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The Experience of Stats NZ in being part of the New Zealand agency managing the COVID-19 Pandemic

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Abstract:
As a National Statistics Office, Statistics New Zealand typically engages in the acquisition, analysis, estimation, and dissemination of critical data and statistics both for decision makers across government and society, and to facilitate an informed public. The advice we provide around those data and statistics is typically limited to that about measurement frameworks, concepts, methodology, quality and accuracy, and the governance of the data. However, beginning during the early stages of the pandemic response in New Zealand, Stats NZ took the opportunity to participate in the central Government agency that was set up to manage the immediate response to the crisis. As the response transitioned from tactical crisis management to strategic risk and recovery management, we have continued to actively participate within the all of government cross-agency group doing this work.

In this paper we discuss the work we did within that context, from the initial stages of the pandemic to now. We approach this in two broad themes. First, the challenge of being useful in a very dynamic operational environment – an environment Stats NZ typically does not find itself in. Second, we discuss modelling that was embraced as a tool to help navigate extreme uncertainty, and the interactions with models in helping both policy advisors and decision makers come to grips with the outcomes thereof.

We describe the rapidly evolving information needs, from data to advise, and the challenges posed by the complex interplay of decisions being made with less information than ideal. We discuss, qualitatively and in brief, specific pieces of work that Stats NZ undertook in assisting with data needs across government. We then reflect on the technical issues, with a particular focus on understanding where modelling is useful in a response, as well the wider data eco-system in a COVID-19 world.

Keywords:
COVID-19; Global pandemic; Government Response; Modelling; National Statistics Offices

1. Introduction:

This paper describes the experience of Stats NZ through the early stages of the COVID management effort. Conscious that many NSOs have reported on their work in increasing the frequency and variety of measures during the period this paper will have more emphasis on the opportunity that Stats NZ took up to be part of the central Government agency managing the crisis.

There are two broad themes to this paper. The first is the challenges of working in the cross-agency context of this period, especially the difficulties of understanding how to make a useful contribution in a very dynamic environment. The second is more technical – modelling was being looked to as a tool to help navigate extreme uncertainty and coming to grips with this required the navigation of unexpected nuances.

2. Background:

As the COVID-19 pandemic began to take hold globally through February 2020, New Zealand, through its highly crossed international border, was also exposed to the virus, recording its first case on the 28th of February, a returning resident [1]. Through the month of March as the situation deteriorated globally, New Zealand saw more imported cases, which eventually led to community outbreaks within New Zealand. In response, the New Zealand Government began imposing restrictions, both across the border, and domestically, culminating in a stringent nation-wide lockdown and closed borders to everyone apart from returning residents and some specific exemptions [2]. New Zealand had decided to adopt an "elimination" strategy to stamp out COVID-19 domestically [3].

During the initial phases of the pandemic arriving in New Zealand, a National Crisis Management Centre, composing of public servants seconded from a variety of Government agencies, was spun up to respond to the emerging crisis. Stats NZ took the opportunity to join this cross-government agency, leading the Data Modelling workstream. In addition, expertise within Stats NZ, and its subsidiary Data Ventures, allowed Stats NZ to coordinate and drive the acquisition and dissemination of relevant data and indicators.

In the early phase of the response, we attempted to help those undertaking operational planning be as informed as possible about the scale of response that might be needed under different scenarios. Though the level of our direct involvement has subsided after the initial frantic stages of the response, we have maintained an active presence in the operational sphere, particularly in the pandemic modelling space.

3. Information needs arising from the New Zealand COVID-19 context, and Stats NZ's response:

COVID-19 and the resulting responses by the Government, the public, and economic sectors across New Zealand brought into stark focus the need for a wide range of information, and how broadly available it must be for effective responses across all sectors of society.

These information and data needs can be broadly categorized as:

- Needs for the acute "emergency response" and operational purposes.
- Needs for the "foreseeable future" and medium-term operational purposes.

While data driven information was always the desired goal, modelling was required to produce the sort of information that decision makers needed.

Information for acute decision making

Through the emergency period, and even now, there was a need to understand what was happening "today". Immediate questions that required answers were about the efficacy of the system of public health controls that were established, how they appeared to be functioning as a risk management system, the likely pathway of local outbreaks, and the compliance of the public.

However, information on the disease characteristics, and its potential effects were largely incomplete. This was further complicated by the long incubation period of SARS-CoV-2 [4], meaning any present observations are likely an indication of the disease situation at least a few days ago. This detail is particularly important when community transmission is occurring. The incubation period meant that to get an understanding of the status "today" a level of forecasting, was required. While this was understood by epidemiologists and public health experts, decision-makers did not grasp the importance of this detail immediately. The decisions had to be made without ever being able to access the full picture of the current situation on the ground. It was an inherent limit imposed by the properties of the virus itself. In contrast, information about the public complying with the controls that were put in place was obtainable, even if initially the information eco-systems were not geared for

understanding of large-scale public behaviour. This was a more straightforward situation of using data to undertake a monitoring function.

We discuss the manner in which we approached answering these questions in section 4 of this paper.

Stats NZ's contributions in the acute phase of the pandemic response

In our work within the National Crisis Management Centre, Stats NZ provided technical and critical insight into the immediate response, modelling of the pandemic and advice to decision makers based on models and scenarios. A critical part of this was ensuring the effective communication of the associated uncertainties, particularly that there were fundamental limits to what was knowable at a given point in time.

To be able to provide the required insight into the models, we also stood up a group of statistical modelling experts within Stats NZ. They were tasked with understanding the mathematical mechanics of the models and assessing what the models were doing at their core. This collective effort enabled us to digest the important mechanics of the modelling in the necessary time frames.

Initially, the researchers undertaking the modelling work were also trying to obtain the data they needed for the work. Apart from the opportunity cost, the need to make structured undertakings to data suppliers meant that data brokering was a substantial and critical task. The Data Ventures unit within Stats NZ took over this function with great success, allowing the modelling specialists to focus on using the data, rather than obtaining it.

In addition, Data Ventures, collaborating with the Population unit at Stats NZ provided indicators of mobility across detailed geographies with hourly frequency, and a lag of only a few hours that proved very important in understanding the extent to which restrictions were being complied with, and where potential risks may be.

We also found that there were opportunities to use existing data to provide useful insight. An example of this was where concern had been expressed in social media, and subsequently general media, that the crisis was being used by some New Zealand citizens who had not lived in New Zealand for some time to be subsidised to return and establish themselves. Some ad-hoc analysis of travel data that was part of routine information releases was able to identify that this was not happening.

Medium term (foreseeable future) decision making

While the public health response, and the broader requirements around that were executed on very short time scales, the rest of the agencies in the government system also had to adapt to changes at an unprecedented pace. This was partly driven by responses required to reduce the negative impacts of the public health measures, and partly by the added uncertainty introduced by the pandemic to their medium-term operational planning.

Government agencies had to rapidly implement interventions designed to assist the public as the economy slowed. In addition, many of the same agencies had to provide intelligence and advice to Decisions-makers about the state of the social and economic domains.

Understanding the effectiveness of the interventions, and the need to provide advice necessitated understanding the macro conditions throughout New Zealand almost in real time. This required up-to-date indications of measures (such as GDP) typically carrying comparatively large lags and produced with a view of informing more long-range strategic policy formulation, rather than tactical interventions intended to provide stability in a rapidly evolving global emergency.

In addition, the plans around provision of services are driven through forecasting work in Government Agencies. It was quickly evident that the uncertainty bounds around these forecasts were going to be considerably greater than usual. Ensuring that this added uncertainty was dealt with coherently needed explicit attention and identification of the interactions that would amplify or clarify these uncertainties.

There was still work needed on disease spread scenarios in order to identify how future pandemic scenarios would be managed and how these events would accumulate into assumptions about medium term impacts to inform the forecasting work.

As this process progressed it became feasible to consider what the next major steps would be in managing the pandemic. Understanding the scenarios around the timing and distribution of vaccines and how this would create new concerns and need for information became a significant requirement.

Stats NZ contribution beyond the emergency phase of the pandemic response

There was considerable interest across agencies to have a standard set of scenarios to use in policy response planning. This was driven by a desire to avoid different agencies planning related activities around a divergent range of assumptions. Stats NZ participated in the development of these scenarios in “narrative” form and then looked to use the modelling tools that had been designated as standard to look at how these narratives might be quantified.

Once it became clear that the direct health consequences of the pandemic in NZ were going to be relatively small, forecasters were more interested in the impacts of the restrictions than in the disease spread. This needed a shift in the focus of some of the modelling

To help establish the required clarity around the Government forecasting work Stats NZ held a series of discussions to understand the challenges being faced by the forecasting community and generated a few insights that helped focus some of the subsequent work.

There were a range of assumptions about societal behaviour change (working at home being an example) that would have impacts across many agencies but there was no existing way of managing the process of ensuring that consistent assumptions were identified and used in their work. It was helpful to build a simple map of which agencies were using which models. It became very easy to develop epidemiological models (e.g. SEIR models) and there was a benefit to building coherence across government in pointing these agencies to standard models and standard assumptions

We also started discussions around how the modelling work could be governed, to ensure that the modellers were asking useful questions for operational and policy agencies, getting structure around communicating the limitations to decisions makers, and ensuring broad quality measures were being identified. Of particular concern was ensuring that the differential impacts of inclusivity, and vulnerability issues were adequately addressed. This led us to establishing a cross agency modelling governance group, discussing how to manage common assumptions across the Government modelling community, building a picture of what type of pandemic modelling was being used by, and useful to different agencies.

As the public health risk reduced away from crisis levels, the crisis management apparatus was absorbed into various existing agencies, and Stats NZ’s formal secondment to the crisis management ended. However, we continued to provide the support and advice described previously. This is mostly done through all of government technical advisory and steering groups. The current focus of this work is the governance of and advice around the modelling being used to examine scenarios about transitioning into a vaccinated world, and reconnecting beyond our borders. The rate of learning needed to manage this part of the pandemic remains high, even if some of the more immediate tension around the pandemic response has reduced.

Data Ventures also remains a critical avenue of data brokering and supply across government agencies, particularly as New Zealand opens up, and the mobility of the populace increases with careful border relaxations.

Stats NZ also developed and sourced relevant indicators currently present them in a COVID portal. While discussion of that would be a paper on its own, it provides useful information to both officials across government, and the wider public.

4. Technical reflections:

While this paper is not an in-depth discussion of modelling, we reflect on the technical issues we encountered as we assessed what knowledge was needed to be useful in this environment.

Reflections on understanding the nuances of models

Understanding the nuances of the models and how these nuances influence what can be determined from specific models proved critical.

The greatest value seems to be in getting an estimate of what range of "input parameters" could be associated with different levels of public health outcomes. Testing the variation in input assumptions that would produce adverse outcomes of different orders of magnitude helped understand issues like how quickly a situation could deteriorate and the magnitude of disease surveillance failures that would have to occur for significant problems to develop. This was true across the different models needed to understand the various aspects of public health situation.

The stochastic nature of infections makes the "stochastic branching process" models [5] very useful for understanding the possible range of trajectories for variables like infection levels, ICU loading, hospitalizations, and fatalities, both in the presence and absence of spread mitigation controls. While these can give an indication of public health resourcing that needs to be planned for, they were not necessarily the best way to estimate the immediate likely number of cases over the next few days. Similarly, simple usable models (such as SEIR models) were underpinned by assumptions about equal likelihood contact within cohorts. [6]

Developing a sense of when more complex methods (that explicitly introduced complex contact likelihoods) may be necessary proved challenging. Both of these types of models were also unable to answer questions around how specific non-clinical interventions (NCIs) such as school closures would affect the spread of disease, as the reduction in transmissibility due to interventions was an input into these models. This made them useful for scenario analysis, but they had no predictive power about NCI effects.

We also had to continually confront the issue that it is only sensible to model as far ahead as you have "usefully accurate" knowledge of interventions that are likely to be used and their effectiveness. Early in the pandemic the models were afflicted by the problem that people were very interested in estimates such as total fatalities under different scenarios. Most of the fatalities were often modelled to occur after the model had assumed that there would be no further interventions (regardless of whether there was an obvious need). We had to learn to only show results as far into the future as the intervention that was being considered. Part of this was communicating the limitations of the input assumptions and making it clear that we could not provide scenario analysis for the end of the pandemic.

Reflections on the process of assumption making

Analysis of reasonable worst-case scenarios was very challenging. They required making assumptions that people found hard to believe could be real. People from agencies tended to view the situation through the lens of their effort to provide effective protection rather than what could happen if the systems they were establishing failed in specific ways. Consequently, they tended to find this exercise unrealistic.

One of the most challenging aspects was understanding how different the circumstances of different communities can be. Behaviour of specific communities, or the impact of restrictions on, and compliance within communities can be very different. For example, not all communities present for COVID testing in the same way. For those in precarious employment situations adhering to mandated isolation until a negative result is returned may be difficult.

This type of risk appears hard to incorporate into a set of "expectations". It is necessary to investigate places that you don't have good line-of-sight to and assess the validity of "extreme" assumptions there.

As the pandemic came under control in New Zealand, people found it unlikely that a significant issue would arise. However, an outbreak in Melbourne, Australia (beginning in June 2020) was on the order of magnitude of our "reasonable worst-case" scenarios. This scenario assumed a significant disease surveillance failure, and the models also built in the delay in intervention due to lags driven by the incubation of the virus. Both these factors played a part in the observed outbreak in Victoria [7]. Some of the practical difficulties of dealing with extreme events appear to be captured by these assumption-driven scenario analyses.

5. Ecosystem reflections

The disruption caused by COVID was multi-dimensional, so the response and the measurements across the response had to be coherent across agencies and topic areas. Our participation challenged our capabilities and our perceptions about the role of officials from an NSO, but all the people we were working with had similar problems and we had to learn to fill gaps that we may have previously perceived to be beyond our remit.

Disruption to business-as-usual assumptions and the need for visibility of work across Government

The statistical measurement system is built around an extensive set of assumptions about timing of events, precision and frequency of information, usual rates of change, and cause and effect relationships, some explicit, and some not so obvious. During COVID these were disrupted in partial and unpredictable ways. Similar disruption was experienced by operational agencies. Many agencies are usually able to do their work relatively independently because they have assumptions that have proved robust over time. They use these to guide their work under standard circumstances.

However, the cross dimensional impacts of COVID meant that more agencies than usual had to be involved in discussions about common approaches. The disruption to standard working assumptions required them to reconsider their information needs, and what other agencies and policy settings they needed to be consistent with. This resulted in some of these agencies needing to access collaboration networks that they did not typically participate in. These networks had organically become as small as possible to work efficiently. For agencies that were not usual participants, visibility of the work being undertaken was difficult to obtain. This highlights the value of keeping work visible across government.

Decision making and understanding the limits of information during large scale disruptions

No one had a process ready for a pandemic, so the challenges of establishing mechanisms to strategize and plan for this unprecedented event required everyone to be able to adapt what they were doing frequently.

The crisis brought a range of policy and operational people into a situation, where simultaneously, quantitative information was both playing a significant role in decision making, while the absence of data and implicit properties of the disease were creating an

inherently uncertain situation. They wanted more certainty and started with a belief that modelling would fill this need. Understanding the limits of what modelling can achieve posed interesting challenges.

People had some experience of using quantitative information as evidence. However, they found it demanding to grasp the subtleties of having questions around mitigation strategies and their effectiveness, quantify relevant assumptions and then understand the extent to which the resulting modelling outputs (which were fairly direct consequences of the assumptions) can be used as evidence. So, our challenge was to continuously adapt the advice we were working on and see what would get traction.

6. Concluding remarks

We always think that we need to find a way to preserve what is best about how we dealt with a crisis and make it part of our ongoing work processes. At a more "meta" level some of the main lessons we learnt were;

- The importance of being able to be very adaptive about what actually generates value and being prepared to at least consider filling in gaps as they emerge.
- The challenges of bringing coherence across agencies – particularly the criticality of keeping work visible so everyone can make informed choices
- Being aware of who is still invisible, despite all the good work that is done. This is about who is not involved in processes (but who should be) and about whose experiences are not reflected in the data.
- Risk is inherently complex and using modelling information in this context is particularly difficult as the structures that are using the information are forming in real-time.

References:

1. New Zealand Ministry of Health (NZ MoH) announcement. (Feb 2020) *https://www.health.govt.nz/news-media/media-releases/single-case-covid-19-confirmed-new-zealand*
2. NZ Prime Minister's announcement. (Mar 2020) *https://www.beehive.govt.nz/release/stronger-border-measures-protect-nzers-covid-19*
3. NZ MoH strategy outline. (Apr 2020) *https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-response-planning/covid-19-elimination-strategy-aotearoa-new-zealand*
4. WHO Scientific brief. (Jul 2020) *https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions*
5. Hendy S., Steyn N., James A., Plank MJ., Hannah K., Binny RN. and Lustig A. (2021) Mathematical modelling to inform New Zealand's COVID-19 response. Journal of the Royal Society of New Zealand 51(S1): S86-S106. *http://dx.doi.org/10.1080/03036758.2021.1876111*.
6. Stehlé, J., Voirin, N., Barrat, A. *et al.* Simulation of an SEIR infectious disease model on the dynamic contact network of conference attendees. *BMC Med* **9,** 87 (2011). *https://doi.org/10.1186/1741-7015-9-87*
7. Parliament of Victoria, Inquiry into the Victorian Government's response to the COVID-19 pandemic (Feb 2021). *https://www.parliament.vic.gov.au/images/stories/committees/paec/COVID-19_Inquiry/Report/PAEC_59-08_Vic_Gov_response_to_COVID-19_pandemic.pdf*