Statistics in school and the future of work

Education Committee of the NZ Statistical Association. March 2017.

Purpose of this paper: anticipating change

We have a school statistical education system in New Zealand that we can be proud of: well designed for the needs of today's workplace, and evolving to meet those needs better. If we want it to meet the needs of tomorrow's workplace as well, do we need to adjust this system? This paper raises some questions about how statistical educators can act to anticipate change, and guide the further evolution of school statistics.

Research on the future of work shows that the workforce in 10, 15, and 20 years' time will have a very different range and quantity of jobs to aim for. Some of this workforce is sitting in our statistics classes now. What statistical education will best meet their lifelong needs?

The Education Committee welcomes feedback on this paper, and discussion of the implications for statistical education in New Zealand. Please contact Mike Camden m.camden@clear.net.nz regarding feedback or issues regarding curriculum planning and change.

Changes to the distribution of work and to the availability of work

The workforce faces two major changes:

- the job market has jobs that will stay, change, go, or be newly created
- the job market may have substantially fewer jobs.

To anticipate the first change, we need to ask what jobs will and won't be around in say 10 years. Then we can ask what statistical skills the people in the jobs will need. We also need to ask what statistical skills matter to people when they shift jobs and change careers.

Jobs that can be automated by computer-controlled machines are at risk. This is not just about manufacturing. For example, it may include most driving jobs. Also, jobs are at risk that involve information processing which can be automated by software. These may include some accounting, health, and legal work.

The second major change above implies another:

- a decrease in the availability of paid work puts stress on society's decision-making methods.

As the employment scene changes, the income distribution of the population may change, and the wealth distribution may change. This means that the distribution of political decision-making power may change. It puts new pressures on how society makes good decisions.

We're educating for life as well as for work, and 'life' includes participating in political decision-making.

The citizens who are our students now will need:

- strong statistical skills for assessing data and data-based policies
- strong probability skills for managing risk.

The first two changes above imply another:

- people in the job market will need to deal resiliently with change.

Resilience includes abilities to manage periods without paid employment, and periods of further learning and reskilling. Resilience is about managing through times of disruptive change, as individuals, households, communities, and states. It includes, among other things, abilities at using data to make sound decisions.

So when we ask what today's students need to go away with, an obvious answer is a set of abilities about flexibility and resilience: flexibility in learning new concepts and software skills, flexibility in transferring learning from one situation to a new one, ability to keep learning, and ability to cope with decisions that have plenty of uncertainty and variability.

Flexibility and higher-level skills

What do flexibility skills consist of? In Chris Wild's address to the Wellington Maths Association, the answer goes like this: there's (only) short-term value in the ability to operate any particular procedure, but there's long-term value in the ability to take a set of instructions and operate an unfamiliar procedure. In Radio New Zealand's Insight programme, a view is that educational thinking needs to shift away from facts and highly specialised skills to higher level skills that can be applied to a range of circumstances.

In New Zealand school mathematics and statistics education, we are already moving down that track, but we can keep investigating how to progress and how to stay ahead of the game.

Software for statistics and data graphics offers an obvious example. Students need skills with a particular software system, but they can also develop skills that will allow them to get into new software systems with new features.

Turning STEM into STEMS

A current response to the changing nature of work is to grow the STEM subjects, where STEM = Science, Technology, Engineering, and Mathematics. This response is already in action, in New Zealand and elsewhere. You can guess what the second S in STEMS stands for! We need to ask now how we make sure that STEM has a very sound second S added to it and that statistics is built into it throughout. This was the subject of the Statistical Society of Australia's symposium in June 2016: *STEMS 2016: Putting Statistics into STEM in the Age of Data.*

If the future workforce spends much of its time not in paid employment, then they'll need skills in the arts: literature, music, drama, dance… So STEMS becomes STEAMS. They'll certainly need 'soft' skills in employment: communication, logic, problem-solving, abilities in working with others, etc. They'll need the social sciences to be part of the first S in STEMS. What might not be so obvious is that all of these will need sound statistics behind them.

Questions for statistical educators

Here are some questions that we can ask ourselves, so that we anticipate future needs, and take preemptive action.

- What statistical content will best support the (other) STEM subjects?
- Do the STEM subjects have the best statistical content within themselves now?
- How do we translate STEM into STEMS?
- What statistical skills do workers need, if they are working with automated systems for producing goods, providing services, or processing information?

- How do we make statistical skills flexible and transferable from task to task, job to job, and career to career?
- How do we make sure that learners learn flexibility in their use of statistical skills? They will need to deal with new data structures, new software, new analysis approaches, and new graphics.
- How do we ensure that sound statistical skills are used by the makers and users of dynamic and interactive graphics?
- How do we tailor the probability in the curriculum so that it enables people to manage uncertainty and variability in their careers, work, and lives?
- What professional development and resources do teachers need, as they enable enhanced statistical learning?
- What are the technological implications to all of this?
- What is data science and how does it connect with statistics?

Further sources of information relating to statistical education and the future of work

We have a vast amount of thinking available to us on the future of work, and some of it deals with the needs of today's learners. Some of it discusses what flexibility for learners' means. Our challenge is to adapt this thinking to school statistical education, and to make sure that it meets emerging needs. The notes below link to some of this thinking.

The Committee for Economic Development of Australia (CEDA) released its major report *Australia's future workforce?* in 2015. They have been releasing further statements since, such as the press release *More than five million Aussie jobs gone in 10 to 15 years*. Among other findings, they say that 'almost 40% of Australian jobs that exist today have a moderate to high likelihood of disappearing in the next 10 to 15 years'.

The UK Commission for Employment and Skills released *The future of work: jobs and skills in 2030* in 2014*.* They are interested in the future labour market and the implications for jobs and skills. The New Zealand Labour Party's Future of Work Commission released *The Future of Work* (2016). It has a chapter on education and training: 'The most important single driver of inclusion, resilience and adaptability in the future of work is education and training. We need to give the highest priority to an education and training system that is resilient, adaptable and inclusive.'

Several books explore the economic and political effects of the likely changes to work. McChesney and Nichols conclude that 'moments of great turbulence will demand more democracy, not less.' Statistical skills for citizens become more important.

The Chartered Accountants Australia and New Zealand are concerned that the workforce has the right skills: 'Skills, training and education are increasingly important but can lose relevance quickly'.

The World Economic Forum's very thorough report aimed, among other things, to 'improve the current stock of knowledge around anticipated skills needs, recruitment patterns and occupational requirements.' A note of relevance to us is that: 'by one popular estimate, 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist.'

The International Association for Statistical Education made the creation of statistically skilled citizens the theme of its 2016 Round Table in Berlin: *Promoting Understanding of Statistics about Society*. In the *Preface to the Proceedings*, Engel, Gal, and Ridgway, state

the aim: ‘Our declared ambition was to promote curriculum reform in statistics education that will broaden the skills that students acquire, in order to make them … also more empowered citizens who can take an active or more informed role in civic life.’

They describe some of the contents: ‘Besides addressing cognitive knowledge elements (mathematical and statistical skills, socio-historical awareness and knowledge) some papers focused on how introducing issues of statistics about society provides opportunities to engage students in evaluating what social justice means to them through the lens of quantitative analytics. Thus, some papers investigated issues beyond cognitive skills, and addressed topics of beliefs, attitudes and values inherently involved when investigating social data.’

They relate statistics to citizenship: ‘With the rise of a political culture in which public debate is framed by appeals to emotion disconnected from the details of policy – so called post-truth or post-factual politics – it is ever more important for citizens to be critical consumers of media reports, being aware of misuse of statistics and knowing effective ways to overcome them.’

The 27 papers in the *Proceedings*, and the workshops and posters, contain a wealth of current thinking that we can make use of.

ProCivicStats is an initiative by statistical educators in six universities, and is supported by the European Commission. Like the Round Table, which it supported, its motivation is not specifically the future of work, but citizen engagement: ‘Social phenomena are complex, and democracies need citizens who can explore, understand, and reason about information of a multivariate nature’. Its site already contains links to many appropriate resources.

What now: statistical thinking with attitude

The answers too many of the questions above is to do what we already do, and centre the skills on statistical thinking. We need to ensure that learners and teachers have a deep understanding of statistical thinking, and know that it involves a wide variety of thought processes and attitudes.

These processes and attitudes of statistical thinking were first detailed by Wild and Pfannkuch (1999), and they already underlie the statistics and probability in the *New Zealand Curriculum* (2007). The changes to the NCEA achievement standards through the realignment process were also designed to support statistical thinking as intended by the *Curriculum*.

We now need to work towards the next stage of curriculum development. We tap into the thinking already being done about the future of work and its effects on society, and translate this into plans for the next stage of statistical education.

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