGAN where Wasserstein GANs exhibit stable training and losses, especially after 1000 iterations where it seems to settle and stabilise.

We repeated this experiment for each data set and adopted WCGAN-GP after 5,000 epochs as the model to use for synthetic sample generation. Once WCGAN-GP is trained for 5000 epochs, the learned generator distribution is used to

create more synthetic samples by feeding it the number of samples to output.

7.4 Logistic Regression

For simplicity, given its wide use and familiarity with actuar-ies, a Logistic Regression (LR) model is trained using Python on both the imbalanced training data and over-sampled data sets to predict the likelihood of each minority case.

7.5 Evaluation

The confusion matrix depicted in Table 3 depicts a report showing how predicted classes on unseen test data using the LR model compare to actual observed classes.

TN is the number of majority cases that were correctly classified as such. **FP** is the number of majority cases that were incorrectly classified as minority. **TP** is the number of minority cases that were correctly classified as minority. **FN** is the number of minority cases that were incorrectly classified as majority. Using these definitions, Table 4 presents the most well known evaluation metrics for binary problems.

Precision is the ability of the LR model not to label a minority case that is actually majority. Recall is the ability of the LR model to find all minority cases. F1-Score is a harmonic mean between Precision and Recall.

Accuracy can be misleading and inappropriate when there are imbalanced classes and thus may be biased towards majority cases [4]. Thus we do not use rely on it in this work. Accuracy, Precision, Recall and F1-Score should be close to 100% for a LR model to do well on the testing data. However, these scores are influenced by what threshold is used to decide between the two binary classes.

The Receiver Operating Characteristic (ROC) curve measures a classifier's performance on a test set over different decision thresholds by varying the Precision and the FP rate. The Area under the Curve (AUC) measures the performance of the LR model trained on both imbalanced and over-sampled data sets and tested on unseen data with values close to 100% considered excellent performance. We also compute the Precision-Recall curve and compute the Area Under the Precision-Recall Curve (AUPRC) to get a weighted score.

8. Results and Discussion

This section presents the results of all the LR models applied on the baseline and over-sampled data sets, with metrics on Precision, Recall, F1-Score, AUC and AUPRC computed on the same unseen test data.

8.1 Comparisons

Table 5 presents the evaluation metrics (based on the testing set) of the LR model applied on the baseline and over-sampled data sets for a default threshold of 50%. Bold shows an algorithm that performs the best for that data set i.e. a higher score for that metric.

Overall, WCGAN-GP shows a higher F1-Score. Thus using a default threshold, WCGAN-GP performs the best on

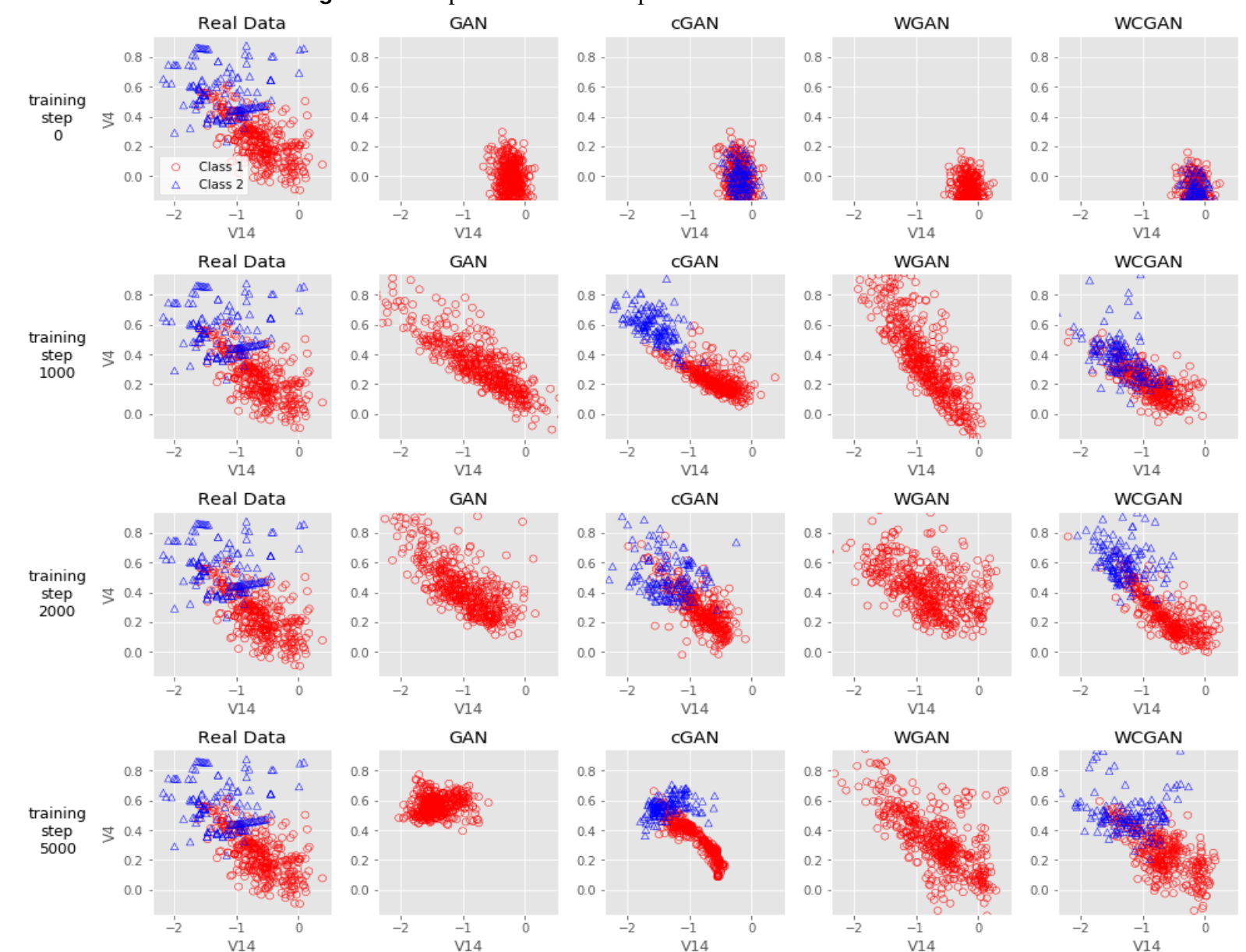
Table 2. Imbalanced data sets used in the experiments

Imbalanced Data Set	Majority Cases	Minority Cases	Number of Features	Numeric Features	Ordinal Features
Credit Card Fraud	284,807	492	31	31	0
Pima Indians Diabetes	500	268	8	8	0
Glass Identification	144	70	9	9	0
German Credit Scoring	700	300	20	14	6
Breast Cancer Wisconsin	357	212	28	28	0

Table 3. The confusion matrix

Confusion Matrix	Predicted: Minority	Predicted: Majority
Actual: Minority	True Positive (TP)	False Negative (FN)
Actual: Majority	False Positive (FP)	True Negative (TN)

Figure 4. Comparison of GAN experiments ran on fraud data cases



F1-Score, followed by SMOTE and the Baseline being last (on the average). While the univariate results on Precision, Recall and F1-Score are useful, they do not give the entire picture over different thresholds and thus may be misleading.

Since AUC and AUPRC are based on varied thresholds,

these metrics are typically preferred over one dimension measurements such as Precision, Recall and F1-Score. Since we are also comparing the above results with the Baseline model, these metrics are impacted by class imbalance. Thus we rely on the AUC and AUPRC. SMOTE improves the classification

²The *imblearn* package in Python can also do SMOTE and its notable variants. Other packages exist in R such as *ROSE*, *unbalanced*, *smotefamily*, *DMwR*, *ebmc* and *IRIC*.

³*Pytorch* and *Tensorflow* are also popular packages available in Python for implementing GANs.

Table 4. Evaluation metrics for binary problems

Metric	Formula
Accuracy	$\frac{TP+TN}{TP+TN+FP+FN}$
Precision	$\frac{TP}{TP+FP}$
Recall	$\frac{TP}{TP+FN}$
F1-Score	$2 * \left(\frac{Precision * Recall}{Precision + Recall} \right)$

effectiveness of the LR compared to the results without applying SMOTE (i.e. Baseline). However, overall and across the majority of the data sets, WCGAN-GP shows better improvements over SMOTE.

Overall, SMOTE improves the AUC/AUPRC compared to the Baseline when applied on the imbalanced data sets but significantly penalises Precision, leading to a lower AUPRC on 2 of the data sets used. However, SMOTE performs poorly than WCGAN-GP across all data sets on the AUPRC and on 3 of the data sets on the AUC. Below we discuss the above results.

8.2 Discussion

SMOTE samples synthetic points along line segments joining minority instances using the Euclidean distance. This approach may end up using majority instances and thus creating noisy examples and over-lapping cases. SMOTE is also not based on the true distribution of the minority class data and thus alters the minority class distribution. The poor performance of SMOTE compared to WCGAN-GP may be attributed to these effects.

Other SMOTE variants such as density-based approaches are meant to improve the above SMOTE weaknesses. However, they make strict assumptions about the structure and distribution of the minority class data such as multivariate Gaussian distribution. GANs are implicit generative models which make no distributional assumptions about the data. Instead, GANs learn the true data distribution in an adversarial manner through a game approach. In this work, WCGAN-GP shows better improvements over the Baseline and SMOTE, showing the potential for GANs for new sample creation, data augmentation and boosting ML models.

However, GANs are well-known for their training and computing powers. Thus they have expensive run-times. However, current GANs such as WGAN and WGAN-GP remedy this impact with stable training. The quality of samples generated by GANs are known to be better than other generative models compared to their training times. In this study, the GANs reached stable training even for small samples such as credit card fraud cases. This means that GANs may still be used even for smaller data sets with enough training capacity.

Using WCGAN-GP to over-sample minority cases provided the best performance on the AUPRC and on 3 of the data used on AUC. GANs do not make explicit assumptions about the probability distribution of the minority class data. This idea has been used to create new samples for images, music, arts, videos and other tabular data sets in a number of

applications [7]. There is a significant potential to create new samples using GANs and augment limited actuarial data sets. Recent work on this report GAN superior performances over SMOTE and other variants.

Given the current surge in interest for GANs, optimising and training GANs is becoming straightforward as there are many implementations in Keras, Pytorch and Tensorflow. Thus running times for GANs might not necessarily be an issue, enabling GANs to provide a superior over-sampling approach to supplement imbalanced data sets. Because GANs have become so popular, their limitations have been improved tremendously.

However, there are still open challenges for GANs. GANs rely on the generated examples being completely differentiable with respect to the generative parameters. As a result, GANs cannot product discrete data directly. Another key challenge is the evaluation of GANs after training even though there are measures to compute the quality of results generated.

Research for GANs grows each year. Practitioners may need to add GANs to their toolkit as this will significantly improve their models and aid on decision-making as GANs will be characterised by advancements in deep learning, training process maturity, open acceptance and their wide use in commercial applications.

Given the superiority of GANs over other generative models and their wide applications, the scope for actuarial use is extensive. The most obvious use is data augmentation and boosting predictive models used for assumption setting, propensity modelling, pricing, reserving and many more areas as demonstrated in the experiments conducted. In particular, GANs may be useful to rival stochastic simulations which can be subjective. Using synthetic data sets created through GANs could allow actuaries to share salient features of their data without sharing the full data set, enabling actuarial data sets to be more widely available for public use and research purposes.

Given the surge in marketing and social promotions, infographics are the main ingredient of social media marketing. Artificial intelligence and GANs can help marketers and designers in the creative process. Other applications include anomaly detection, joint distribution learning, discriminative modelling, semi-supervised learning, domain adaptation, attention prediction, data manipulation, missing data imputation, time series generation, privacy preservation and many computer vision areas.

All these GAN applications have immediate actuarial adoption in insurance, banking, health and care and other non-traditional areas, as GANs have been shown to provide better alternatives to current approaches. Research for GANs grows each year and actuaries may need to add GANs to their toolkit as this will significantly improve their models and aid on decision-making.

Table 5. Evaluation metrics based on a default threshold of 50%

Method	Precision	Recall	F1-Score	AUPRC	AUC
Credit Card Fraud					
Baseline	85.71%	63.41%	72.90%	74.60%	81.70%
SMOTE	5.11%	93.33%	9.69%	72.28%	98.36%
WCGAN-GP	86.24%	76.42%	81.03%	81.35%	88.20%
Pima Indians Diabetes					
Baseline	74.47%	56.45%	64.22%	72.49%	73.61%
SMOTE	62.86%	70.97%	66.67%	71.6%	75.48%
WCGAN-GP	75.51%	59.68%	66.67%	74.10%	75.22%
German Credit Scoring					
Baseline	60.31%	51.34%	55.47%	63.02%	68.57%
SMOTE	54.22%	60.80%	57.32%	63.31%	69.61%
WCGAN-GP	46.51%	81.08%	59.11%	66.60%	70.94%
Glass Identification					
Baseline	50.00%	42.86%	46.15%	53.83%	63.93%
SMOTE	42.86%	85.71%	57.14%	66.14%	72.86%
WCGAN-GP	55.00%	78.57%	64.71%	69.56%	78.03%
Breast Cancer Wisconsin					
Baseline	94.34%	94.34%	94.34%	95.39%	95.50%
SMOTE	94.44%	96.23%	95.33%	96.03%	96.45%
WCGAN-GP	96.23%	96.23%	96.23%	96.93%	97.00%

9. Conclusion and Future Work

Gaining an advantage in competitive markets through offerings of suitable tailored products on customers relies on building and maintaining adequate predictive models. To build these models, a substantial amount of data and a sizeable number of records is desirable. However, when expanding to new or unexplored markets, that level of information is rarely always available.

As a result, actuarial firms have to procure data from a local provider, through purchasing reinsurance from a re-insurer, use limited unsuitable industry and public research or rely from extrapolations from other better known markets. In this work, we show how an implicit model using GANs can alleviate this problem through the generation of adequate quality data even from very limited small samples, from difficult domains or without alignment.

This work is a classic data augmentation application of GANs where we showed their superiority of SMOTE. Using WCGAN-GP, it is possible to create synthetic cases implicitly and this turned out to offer a significantly better improvement over SMOTE. This work comprehensively reviewed GAN theory and applications in a number of domains, with possible adoption for actuarial use. We believe that these applications have scope for actuarial science and actuaries can add them to their toolkit to aid predictive models.

Our future work includes a consideration on actuarial data

sets to apply the same methods, especially complex data sets that include small disjuncts, over-lapping, mixed data types and multiple classes. A promising area of semi-supervised learning and domain adaptation will pave a significant scope for many commercial applications.

In our opinion, the future of GANs will be characterised by their open acceptance, their applications by the research community and being used in commercial applications. Given their impressive results and advancement in deep learning techniques, we expect a wider extensive use of GANs. The training instability of GANs will soon be done without any problems as the maturity of the training process improves with new techniques being invented at a rapid speed. There are many potential future applications of GANs, with significant potential for actuarial use and improving existing models and being applied in other areas by actuaries.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Eileen Heenan-Kennedy THINKS BACK

Pat Potgieter (née Wood) was the first South African woman to qualify as an actuary (1955). Stephné Behrend qualified in 1976. The third South African woman actuary, Eileen Heenan (née Kennedy) qualified in 1984.

Eileen lives in the UK, but took time out of her schedule to share a few memories with us.

Why I became an actuary

I thought I would share a little of how I decided to become an actuary. When I was at school, the only subject I really liked was maths and the initial ideas I had was to study computer science or accountancy. I went for a career aptitude test and then discussed the results with one of the career advisers. He said both my suggestions would be a good match for me along with engineering ... but girls did not generally become engineers! He then suggested becoming an actuary. I had never heard of the profession, but he said it was good for people who liked numbers. When I got home, my father, who was an accountant in the general insurance field, did know what an actuary was.

I arranged a meeting with the Chief Actuary of the Prudential at the time and he said, "Why not become an actuary and if you don't like it, you can easily switch to computer science? It would not be so easy to switch the other way round."

The final piece of the puzzle was that I wanted to study at UCT, which at the time had the

only actuarial university course in South Africa as one of the Business Science special fields. At the time, the only other universities offering actuarial courses for the Institute of Actuaries (England) or Faculty of Actuaries (Scotland) professional exams was UCT, Macquarie University in Sydney and Heriot-Watt in Edinburgh. Finally, it was much easier to get a place on the Business Science course than it is now – a First Class matric and an A for maths were suggested for the actuarial field. With all the boxes ticked, I studied Business Science from 1975 to 1978.

Fortunately, my parents were able to pay my fees for UCT as I was not able to get a bursary at all during my studies there, on the simple basis I was female and bursary holders were expected to then work for the insurance company that gave them the bursary for the number of years of the bursary and even longer. However, when I graduated, I had job offers from all the companies I had applied to for bursaries.

I decided I would like a job close to home, living in Newlands in the Cape. Shortly before graduating from UCT, I called Southern Life

and went in for an interview within a day or two of my phone call. I had a relaxed chat with one of the HR managers and was asked what department I would like to work in. After discussion together we decided Life Actuarial would suit me the best.

My first job was working on individual policy alterations and quotes. The HR manager that interviewed me asked why I would like to work at Southern Life and my response was, "because it was close to home". It turned out that is why he had joined Southern Life, too, and lived just down the same road as I did! And so began a very happy and successful eight years at Southern Life where I completed all the exams to qualify as a Fellow of the Institute of Actuaries, completing the exams in 1982 and qualifying in 1984 (you had to wait two years after your last exam to become a Fellow of the Institute of Actuaries).

Early computer work

I joined Southern Life in 1979 and it was at the time when mainframe computers were being introduced. For the calculation work we did, we used simple calculators and tables of actuarial factors. The work I was involved with was individual policy alterations, company valuation work, annuity calculations and new premiums for life assurance products.

For policy alterations we had a file of the formulae to change policies from one type to another, e.g. whole life to endowment, and to quote on individual annuities. So, the work was all done with pencil and paper and a calculator until we started writing our own simple programs.

This was the start of writing simple Basic programs. The computer languages used were Fortran and Basic. Basic even had a limit on the number of lines for its programs. In order to write these short routines, we would have to walk around the building to the Computer Department where they had a number of

screens and keyboards to type them in and run them off. We then printed results and brought them back to the department to check. The day we received our own screen and keyboard in the department was a day to celebrate – very different now from all of us using our own laptops and being able to connect from anywhere in the world into a company network.

For product development we used an IBM language called APL (a programming language).

(from Wikipedia: APL (named after the book A Programming Language) is a programming language developed in the 1960s by Kenneth E. Iverson. Its central datatype is the multidimensional array. It uses a large range of special graphic symbols to represent most functions and operators, leading to very concise code.)

And for anyone interested I found the website <https://tryapl.org> – have a go at this! **CLICK HERE**

In simple terms this had a range of symbols that each had a function such as multiply, divide, maximum, to the power of, etc. It worked in a number of dimensions, e.g. if three dimensions, you could have one for age, one for duration and one for interest rate. You could then manipulate this grid to get a set of premium rates, valuation factors, annuity rates very simply.

The way we used APL was to dial in to the IBM office in Cape Town using an electric golf ball typewriter. The golf ball type meant that you could use a normal typeface to interact initially and then change it to one with the APL symbols while working on your project. You typed in your request and it typed back the answers – so you can imagine the amount of paper generated! And if you made a mistake ... you had to type the line again!



In those days, all requests for quotes came in via telex from the branches or by post using typed memos. If anything was urgent, it came by phone call. When an answer was ready, we had to send it back in a typed memo or most likely by phone. Faxes started to be used during my time at Southern Life and email was still a dream somewhere in the future!

When you were writing reports you usually wrote them out by hand and then sent it to the typing pool (yes, a group of usually ladies who typed memos, reports and letters) and then waited for it to come back before sending it out. You learnt very soon that you should get the message correct first time round as you were not popular if you kept asking for corrections, i.e. to have it typed again. The first big change that came here was a memory type-writer that could remember one line you typed so you had time to change it before it printed line by line on paper.

No-one typed anything for themselves then – and we relied on and valued the secretaries and ladies of the typing pool. The secretaries usually had better language skills than we did so were able to improve what you had written for a report and also checked to make sure what you wrote made sense. I am not sure we could visualise then that most workers would do their own typing and sending of messages as we now do today.

However, the one electronic tool that has stood the test of time is the HP 12C financial calculator, which was launched in 1981. I am pretty sure I was given one at work not long after. This became the standard for actuaries to use and to this day, I still use one regularly. There are not many electronic products that are still as useful nearly 40 years later and still on the market. I wonder how many actuaries still use one regularly! ☺

Roy Recalls ...

I worked with Eileen when she first joined Southern Life from university. Those pre-email, pre-PC days were classic and we were involved in the transition from manual systems to the first computerised policy-values system at Southern. This work was previously very labour intensive – the calculations were written manually on a worksheet which was then checked by two people. We had to look up the policy-holder's latest bonuses in bulky computer printouts, which were kept in a long row on a special sloping-topped cupboard. Before we got calculators, we did the calculations using big Marchant mechanical calculating machines – there was a forest of electric wires hanging down from overhead plugs to each desk – like a garment-making factory.

Eileen was very bright – after university she completed her actuarial exams in four years (I took six years, with a couple of exam failures along the way). She was hard-working, resourceful, positive, a can-do person, cheerful and with a ready laugh and a good sense of humour. Southern was sad to see her leave. Interesting that Eileen, who was only the third lady actuary in South Africa, experienced prejudice against women when seeking a university bursary, although the companies were keen to employ her when she had completed her degree!

- Roy Lennox, FASSA.

THE MEMBER ENGAGEMENT MOVEMENT

- Michelle Abrahams

In 2019, the Actuarial Society embarked on a strategic initiative mandated by Council to investigate how best to acknowledge that Student/Technical/new AMASSA and FASSA members contribute to the sustainability of the profession. This mandate took ASSA through a journey of introspection into the way we engage with members on a daily basis, through to addressing ways in which at the highest level, a specific mandated role could be created where the member voice could be heard.

The journey started with feedback from our member body, combined with data and the enlightening discovery that more than 70% of the ASSA membership fell within the millennial threshold. The conclusion was clear – we were not engaging with our biggest client base and through the ASSA Council, a task force was constructed. With input from the body that was taking on this mammoth task of engagement with our “young members”, the Student Liaison Committee (SLC) along with voices from ASABA and the ASSA Council, the road to engagement was paved. It is thanks to the SLC and their work over the years, fielding student queries and championing causes for student members when they were called to that, we were able to find the gaps that needed filling. Gaps in engagement that were however not limited to student members, they include Fellow and Associate members, as well as Technical members who are still journeying through to qualification.

It is through the work of the task force that the Member Engagement Board was established along with the introduction of a new executive role within ASSA, the Member Engagement Executive as well as several proposed changes to the Council structure and voting process.

The SLC has been invaluable over the years and we are grateful for the work and legacy they

have created in holding ASSA accountable to the needs of student members, notwithstanding their ability to pull off the most successful quiz nights in ASSA history. We look forward to seeing the legacy of the SLC value continue through the Member Engagement Board.

Key focus areas for the Member Engagement Executive role

The role and vision of the Member Engagement executive, as I see it, is about encouraging our members to interact and share in the experiences we as ASSA create for them.

I see the role as a platform to develop a value proposition across the member's journey (non-member, CAA, Student, TASSA, AMASSA, FASSA) that recognises progress; ensure alignment across all touchpoints within ASSA and to give credence to the member's needs at these various milestones.

In order to create that value, I will provide input to the ASSA communication strategy to connect with members and keep them informed through appropriate channels; create engaging campaigns across the member's journey; establish feedback loops for quick response and resolution where relevant.

I will lead the Member Engagement team in the delivery of member and student support services, shifting the mindset from administration to engagement support. A large part of the role requires resolving the escalation of queries and concerns in a way that the member feels heard. This does require in-depth understanding of the curriculum and how it impacts on the designatory framework and member's journey.

We acknowledge that we are in a competitive environment where actuaries are spoilt for career choices. ASSA is not complacent in this space, we want to continue to acquire new members by reaching out to the highest calibre of potential future actuaries either at school, university or in other professions.

Through the ASSA office and in the provision of a platform, we hope to support the student and TASSA members as they strive to meet the requirements of the profession. This includes establishing and implementing effective communication strategies for engaging effectively with members.

Looking to our newly qualified members, we would like to make provision for experiences to enhance development and network within the ASSA structures by encouraging a sense of volunteerism and active participation amongst members through knowledge sharing.

Engaging with our members requires an understanding of their environments and how we can influence and provide beneficial input into these environments. We want to enhance the services and support of the individual members and we can see the value in strengthening ASSA's relationships with employers of actuaries and actuarial students as a mutually beneficial experience.

The oversight for the role comes from the Member Engagement Board, which is led by Chairperson, Anne Livingstone. The Board has done extensive work in the kick-off to the Member Engagement venture by determining key objectives for the ME Board that align with the vision and strategy of the ASSA Council and the role of the ME Executive.

If you feel that there is value that you can add to the Member Engagement Board, please look out for the call for volunteers and join us as we venture into this movement to a member centric ASSA. 

Council Related SANDY GOVENDER Public Actuary

- Niel Fourie



I have been working in the financial services industry for 18 years across Short term, Life Insurance, and Pensions environments in technical and executive roles. I am now an independent business consultant, working with financial services and general start-up companies to assist with technical and strategic support. My new world is exciting because my environment is always changing. Every time I have a new client, I feel like I have a new employer and get exposed to new cultures which I find interesting and exciting. Sandy Govender from 15 years ago will not recognise the new me. From a person who loved routine I now thrive on the unknown and the ever-changing client environment but also nature of work. The one day it's a technical piece of work and the next it's something more high level and strategic. I also thrive on finding solutions to problems of differing nature and that energises me.

From the 1st of April 2020 I have joined ASSA on a consulting basis for 1 day a week. A large part of my role at ASSA is to assist in executing the new research strategy. In addition, I will be involved in the following committees as an ASSA representative:

- Systems and Technology Committee
- Wider fields (incorporating Data Science)
- Market Conduct Committee
- Alternative Investments Committee

During the last 6 months, the ASSA Council has reviewed its strategy for Research in South Africa. Jannie Venter, who is the new Chair of the Research Committee, will be leading the execution of this new framework.

As a professional body, the primary objective of ASSA is to enhance the substance and stature of the profession with the aid of research. As a result, we would like to focus on the following areas:

Core research

This refers to areas that are close to the heart of our profession, e.g. CSI studies, HIV/AIDS modelling and the study of the demography of South Africa. We must own this space and drive the research effort.

This requires a well set-up environment that can drive the ongoing research effort with the necessary skill and specialisation. This will require efforts from all Practice Area Committees (PACs) and industry players who share a vested interest in the relevant areas.

In addition, many practice areas share common interest in the same research (for example, the LAC, Damages Committee and Pensions Committee may all be interested in updated lifetables). We need to find ways to enable collaboration between the different parties.

Public policy and debates

One of our objectives is to contribute to topical issues in the broader society from an actuarial perspective. These are changing constantly, e.g. NHI and Covid-19. We must be

able to commission research that will be useful for those involved in these discussions on behalf of the profession.

This type of research will often take us outside our traditional areas of expertise so requires the skills and expertise to translate our expertise into new areas and find pragmatic applications that would be seen as valuable in a broader discussion. Scanning the horizon for new developments is important but so too, is the ability to act on short notice when required. By being organised and active in our research activities will go a long way in enabling us to respond to these broader requirements.

Research as a profession

We need to foster research as a core activity of our profession. We need to build the appreciation and skills for research through the path to qualification and to encourage research as part of the post qualification activities.

Some of these are matters that will also sit with the Education Board and Professional Matters Board to consider the appropriate route.

We need to review the grants, awards and recognition for research to elevate this activity and display the importance of research and hence encourage people to put in the necessary effort to produce meaningful research.

This may also be the space where we encourage more explorative research, the type that may take us into new fields or thinking.

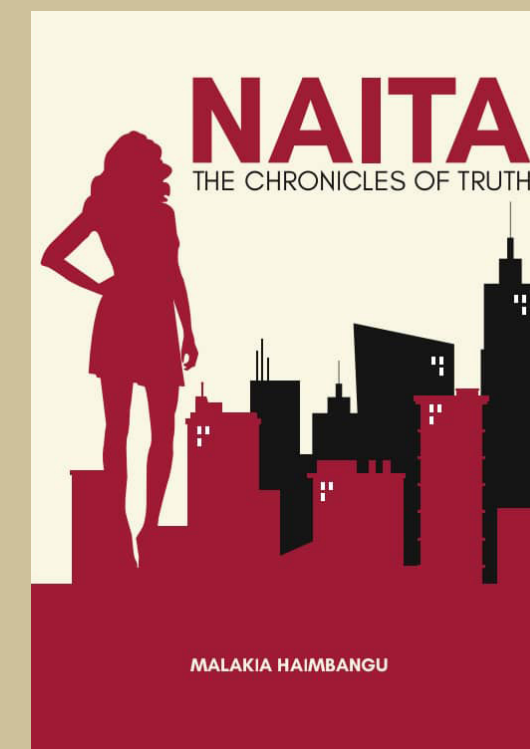
Resource centre for research

The idea is to have a central place that collates the research work done, a library function, that people can access. There is no place where one can currently go to and find out what kind of research has been done on a particular topic.

Collaborating with other organisations, eg. IFoA that, will also provide access to a more global view on research. 

BOOK REVIEW:

Malakia Haimbangu:



This novel tells a story of Naita, a young Oshiwambo-speaking girl who grew up in Northern Namibia. After completing her matric she moved to Windhoek to begin the journey of pursuing her studies.

Naita, like any other young Oshiwambo girl, was battling with the balance between focusing on her studies and the expectation of building a romantic relationship to take a potential husband back home in time for her graduation. This is how she met Lukas. The events describe her growing pains, how she had to lose herself in order to find and teach us that success is intentional.



A short background:

I am a 31-year Oshiwambo lady. I grew up in the North of Namibia and attended school in Tsumeb, a German and Afrikaans culture town central North of Namibia. I was considered a brilliant student at school. Back then our parents only gave us 3 career options when you are a brilliant student: Law, Medicine or Engineering.

I always wanted to become a Scientist. My passion for mathematics guided me to learn already when I was in Grade 10, that I wanted to become an actuary. However, that was such a big word to explain to my parents. I could not even pronounce it correctly and, even worse, I could not seem to explain exactly what actuaries do, despite having done in-depth research on it, the word was simply intimidating. Furthermore, it was not offered in Namibia and my father was funding my studies out of his pocket.

I got admitted into both Medicine and Civil Engineering at the University of Namibia. I chose Medicine because the university had a programme that transfers students to South African universities after completing 2nd year of the 6 years, to complete the rest of the course. This was my best shot at getting into South Africa, where universities offer programmes in Actuarial Science.

Fast forward, I made it into Stellenbosch University. Got awarded a bursary by Metropolitan, now MMI, to study Actuarial Science. Dreams do come true, that was my beginner's luck.

I have had to hit rock bottom to align myself with my career path both mentally and financially:

- To realise that what matters most is to believe in myself, even when those around me do not understand.
- To learn that success is intentional, failure is not fatal and that what matters most is that you get up and keep going.

Today, I am confident, without a doubt in my heart, that I will qualify as a Fellow, and I am perfectly at peace with the fact that I will make it happen in my own time frame. 



STUDENT FOCUS

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Ciara is the chairperson of the Actuarial Science House Committee 2020.

The UCT Actuarial Science House Committee had been a longstanding notion until 2019, when Landi du Toit decided to execute the idea. The student-run committee was created to facilitate more cohesion between actuarial science students from different year groups. I saw this as a great opportunity to inject some social interaction into the veins of the students, who were known to spend most of their time in the library. I applied and was elected to be part of the committee for 2019.

The 2019 committee consisted of seven actuarial students who were keen to create opportunities through which we could establish better relationships within the student body, in areas outside the lecture room. Whilst we intended on hosting a number of events, many were not possible due to the greater significance of gender-based violence protests that took place on and around campus at the time.

This left the 2020 house committee with some shoes to fill, but after the first meeting, it was clear that all newly elected members were willing to rise to the challenge. Apart from establishing the capability of the 2020 committee, the introductory meeting allowed us to establish our objectives for the year and the events that we intended to execute.

The future of the committee seemed prosperous until the first Covid-19 case was reported in South Africa, followed by the shutdown of campus. As a committee, we certainly

01

PIONEERING A CORONA-PROOF COMMITTEE

could have taken the easy way out and postponed all our intended efforts given that we no longer had direct, physical access to students – which many of the events required. Instead, we saw this as an even better opportunity to help students given the inevitable struggles that would come with online learning. Covid-19 has often been described as a “lonely” disease – it isolates people from one another. Thus, we saw it fit to set up platforms and create other means through which our students could connect and communicate with each other online despite the lack of physical interaction.

We began by setting up a Padlet page. This page provided a platform where students and lecturers could share the methods they were using to cope with social distancing, their thoughts about the current circumstances, and any motivational messages that could help everyone feel a little less alone. This was followed by an advice document, which included course-specific advice from senior students. Given that students no longer had immediate access to students in years above them, whether it be in the library or their residence study room, we hoped this document would serve as a replacement to such interactions.

Our most recent initiative involved setting up a mentorship programme. Thanks to the great engagement from students, either eager to become mentors or interested in being mentored, developing the programme proved a lot easier than we anticipated. We are excited to see the progress from each mentor group and the impact the programme will have on the experience of students during the time of online learning.

The committee has a couple more tricks up our sleeves which we intend on releasing in the upcoming months. All in all, we hope that our efforts will continue to strengthen and grow the UCT Actuarial Science House Committee. 

02

Interview: THE NEW FIRST YEAR EXPERIENCE



Naashitah Safedien & Siyolise Masindwa

Naashitah and Siyolise are two diligent and hardworking first year Actuarial Science students who are navigating their first-year at UCT during Covid-19 using online learning. Siyolise is from a small town called Mthatha in the Eastern Cape. She was one of the NSC top achievers in her province. Naashitah grew up in Port Elizabeth, where she excelled in public speaking, academics and also graduated at Al-Azhar Institute for her Islamic studies.

Actuarial Science House Committee (HC): How were your first few months at UCT pre-lockdown?

Siyolise Masindwa (SM): My experience was eye-opening. I learnt so much about myself in that short period. When pursuing Actuarial Science, I anticipated that there would be a lot of pressure, but I couldn't have predicted how intense it would be. After eight hours of lectures I would take a nap and once I wake up – study the night away. The support system I had formed made everything a bit easier.

Naashitah Safedien (NS): One way to describe it is “heeectic”. It was a huge adjustment from high school, I went from always knowing what was happening and never being behind schedule to having the biggest reality check within two weeks. What helped me the most was having friends to work and discuss problems with, especially those computer science assignments!

HC: How have you been adjusting to life and academics during lockdown?

SM: At first, I tried to recreate the same regime I had developed at university. Wake up early, follow the lecture timetable and study in the evenings. This proved a lot harder than I thought it would. Eventually, I adjusted by studying in the evenings, after my siblings had gone to sleep. This worked at first, but lately with tests and assignments I've had to adjust yet again.

HC: Did lockdown play a role in your decision to extend your degree?

NS: Yes, but not a huge one. During my first term on the mainstream programme, I was living from assignment deadline to tutorial test to actual test and then all over again. I was living off five hours of sleep, no social life and yet, when I received my marks back, I still was not getting those upper second passes. After hearing about the lockdown, I spoke to the Actuarial Science councillor, my Intros tutor and lecturers and ultimately decided that the extended programme would be best for me. It has allowed me to focus on my work more and spend more time practising what I am learning which has led to an improvement in my marks and a few extra hours of sleep.

HC: What positives or opportunities have arisen from the pandemic?

NS: I think being at home with family has really helped in terms of support to combat academic stress. Also, the pandemic has taken away the “rush” of academics, it has allowed me to work at my own pace and I've gained a greater understanding in my lecture material as a result.

HC: What advice would you give prospective Actuarial Science students?

SM: People may discourage you from studying actuarial science. Stay positive, believe in yourself and in your abilities. 



Sango Socikwa

Sango is a driven final year BBusSc Actuarial Science student at the University of Cape Town. He has a strong penchant for leadership, public speaking, teamwork and entrepreneurship. Sango is currently the president of the largest student society at UCT (InvestSoc) and an Allan Gray Orbis Foundation candidate fellow.

UCT Actuarial Science House Committee (HC): Tell us about your InvestSoc journey.

Sango Socikwa (SS): Being interested in many things, in my first year, I wanted to find out more about the opportunities across different industries and to build my professional networks. This led to me identifying InvestSoc as the perfect society to do just that. In my 2nd year I applied for a role in the "Investor Series" sub-committee. This gave me a better look at the behind-the-scenes operations which intrigued me even more. After that experience, I was sure I wanted to remain deeply involved in the society. I, subsequently, was appointed as corporate relations director in my 3rd year which saw me managing external relationships with our collaborators. I learnt a lot in this executive role, not just about the management of the society but about leadership, shared-value collaborations and the power of access to information. Approaching my 4th year, I was appointed as president of the society.

03

Interview: THE ONE TO WATCH

Beyond the amazing opportunities that I have accessed through the society, the biggest reward has been in knowing that I played a role in other students' professional journeys – be it through a network formed, insights gained or professional opportunities accessed.

HC: How have you been maintaining InvestSoc given the inability to have physical interaction?

SS: COVID-19 has caused a lot of businesses and organisations to adapt, particularly, to find avenues of digitisation. Beyond just adapting, we have taken it as an opportunity to enhance the society's digital offering. We have managed to fully digitise our operations from meetings over Zoom, to webinars being hosted across different platforms. We focus on offering consistent high-value opportunities and content relevant to students during this time such as budgeting, saving and investing workshops. The team has really been phenomenal regarding adapting to the new normal.

HC: What qualities do you believe a successful actuarial student should possess?

SS: Resilience. To get through the degree and ultimately qualify, we are forced to face challenges head-on and find ways to overcome them. Without resilience, the actuarial journey is sure to be overwhelming. Moreover, we need to remain curious, not just about actuarial matters, but the world around us. I think a holistic outlook/perspective gives greater insight into the macro-context across which actuarial insight is widely applicable.

04

Interview: THE ROAD FROM 3 TO 6

HC: How were you able to balance your extra-curricular activities while consistently remaining on the Deans Merit List?

SS: I thoroughly enjoy my extra-curricular activities because they are not only a productive break from my studies, but they also allow me to nurture skills outside of the academic sphere. The enjoyment encourages me to make time for them. I stay organised by regularly updating my calendar and planning at least three weeks ahead.

However, it should be said that it's not always a perfect balance. During crunch times it can become extremely difficult to find a balance. These periods require more planning and prioritisation of specific tasks to ensure that what's most crucial always gets done first – ultimately, just facing one challenge at a time.

HC: What is your take on gender-based violence in South Africa?

SS: Many people believe that GBV in SA is now getting worse, but I think the sad reality is that it has always been pervasive in our country. It is simply getting more coverage now. There needs to be change but the change we want to see can't simply be left to the perpetrators of GBV, but rather needs to be championed by every member of our society, particularly men. There needs to be an explicit effort by South Africans to create an environment where GBV can no longer take place by getting to the grassroots cause of it and stamping it out, which is the subjugation of women. ⚠️



Dalia

Dalia is currently a fourth-year Bachelor of Business Science student majoring in Actuarial Science at the University of Cape Town.

After missing out on the university exemption for subject A211 (Financial Mathematics) in her second year in 2018, she secured all available third-year exemptions the following year, won the class medal for subject A212 (Models) and passed subject A211, which she had previously stumbled over, through ASSA.

UCT Actuarial Science House Committee (HC):
How did you manage to not allow the initial setback of A211 to hold you back?

Dalia Solomon (DS): I think it was important for me to accept that I cannot always perform at 100%. Some days I will be tired, demotivated and stress will get the better of me, but that is completely natural. I needed to acknowledge that this one failure did not mean that I was any less capable. Instead, I reached a point where I reflected on what I was doing and identified where I needed to improve. I have found that falling short of my own expectations is the best motivator for improving.

HC: How did you manage to “soldier on” and achieve the class medal for Models?

DS: At the start of my third year, I spent time identifying the poor habits I had formed with regards to my studies. I found that during high pressure periods I would approach my day with a mindset that the most important thing was to study for as many hours as possible. However, the number of hours I slept, the food I ate, and the exercise I did were all activities that I would neglect. I changed this during my third year. Before every test or exam, I slept for at least 9 hours, I stopped the late-night trips to the Creamery and I prioritised exercise during all weeks of high stress. I believe that looking after my mental state was the key that allowed me to go on to win the class medal.

HC: How were you able to balance your full third-year workload and find time to write subject A211 through ASSA?

DS: My main focus was always my third-year courses. I knew that I could not allow writing this exam to interfere with my other subjects. I realised that taking on this additional exam would only be worth it if I still managed to meet my other academic requirements. My initial plan was to use my mid-term break, about 4 weeks before the exam, to do most of my studying for this additional exam. However, I fell ill during that time and was unable to follow my original plan.

Before every test or exam, I slept for at least 9 hours, I stopped the late-night trips to the Creamery and I prioritised exercise during all weeks of high stress. I believe that looking after my mental state was the key that allowed me to go on to win the class medal.

I ended up setting aside one hour every morning and one hour every night for the two weeks before the exam to study for it.

HC: What approach are you taking to online learning?

DS: I did not manage to go home to be with my family during this time, which has been difficult. It has definitely been a challenge to maintain a healthy lifestyle and positive mindset during this time. However, I have found that online learning has given me a lot more flexibility to try out different methods and see what works best for me. I prefer to concentrate on one subject a day rather than changing every few hours, as one does on campus. I set my mornings aside to do tutorials or past exam questions and then leave any reading and lectures for my afternoons. This works well for me because my concentration tends to fade over the day.

Online learning has also meant that I have more free hours in the day, as I no longer need to commute to campus and generally leave the house less often. I have tried to ensure that I use this additional time wisely. I set aside time every day to do a few non-academic activities to keep me sane. This includes yoga, running and cooking. I also try to spend a few minutes every day reading the news and learning French on Duolingo. 

05 Interview: TWO SIDES OF THE ACADEMIC COIN



Murray Klein

Murray is an Actuarial Science Honours graduate from UCT. He is also the teaching assistant and head tutor for the UCT Actuarial Science department and is simultaneously completing his Master of Commerce in Actuarial Science.

UCT Actuarial Science House Committee (HC):
What makes you passionate about tutoring?

Murray Klein (MK): I started tutoring Models in my final year. Models for me was one of those subjects that was incredibly difficult, but it rewarded you for diving deeper into it. It's an amazing feeling to be able to help students with questions I found extremely challenging when I first attempted them in my 3rd year. I went into my tutorial rooms with the aim of inspiring some sort of passion for the content.

In head tutoring, we tried to inspire a change in the calibre of tutors. Focusing on individuals that are highly technical, but also highly diverse in their experiences. I wanted to create an environment where students could feel heard and free to open up to their tutors, whilst also allowing for a deeper engagement of the concepts and encouraging a focus on understanding rather than merely remembering the work.

HC: How do you manage to balance being head tutor while simultaneously working towards your MCom in Actuarial Science?

MK: I informally list my priorities when writing down my to-do lists. Thereafter, I balance it between what is most pressing and what is most important to me, student affairs would be number one. Knowing when to work hard and when to take a break is very important.

HC: What has your contribution been in moving from normal tutorials to online tutorials and assessments during online learning?

MK: My fellow head tutor and I were tasked with creating a new way for online tutorials to take place. We planned, prepared and practised using different platforms, coming up with course specific pros and cons as we did so. I aimed to make sure that even if you just have a cell phone, you are able to participate and benefit from all the resources available.

I also created a marking schedule that tutors could use when marking students' tests. These schedules aim to give sufficient feedback to the student regardless of the format of their submissions.

I'm very proud of the progress that has been made and I am hopeful for all the positive change that is to come.

HC: What advice can you give to students during this time?

MK: Self-discipline. You need a strategy for all your work. Sit down and be realistic. Plan when you are going to work and when you are going to rest. You may need to let go of how you used to do things. Don't judge your progress by what you used to do. It's more important to understand what was working in your learning process, keep those habits and think of a realistic way to learn now.

Balance. Get enough good sleep, take time to be still with no distractions, eat as well as you can and exercise. The point of the strategy is to be consistent, not intense. It's better to work 4 hours a day consistently than 8 hours for 2 days in a row because, over time, the 4 hours become 5 and you start to get into your routine.

Implement your strategy. Every small decision you make influences your motivation. It shapes how you approach the next decision, and it rolls into each other with a compounding effect. Start your day by waking up at the time you set for yourself, follow your daily plan and know when to push yourself and when to ease up. You won't always get it right, but keep learning and growing through it.

HC: What are your thoughts on the value of honesty and integrity in the long run and in being a professional?

MK: In a world where there are many promises that often go unfulfilled, trust is a commodity that is earned. Once gone, you may never get it back and even a small action can cause all your hard work to come crashing down in an instant. If you want

any team to work, sale to take place or change to be implemented effectively, you need to transact in trust.

The point of the strategy is to be consistent, not intense. It's better to work 4 hours a day consistently than 8 hours for 2 days in a row because, over time, the 4 hours become 5 and you start to get into your routine.

When it comes to insurance, an art many people don't understand, trust is paramount. The policyholder puts their trust in your promise that you have fairly priced the product and will take care of their needs when they no longer can.

But how can one trust you without honesty and integrity?

I believe one has to learn how to be honest and how to have integrity without being arrogant or prideful. Throughout life we are trained in these virtues and grow a deeper understanding of its importance. Then we get to a point in life when we are expected to practise these virtues without someone watching over us.

At the end of the day, the decisions you make shape you into who you are. If you want people's trust, especially in an industry so heavily reliant on trust and the responsibility you bear for people's livelihoods, you need to make the decision today to earn it. Earn it and treasure it when people aren't looking so that when they are, you won't ever lose it. 🇿🇦

06 THE JOURNEY



Cara Bez Geduld

Let's start at early 2015 when #RhodesMustFall sparked to life on UCT campus. Admittedly, I started out not understanding the significance of protestors' pleas. I couldn't understand why students would take of their precious academic time to fight for a statue to be removed. Fortunately, along my journey I became far more open-minded and cognisant of the struggles and the systemic problems that were being challenged.

This is the point when my roller coaster reached the top of the hill and was about to take off into a violent and turbulent personal journey. What started off as strong progress in my academic career drastically overturned to somewhat of a wreck

A plot straight from Hollywood's finest. My past six years at the University of Cape Town has been filled with books, friends, Rhodes Must Fall, Fees Must Fall, Shackville TRC, gender-based violence, the Am I Next Movement - following the passing of Uyinene Mrwetyana, COVID-19, Lockdown and Black Lives Matter. My journey has been a rollercoaster of note and though it has been traumatic at times, I'd like to see it as a tale of hope rather than pain.

when I was sexually assaulted in the once tranquil space I called home. The trauma was intense and the pain was deep but I refused to become a victim of my circumstances. I tried to run from my trauma and threw myself completely into the Fees Must Fall movement that had begun to unfold. The utter turmoil of that period was extremely taxing on my mental health and it was no surprise that I was then diagnosed with a severe case of acute stress disorder.

Life felt like a rollercoaster filled with twists, turns, ups and downs. For months I had a distorted sense of reality. I lived in a dreamland and the challenge with this is that you then become subject to the

good dreams and the terrorising nightmares. My life was filled with vivid hallucinations such as seeing blood fall from the sky and watching the ocean flood the beach camp I had stayed at. I saw people around me as genetically modified versions of my loved ones and found myself giggling in anticipation of a fantasy proposal from my Prince Charming that I thought was around every corner. On Christmas Day, I was able to show some progress. For the first time in two months I was able to dress myself, somewhat. Two dresses on, a shirt over the dresses, another shirt wrapped around my legs, a scarf and my father's hat on is not what people would picture as progress, but it was my progress. Trying to get back to reality was one of the hardest battles I have ever had to fight.

I lost touch with reality but somehow still managed to put tremendous pressure on myself to write my deferred exams in order to not fall a year behind. With a foggy state of mind, I travelled to and from Cape Town in my attempts to take on exams when, clearly, I was in no condition to do so. My attempts were ultimately futile as I ended up in a spiral of relapses and panic attacks. I was going to have to work to get back to anything close to normal and so my rollercoaster ride looped into the road to rehabilitation and ultimate recovery. The task was twofold. I needed to evaluate how I could restructure my academic career and continue my studies while also figuring out how to heal my mind and form healthy habits to support that.

2017 and the road to recovery felt like an endless, sometimes empty, boulevard and every single step was met with fresh challenges for about eight months. That is how much time it took to go from barely managing mundane daily tasks to taking on a full course load. In hindsight, I should have given myself more time, but I wanted to push myself. That year I failed two courses and had to swallow the bitter pill of a one-year extension to my degree. I always look at this failure not as an indication of my inability but rather as a testament to my



progress. My first sign of progress was being able to dress myself, and that changed me to fighting my trauma and passing several courses. I did not allow my failure to break me down but rather used it as fuel to motivate me to work even harder towards my degree and, more importantly, protect my well-being.

Life has and always will be a rollercoaster ride. I'm still going through the twists and turns and ups and downs, but I have also learnt how to find joy in the thrill of it all. I have had a few more signs of progress along the way. I now have four exemptions to my name. I am two courses away from completing my degree and am pursuing two more exemptions through ASSA. I have undertaken roles as a first-year Actuarial Science tutor at UCT, an Actuarial Analyst Intern at Old Mutual, a voluntary online high school Mathematics tutor for Tutonic NPO, UCT Teaching Awards and Grants student representative and the editor of the first Actuarial Science House Committee yearbook. Looking back, I think the road to recovery is endless, but every stride forward is a bit longer than the one before

and every footstep leaves a bigger footprint than the last.

An important lesson I learnt is that sometimes the road feels empty, but you are never alone. The support of my friends and family carried me when I couldn't carry myself. I reflect a lot on my time spent at Old Mutual and the magnitude of the value of that experience. Much of what kept me motivated to continue this journey of obtaining my degree in Actuarial Science was a result of the positive experiences I had during my vacation work opportunities. There was so much power in being surrounded by individuals who not only focused on my growth as an actuarial student, but as a person in self-discovery. My experiences were living testament to how a diverse and unified team brings out the best in each of its members for the good of not only oneself but for the greater good of everyone.

This journey we call life is going to happen whether we like it or not. A beautiful poem, The Dash by Linda Ellis, comes to mind.

I read of a man who stood to speak at the funeral of a friend. He referred to the dates on the tombstone from the beginning ... to the end.

He noted that first came the date of birth and spoke of the following date with tears, but he said what mattered most of all was the dash between those years.

For that dash represents all the time they spent alive on earth and now only those who loved them know what that little line is worth.

For it matters not, how much we own, the cars ... the house ... the cash. What matters is how we live and love and how we spend our dash.

Life, or our dash, is filled with twists and turns and ups and downs. It will be a rollercoaster of turmoil, triumphs and tragedy but it is yours to embrace and to own. May we each find the joy in the thrill of our journey. May we recognise the fact that we all have our own challenges to face up to and may we all be brave enough to open a dialogue about the experiences, challenges and contributions of those with unheard voices in our society. There is no reason for a plot straight from Hollywood with all its twists and turns, not to have a happy ending. You are the author after all. 

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