



# The coming of age of statistics education in New Zealand, and its influence internationally

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*Journal of Statistics Education* Volume 22, Number 2 (2014),  
[www.amstat.org/publications/jse/v22n2/forbes.pdf](http://www.amstat.org/publications/jse/v22n2/forbes.pdf)

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**Key Words:** Statistics education; Statistics education research; Statistics education in New Zealand; School statistics curricula; History of the International Association for Statistical Education

## Abstract

New Zealand has been leading the world in terms of the data handling, and in more recent years, data visualisation approach in its school statistics curriculum. In 2013, bootstrapping and randomisation were added to the senior secondary school ([Ministry of Education 2012](#)). This paper gives an historical perspective of the people and groups that have influenced this statistical literacy based curriculum, including the local professional statisticians' association, the New Zealand Statistical Association (NZSA). The paper includes a short analysis of factors contributing to the successful implementation of the curriculum and its possible long-term impact on tertiary statistics teaching. It also outlines the impact of some of these New Zealanders, such as Professors David Vere-Jones and Chris Wild, and also Maxine Pfannkuch and John Harraway, on statistics education internationally through their involvement in the International Association for Statistical Education (IASE) and their statistics education research activities.

## 1. Background

The 1992 *Mathematics in the New Zealand Curriculum* included a statistics strand for the first time for all levels of school, from new entrants to the senior secondary school. In 2007, a new Mathematics and Statistics curriculum was introduced. According to the New Zealand Ministry of Education, this curriculum aims to help students think creatively, logically and critically, to learn structure and organisation skills and how to carry out procedures flexibly and accurately, to

process and communicate information, to create models and predict outcomes, to conjecture, justify and verify, and to seek patterns and generalisations. The statistics strand is described as “the exploration and use of patterns and relationships in data.” It has three strands running through eight progression levels covering the beginning to end of schooling. The strands are Statistical Investigation (doing), Statistical Literacy (critiquing reports of work by others) and probability. The goal of the Statistical Literacy strand at Level 1 (first year of Elementary School) is described as *Interpret statements made by others from statistical investigations and probability activities* and that of Level 8 (last year of high school) as *Evaluate a wide range of statistically based reports, including surveys and polls, experiments and observational studies: critiquing causal-relationship claims and interpreting margins of error* ([Ministry of Education 2008](#)). The statistics curriculum is characterised by its data handling, and in more recent years, data visualisation approach. In 2013, bootstrapping and randomisation were added to the curriculum achievement objectives for the senior secondary school ([Ministry of Education 2012](#)).

This paper chronicles the New Zealanders (both individuals and groups) who have greatly influenced statistics education in this country. A particular focus is on the development and scope of our schools’ statistics curriculum, but their wider contribution to statistics education and statistics education research, nationally and internationally, is also discussed.

## 2. Early New Zealand influencers

Professor James (Jim) Campbell of Victoria University of Wellington, founding President (1949-50) of the New Zealand Statistical Association (NZSA), was one of the earliest New Zealand statistics education pioneers ([http://stats.org.nz/archive\\_office\\_bearers.shtml](http://stats.org.nz/archive_office_bearers.shtml)). He was well known for actively promoting mathematics and statistics as a field of both research and practice. [Roberts \(1999\)](#) described him as being “devoted to teaching and his students” (p. 85), giving “a remarkable amount of time to consulting in statistics” (p. 84) and actively encouraging the participation of women in mathematics and statistics “vehemently” challenging “the idea that women could not do mathematics” (p. 83). Despite all his own achievements, perhaps his greatest influence on statistics education in New Zealand was through his students, in particular David Vere-Jones and Megan Clark.

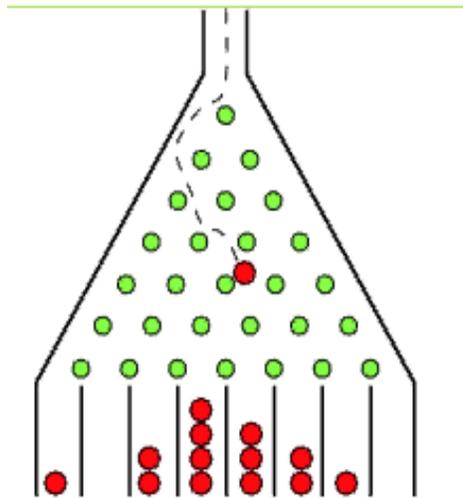
**Figure 1.** Professor James Campbell (1906-1994)



Professor Campbell was awarded life membership in the NZSA in 1983, and in his later years, provided the association with generous financial assistance. His legacy also lives on through another set of awards, the Jim Campbell Awards, conferred at every conference of the New Zealand Association of Mathematics Teachers (NZAMT).

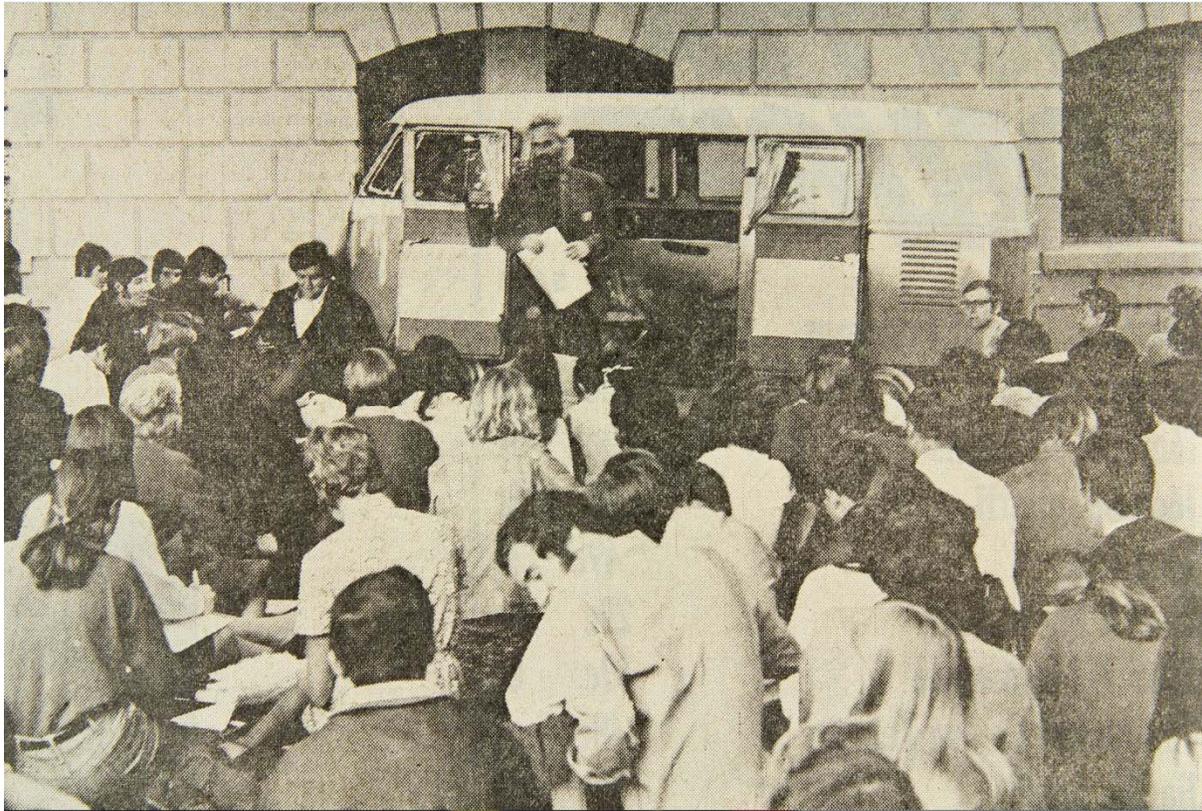
In 1964, Geoff Jowett was appointed as the first Professor of Statistics at Otago University from his role as a consultant statistician at Sheffield University in the United Kingdom. (Sheffield later became the home of two giants of British statistics education, Vic Barnett and Peter Holmes). Geoff Jowett advocated the use of “practical experimentation as a teaching method in statistics” (Jowett and Davis 1960). Among the classroom tools that he used were a shove-halfpenny experiment, sampling bottles and a Galton Board (or Quincunx - [Figure 2](#)) for demonstrating the binomial distribution and the normal approximation to the binomial. He employed a carpenter in the university department to build his devices – the position later becoming that of a computer technician. In order to obtain university funding for equipment, Jowett often used creative descriptions for his equipment. For example, the gingernut biscuits used in an experiment looking at how many times they needed to be dipped into a cup of tea before disintegrating became “dehydrated dunking discs” (Frances Krsnich, personal communication, 26<sup>th</sup> March, 2013).

**Figure 2.** Galton Board



Jowett also had some local notoriety for taking a class in the car park when the lecture theatre was locked. He was reported ([Figure 3](#)) in the local paper (Otago Daily Times, 9 March 1971) as sitting in his van playing his “The mean mean” to an assembled crowd of students. A recent unaccompanied version sung by Alan Keegan can be viewed on YouTube at <http://youtu.be/BKUb4krkw-M> and the words and lyrics are available from the author.

**Figure 3.** Professor Jowett lecturing in the car park of Otago University (1971)



Jowett continued to be heavily involved in consultancy work while at Otago University and was the first proponent of a statistics curriculum for the senior secondary school in New Zealand, producing a complete draft that was read out by a colleague at a secondary schools teachers' conference in 1964.

Also present at this conference was applied statistician Stan Roberts from the New Zealand Government's Department of Scientific and Industrial Research, who had been invited as the NZSA representative to give a presentation to the teachers. Jowett and Roberts became close friends and advocates for changes in the New Zealand school mathematics curriculum. In 1969, statistics was included in the senior secondary school subject, Additional Mathematics. [Roberts \(1999\)](#) described this as a "turning point for statistics in secondary schools" (p. 122). Len Cook, a past New Zealand and United Kingdom Government Statistician, was a student of Jowett's. He is cited in [Roberts \(1999\)](#) as stating that it "was only after we left Otago that I appreciated the full depth of Geoff Jowett's impact on statistics education, through friends who became teachers and whose keenness for statistics was enriched by his holiday programmes for school teachers, along with Stan Roberts, for more than a decade" (p. 115).

**Figure 4.** Early advocates for school curriculum change

Geoff Jowett (1922- )



Stan Roberts (1920-2000)

Both Jowett and Roberts were also involved with service in NZSA. Stan Roberts was both Secretary (1951-53, 1970-72) and Treasurer (1970-73) and was elected as the first life member of the association (in 1981). In 1999 he was also the first recipient of the NZSA's most prestigious award, the Campbell Award, named after Professor James Campbell (<http://stats.org.nz/honours.shtml>). Although Jowett never served on the executive committee, he was described by [Roberts \(1999\)](#) as one of NZSA's most active, liked and respected members, known for his "entertaining and original conference papers" (p. 114). Jowett was also elected to life membership of the association in 1984. Two other well-known New Zealand statisticians are among Jowett's direct descendants and both have also served in NZSA executive positions; son John Jowett as Secretary from 1980-83 and granddaughter Frances Krsnich as Secretary in 1998 ([New Zealand Statistical Association 2013](#)).

## 2.1 David Vere-Jones

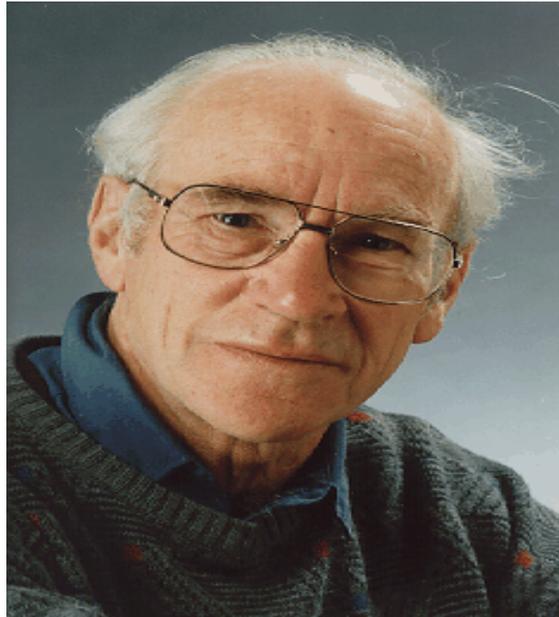
The most significant influence on statistics education both in New Zealand and internationally was undoubtedly David Vere-Jones who, as the last Chair of the International Statistical Institute's Committee on Statistical Education (1987-1991), led the foundation of the International Association for Statistical Education (IASE) in 1991 as its Interim Executive President (see Section 6). David Vere-Jones was persuaded by James Campbell to apply for (and obtained) a Rhodes Scholarship to Oxford and Moscow. At Oxford he studied probability theory under D.G. Kendall then went to Moscow University as an exchange scholar ([New Zealand Mathematical Society 1982](#)). His first statistics education publication ([Vere-Jones 1966](#)) stems from his time in Moscow. Campbell's wider influence on Vere-Jones is seen in his statements such as that the "special feature of statistics...breaks away from the vision of mathematics as a male-oriented subject" ([Vere-Jones 1995](#), p. 14) and in his concern for "people from less fortunate situations" ([Phillips 2001](#), p. 4). In his 1995 paper Vere-Jones stated that "One of the most notable achievements of western societies in the last few decades has been the extension of

modern education, including mathematics, to a very substantial proportion of the population...It is within this context that the movement for statistics education has taken root” (p. 13). Vere-Jones was another active participant in professional societies in New Zealand, being President of the New Zealand Statistical Association (NZSA) from 1981-1983 ([http://stats.org.nz/archive\\_office\\_bearers.shtml](http://stats.org.nz/archive_office_bearers.shtml)) and founding President of the New Zealand Mathematical Society from 1974-1975 (<http://nzmathsoc.org.nz/?historylists>). His major influence on statistics education, both nationally and internationally, was during his period as Professor of Mathematics, with special responsibility for statistics, at Victoria University from 1970–2000.

David Vere-Jones is an exceptional person both as an academic statistician and as a statistics educator. While best known to statisticians internationally for his highly influential work on point processes, he has at least 16 international publications in statistics education as well as being the author of, or a major contributor to, a number of influential reviews of mathematics and statistics within New Zealand [e.g., [Vere-Jones \(1981\)](#); [Clarke and Vere-Jones \(1987\)](#); and [Ministry of Research, Science and Technology \(1988\)](#)]. From 1987-90 he chaired the Education Committee for New Zealand’s national science academy the Royal Society of New Zealand. He has been a Fellow of the (United Kingdom) Royal Statistical Society since 1969 and a Fellow of the Royal Society of New Zealand since 1982. In 1995 he was awarded the International Statistical Institute’s Henri Willem Methorst Medal and in 2000 the Royal Society of New Zealand’s Science and Technology Gold Medal ([www.stats.org.nz/Newsletter61](http://www.stats.org.nz/Newsletter61)). In 2009 he also received NZSA’s Campbell Award.

In 1978, Vere-Jones became the Subject Convenor for Mathematics for New Zealand’s University Entrance Board of the University Grants Committee (holding this position until 1985) ([www.stats.org.nz/Newsletter61](http://www.stats.org.nz/Newsletter61)). In part, at least because of his personal influence, in 1980, a new paper, *Mathematics for Statistics*, was introduced for the final year of secondary school. A feature of this paper was that it included a practical statistics project worth 20% of the final mark. Begg 2000 (cited in [Phillips 2001](#), p. 11) stated that Vere-Jones “obviously supported this increasing emphasis on statistics in school mathematics” speaking to “teachers at many meetings.” The first national examiners for *Mathematics for Statistics* (1980-89) were all members of the Department of Mathematics and Statistics at Victoria University where David Vere-Jones was Professor. Phillips (2001) describes David as recognising “that one of the main problems holding back the teaching of statistics in schools was the lack of statistical knowledge of the teachers’ and that he also ‘was early to recognise the place of technology’” (p. 12).

**Figure 5.** David Vere-Jones (1936- )



Both Jowett and Roberts were well-known to Vere-Jones and they shared some common features, including a passion for their subject and a concern for students and teachers. Another feature of all four of these early pioneers was that they were all involved in applying statistics in real world projects and advocated hands-on “playing with the data” in the statistics classroom at all levels. For example, Vere-Jones co-supervised (with another Victoria University staff member) a postgraduate student project that developed a programme for randomly generating a small data set containing mothers’ smoking habits and babies’ birth weights from a population with known parameters. This allowed students in the large first-year statistics class to each be given a unique data set that was used in all their tutorial assignments, enabling them to work collectively but be assessed individually. This programme was used for approximately twenty years, from the mid-1980s until 2006.

These early statisticians worked both independently and together to change the school curriculum, but they had also had strong support, both from NZSA and also from officials within the New Zealand Ministry of Education.

### **3. Role of the professional association (NZSA)**

Several NZSA members, including Jean Thompson and Mike Camden, had formal input into vocational statistics courses during the 1980s. Then, in the mid-1980s the NZSA became increasingly concerned with, and involved in, school statistics education. In 1987, its Education Committee, convened by Sharleen Forbes, was formed. It soon included those working in the vocational tertiary sector, a couple of school teachers, together with a few academics and professional statisticians wanting to improve statistics education and make more of technological advances. In the early 1990s, with the advent of the National Qualifications Framework in 1991 (<http://www.nzqa.govt.nz/studying-in-new-zealand/nzqf/history-of-nzqf/nzqf-timeline-1980s->

[2008/](#)), some of the early members of the committee were commissioned to write formal statistics standards for the secondary and vocational tertiary sectors.

The Education Committee, together with other NZSA members, were active lobbyists and advisors throughout the development of the 1992 mathematics curriculum that included a statistics strand for all levels of schooling for the first time. For example, Mike Camden (then a lecturer in statistics in vocational Polytechnic courses and currently an employee of Statistics New Zealand) provided specialist advice on the content of the statistics strands. Associate Professor Megan Clark, a colleague of David Vere-Jones from Victoria University and another of Professor Campbell's students was, according to Tim McMahon (personal communication, April 4th, 2013), often the person turned to for advice on statistics.

In 2001, the Ministry of Education began a revision of the 1992 mathematics curriculum with a conference in which views of interested parties were expressed. Mike Camden, as a member of the NZSA Education Committee, presented NZSA's proposed options for statistics and, for the next three years, continued to do so at the Ministry's expert groups on science, social sciences, primary education and mathematics (personal communication, Mike Camden, July 3<sup>rd</sup>, 2013). The committee also proposed that a review of the statistics education literature be undertaken and in 2004, the Ministry of Education commissioned Maxine Pfannkuch and Andy Begg to do this ([Begg, et al. 2004](#)). In her 2005 paper ([Pfannkuch 2005](#)) Maxine Pfannkuch referred to the statistics education literature on resampling. The 2004 review helped inform the previously mentioned 2007 Mathematics and Statistics curriculum. The development of the new Mathematics and Statistics curriculum was overseen by a Ministry of Education advisory group (called the Reference Group), on which Maxine Pfannkuch was the NZSA's representative. This, in turn, was strongly influenced for the statistical strands by many submissions from the NZSA Education Committee. The NZSA Education Committee also formed an unofficial writing group led by Maxine Pfannkuch, Chris Wild, Pip Arnold (a teacher developer), Mike Camden and Alex Neil. Other key members included school teachers such as Jeanette Saunders and Lisa Darragh, and teacher-educator Peter Hughes (a lecturer in Mathematics Education at Auckland University). They were heavily influenced by international statistics educators, in particular Jane Watson of the University of Tasmania, as well as local educators and international research literature including the work of Michael Shaughnessy from Portland, USA and Graham Jones from Australia (V. Wright, personal communication, April 8th, 2013).

The NZSA Education Committee formally submitted recommendations to the Ministry of Education that also advocated the inclusion of resampling and bootstrapping in the senior secondary school curriculum together with times series, etc., for the senior secondary school in the curriculum finalised in 2007 ([Ministry of Education 2008](#)). These recommendations reflect the philosophical shift from a mathematics based to a data-handling based statistics curriculum. With very few changes the documents submitted by the NZSA Education Committee became the text of the Tier 1 (high-level) specification of the statistics strands of the curriculum from Year 1 to Year 13. The current Year 13 Curriculum Achievement Objectives for statistics in Year 13 (level 8) are ([Ministry of Education 2012](#)):

#### Statistical investigation

- Carry out investigations of phenomena, using the statistical enquiry cycle:

- conducting experiments using experimental design principles, conducting surveys, and using existing data sets
- finding, using, and assessing appropriate models (including linear regression for bivariate data and additive models for time-series data), seeking explanations, and making predictions
- using informed contextual knowledge, exploratory data analysis, and statistical inference
- communicating findings and evaluating all stages of the cycle.
- Make inferences from surveys and experiments:
  - determining estimates and confidence intervals for means, proportions, and differences, recognising the relevance of the central limit theorem
  - using methods such as resampling or randomisation to assess the strength of evidence.

#### Statistical literacy

- Evaluate a wide range of statistically based reports, including surveys and polls, experiments, and observational studies:
  - critiquing causal-relationship claims
  - interpreting margins of error.

#### Probability

- Investigate situations that involve elements of chance:
  - calculating probabilities of independent, combined, and conditional events
  - calculating and interpreting expected values and standard deviations of discrete random variables
  - applying distributions such as the Poisson, binomial, and normal.

The taught curriculum often differs from the written curriculum and can be driven by assessment practices. In New Zealand in the final years (11, 12 and 13) of school, students complete both internally assessed and externally examined Achievement Standards as part of their National Certificate of Educational Achievement. These are competency based and students can gain a standard with Achievement, Merit or Excellence. Each standard is quite small – students typically do six standards per subject area per year – and, in general, schools make a selection from those available at each year. The statistics Achievement Standards for the new curriculum were introduced in a staggered process: Level 1 (about Year 11) in 2011, Level 2 in 2012 and Level 3 in 2013. Statistical Literacy is specifically assessed in Levels 1 and 3 and in Level 2 an Assessment Standard entitled “Evaluate a statistically based report” is offered (<http://www.nzqa.govt.nz/framework/>). Included among those that became available for teachers to select from in 2013 were *Investigate Time Series*, *Use statistical methods to make a formal inference* and *Conduct an experiment to investigate a situation using experimental design principles*. The latter two Achievement Standards respectively contain bootstrapping and randomisation. Members of the NZSA Education Committee not only helped draft the Achievement Standards for these but also fed back extensively on the assessment exemplars that are available to teachers (<http://ncea.tki.org.nz/Resources-for-aligned-standards/Mathematics-and-statistics/Level-3-Mathematics-and-statistics>). They also developed new dynamic visualisation tools, iNZight (<http://www.stat.auckland.ac.nz/~wild/iNZight/>) and VIT (Visual Inference Tools, <http://www.stat.auckland.ac.nz/~wild/VIT/>) for the new material

(randomisation and bootstrapping) and new visualisation-based approaches to existing topics (e.g. time series) that entered the senior secondary school in 2013.

The best source for information on all aspects of the New Zealand statistics curriculum, assessment and associated teaching materials are the teaching resources pages of CensusAtSchool New Zealand (<http://www.censusatschool.org.nz>), a one-stop-shop for New Zealand's statistics teachers.

For over a quarter of a century, through its Education Committee, NZSA has promoted a data-handling and problem solving approach in the school curriculum with an emphasis on graphical visualisation and the use of technology wherever possible. NZSA became a powerful lobby group for change in the school statistics curriculum, influencing both the 1992 mathematics curriculum and the 2007 Mathematics and Statistics curriculum. As an example, the NZSA Education Committee has consistently advocated the explicit mention of Statistical Literacy in the curriculum document for statistics and the latest version of this school curriculum now has a "Statistical Literacy" section within each level ([Ministry of Education 2008](#)).

It is too soon to know if New Zealand is moving too far, too fast for our teachers to keep up. The challenging (from a teacher's perspective) new curriculum material on bootstrapping and randomisation has been introduced into the final year of schooling prior to the release of significant new research investigating ways of teaching this material ([Pfannkuch, et al. 2011](#)). However, the most likely outcome of the lack of teachers' skills will be that they do not offer some of the newly available (and optional) standards to their students. Although the integration of recent statistics education research findings in the school curriculum is a feature of the New Zealand situation, in the longer term the success of the New Zealand school statistics curriculum may well depend on the Ministry of Education's ability to invest in teacher development so that these research findings can be implemented in the classroom.

#### **4. The Ministry of Education**

This has been a dramatic reform of the school curriculum. However, it needs to be remembered that it would not have been possible without sympathetic officials in the New Zealand Ministry of Education who were willing to listen and respond to the concerns being expressed. Perhaps most important were Jim Neyland (who spent two years seconded from his university position to the Ministry of Education) and Tim McMahan. McMahan was the Ministry of Education official in charge of development of the 1992 Mathematics curriculum that included a statistics strand for all levels of schooling for the first time. He also managed a small team of writers that produced the material (including statistics) for the last two years of schooling (pre-university level mathematics). Jim Neyland coordinated the team of teachers who produced the curriculum text for statistics for all levels apart from the last two years of secondary school (Tim McMahan, personal communication, April 4<sup>th</sup>, 2013). Vince Wright was the convener of the previously mentioned Writing Groups for the 2007 Mathematics and Statistics curriculum and another advocate within the Ministry of Education was Malcolm Hyland who was also involved with the 2007 Mathematics and Statistics revision together with a numeracy and mathematics publishing programme [including the *Figure It Out* books (He Tau Ano Te Tau) that contain *Statistics in the*

*Media* volumes for the primary school - available nationally at <http://nzmaths.co.nz/figure-it-out>].

It also needs to be acknowledged that the above were not the only New Zealanders involved in changing school statistics education. Support for change in schools has been widespread and one of the features of statistics curriculum development in New Zealand is the active involvement of classroom teachers in its development. In a sense, it was fortuitous timing (described by [Chris Wild 2013](#) as the “planets lined up”) combined with the strength of the connections between academics, school teachers, teacher educators and developers, the Ministry of Education and NZSA Education Committee members that facilitated the 2007 curriculum changes.

The New Zealand school curriculum has developed to the stage where it now serves as a working model for other countries to adapt to fit their particular circumstances. It should be particularly useful for smaller, single state nations similar to New Zealand but could also be used as a resource for curriculum and pedagogical changes in other countries.

Many of the statistics advisors, mentioned above, for both the 1992 and 2007 Mathematics with Statistics curricula, were not just familiar with international statistics education research but were active contributors to that research. The growth of statistics education as a research discipline in New Zealand is discussed in the following section.

## 5. Statistics education research

While changes in the school curriculum were influenced by a number of New Zealand statisticians, it was primarily David Vere-Jone’s promotion of statistics education as a field of research and practice that influenced the growth of statistics education research in New Zealand. Not surprisingly, one of the first groups involved in mathematics and statistics education research was based at Victoria University where he was Professor. This group was a collective of women, Equity in Mathematics Education (EIME), who were interested in examining disparities in educational outcomes between different groups of students. Within the main group of researchers were three women from Victoria University, Megan Clark, Sharleen Forbes and Thora Blithe. Over the period from 1987-2000, they produced a number of publications. Some of this research could be viewed as the application of statistical analysis to education data, such as *Mathematics for All?* ([Forbes, Blithe, Clark, Robinson 1990](#)), but other projects, such as [Clark, Forbes, Blithe \(1994\)](#) and [Forbes \(1996b\)](#), investigated the differential impact of assessment mode and content on achievement. [Forbes’ \(2000\)](#) doctoral dissertation developed a longitudinal index for accumulating participation and achievement differences to measure disparity growth over time, as well as examining the influence of assessment context on student choice and achievement. Most of the members of EIME were either school or academic teachers of statistics and all were active in presenting at teacher conferences, helping teachers develop classroom resources (in particular, for the senior secondary school Mathematics with Statistics project) and lobbying for, or helping implement, change in the school statistics curriculum. As described above, Clark in particular was influential in curriculum change over this period. Several members were also active in the NZSA Education Committee and/ or held executive positions in NZSA. For example, Sharleen Forbes was President of the Association in 1998 and was recognised both with life membership of NZSA and the Campbell Award in 2008.

Another group of statistics education researchers started to take form at Auckland University in the mid- 1990s. This group is led by Maxine Pfannkuch and Professor Chris Wild (a past President of IASE). Their early interest ([Wild and Pfannkuch 1999](#); [Pfannkuch and Wild 2000](#)) was in developing models for the way statisticians think to underpin research in, and the development of pedagogy for, statistics education. An important component of these models was [MacKay and Oldford's \(2000\)](#) PPDAC (Problem, Plan, Data, Analysis, Conclusion) inquiry cycle. They have been advocates for the use of visual tools in the classroom, including using dynamic displays of box-plots to develop informal inference concepts in the junior to middle secondary school ([Wild, et al. 2011](#)), and developed the dynamic visualisation tools mentioned previously. Since 2005, the Auckland team has received funding from the New Zealand Ministry of Education and Statistics New Zealand to help deliver the New Zealand CensusAtSchools project which they began in late 2002. This not only allows school students to enter their own data biennially and to take random samples from the overall data set but has been extended to provide a linking mechanism for teachers between the statistics curriculum and teaching resources and research. Members of the Auckland group have also been strong advocates for, and had close connections with, changes in the school curriculum, running teacher workshops and presenting to teaching conferences in addition to writing reference material for teachers at all levels [e.g. [Wild and Seber \(1999\)](#), [Forbes and Pfannkuch \(2009\)](#), [Pfannkuch, Regan, Wild, Horton \(2010\)](#), and [Arnold, Pfannkuch, Wild, Regan, Budgett \(2011\)](#)]. Several members, including both Chris Wild and Maxine Pfannkuch, are currently active in the NZSA Education Committee, and in 2012 Chris Wild received the association's Campbell Award. Chris is also a Fellow of both the Royal Society of New Zealand and the American Statistical Association. The Auckland group continues to grow in both the scope of its research and the number of researchers involved has expanded in the last few years to include both Sharleen Forbes of Victoria University and John Harraway of Otago University (the current IASE President) and to include tertiary and workplace education in the scope of its research ([Pfannkuch, et al. 2011](#); [Pfannkuch and Wild 2013](#)).

Not surprisingly, the research undertaken by both groups of researchers has focused mainly on aspects of statistics in schools; curriculum, assessment and pedagogy. The Auckland group in particular have nurtured a crop of new statistics education researchers whose work is likely to continue having an impact both nationally and internationally for some time (e.g., [Arnold, et al. 2011](#), [Budgett, Pfannkuch, Regan, and Wild 2012](#)). A common feature of all the above researchers is their efforts to pass on directly the knowledge gained from their research to the classroom teachers of statistics.

## 6. International influence

[Phillips \(2002\)](#) states that an International Statistical Institute (ISI) interest in statistics education began with the formation of its Statistical Education Committee in 1949. According to [Vere-Jones \(1995\)](#), this committee initially focused on academic statistics and the training of official statisticians with involvement in three types of activities: teaching/training projects, publications and sponsoring of conferences and roundtables. However, by the 1970s, its activities had expanded to include statistics education in schools, with several task forces being established. Two of these were the Task Force on Teaching Statistics at School Level (that helped establish

the *Teaching Statistics* journal) and the Task Force on International Conferences in Statistical Education (that initiated the four-yearly International Conferences on Teaching Statistics – ICOTS, beginning with ICOTS 1 at Sheffield, UK in 1982). The ICOTS conferences are described by [Vere-Jones \(1995\)](#) as “arguably the most important project initiated by the Education Committee” bringing “together statistics teachers at all levels, from within all disciplines, and from all continents” (p. 8). [Phillips \(2002\)](#) states that David Vere-Jones (New Zealand), Joe Gani (Australia) and Lennart Rade (Sweden) were the main proponents of the creation of a new section of the ISI for statistics education issues. Each was an eminent statistician with influence in the ISI, but it was the New Zealander in this group, David Vere-Jones, who was the Chair of the ISI Statistical Education Committee (1987-91) when IASE was established and who became the IASE Interim Executive President (1991-1992) until the First Scientific Meeting of the IASE in 1993, Perugia, Italy where David Moore (USA) was elected as the first President of IASE. During this time, Vere-Jones was also the International Program Coordinator of the Third International Conference on Teaching Statistics and the editor of its proceedings.

New Zealand is a small country, both in terms of area and population, so there are opportunities for statisticians and statistics educators to interact and influence each other. It was perhaps at the Third International Conference on Teaching Statistics (ICOTS 3) held at Otago University, Dunedin, in 1990, that the interconnectedness between these early New Zealand statistics educators is most clearly demonstrated. David Vere-Jones was Chair of the ISI Statistical Education Committee responsible for the conference and also Vice-Chair of the Programme Committee and Editor of the Proceedings ([Phillips 2001](#)). Geoff Jowett was one of the plenary speakers giving a paper entitled ‘[Expanding Statistical Education - A New Zealand Retrospect](#)’ ([Jowett 1990](#)). Sharleen Forbes was a co-organiser of one of the sessions, *Statistics in Her Education*, and also one of several EIME members delivering papers ([Forbes and Robertson 1990](#); [Clark 1990](#)).

One of the NZSA Education Committee’s early projects was the 1990 Children’s Census run in conjunction with ICOTS 3. This was designed to encourage primary school teacher participation in ICOTS 3. However, following international publication of its results ([Forbes and Harte 1994](#); [Forbes 1996a](#)), both Statistics Italy (ISTAT) and The Royal Statistical Society Centre for Statistical Education, together with the National Statistics Office in the United Kingdom, undertook similar projects in 2000, respectively called “Censimento a scuola” ([Conti and Lomardo 2002](#)) and *CensusAtSchool*, <http://www.censusatschool.org.uk/> ([Davies, Richards, Aliaga, Nichols 2010](#)). The latter extended the form of the original Children’s Census to an internet survey linked to the 2001 United Kingdom population census. In its first year, over 2000 schools registered and 60000 students took part. Inspired by Neville Davies, Auckland University started running CensusAtSchools New Zealand in 2002, with surveys in 2003 and biennially since. Its website, <http://www.censusatschool.org.nz/>, has become the first “port of call” for school teachers of statistics, providing links to other data sets and curriculum statements as well analytical tools and teaching resources. There is now an international project, CensusATSchool International, <http://www.censusatschool.org.uk/international-projects>, run by the UK Royal Statistical Society Centre for Statistical Education that currently has nine countries as participants (Australia, Canada, Ireland, Japan, New Zealand, South Africa, South Korea, the United Kingdom and the United States of America).

Another measure of New Zealand's international influence is that, of the 10 presidents of IASE that have been elected to date, three have been New Zealanders (Chris Wild from Auckland University and John Harraway from Otago University, in addition to David Vere-Jones). This is disproportionately large compared to our population size (currently just over 4 million).

## 7. Characteristics of New Zealand Statistics Educators

The people mentioned above share some common characteristics. One is that a number are respected international academics in their own fields in mathematical statistics (e.g. David Vere-Jones in point processes and earthquake prediction and Chris Wild in non-linear regression and sampling theory). In his plenary paper at the 2012 International Conference on Mathematics Education, [Hodgson \(2012\)](#), citing Bass (2008), conjectured that it was a common belief among mathematicians that attention to education was “a kind pasturage for mathematicians in decline” (p. 30) and queried whether it was reasonable to expect young mathematicians/statisticians to spend 20 years getting established in their field before they can get respect in their educational activities. It may well be a commonly held view among other academic statisticians that statistics education research is of lesser quality than mathematical statistics research (what [Hodgson \(2012\)](#) describes as skepticism with respect to educational research). This may be one of the reasons that changes in the school statistics curriculum have happened rapidly in New Zealand but have not been mirrored to a large extent in tertiary curricula. While a few universities have made changes to their first-year courses, these seem to have been driven by pressures other than the school curriculum. For example, Auckland University's innovations in 2003 that led to a national Tertiary Teaching Award were, in part, a reaction to large class numbers and Canterbury University's radical changes to the content and delivery of their first year courses were implemented following the devastating earthquake in Christchurch in February, 2011 ([David and Brown 2011](#)). To date, there has not been the same emphasis on changing university curricula as was seen in the school system. While there may be many reasons for this, including the autonomy of individual universities, we may be in danger of disenchanting potential statistics students if we continue to have a mathematics dominated statistics curriculum at the tertiary level. [Hodgson \(2012\)](#) suggested that one of the causes of the lack of attention by academics to education research may be the relative newness of this compared to subject specific research and suggested that there was a need for strong consultation and collaboration mechanisms between educators and other groups of mathematicians/statisticians as well as more text books on didactics.

In New Zealand, the professional statistics association (NZSA) has played a major role in facilitating collaboration between statisticians. Almost all of New Zealand's well-known academic statistics educators have been or are active members of national and international associations, doing hands-on work in organising conferences or serving on executive committees. NZSA has become a powerful national lobby group advocating curriculum change in schools in particular. Many have also been willing to serve on national committees implementing changes, for example participating in the oversight or actual drafting of national standards. They all also share a concern for the classroom teacher, participating in their own time in workshops etc. to help provide teachers with knowledge and resources. However, it is clear from annual reports from the association's annual education reports (for example,

<http://stats.org.nz/agm2012/NZSAEdComAnnualReport2012.pdf>) that the focus to date has been on the school and not the tertiary sector.

Individual statistics educators in New Zealand are noted for exhibiting their passion for statistics and developing creative ways of making it accessible to students. Their common views include:

- putting students first
- the power of students having practical and “hands-on” experiences of playing with data
- the use of technology, including visualisation and simulation tools, in the classroom
- a focus on developing conceptual rather than mathematical understanding
- the importance of the teacher having sufficient statistical as well as pedagogical skills.

Another feature of statistics education in New Zealand has been the increasing involvement of women at all levels (including professorial).

## 8. Concluding comments

The periods of individuals’ major activity in statistics education in New Zealand overlap. Collectively, they have formed a critical mass of consistent opinion that has been effecting change in our schools for the past fifty years. From the very beginning, statistics educators and statistics education researchers actively demonstrated their passion for their subject by “getting their hands dirty.” That is, by becoming active drivers and participants in curriculum and assessment changes and by providing workshops for teachers at a local level. Many have performed multiple roles, and one of the features of the new school statistics curricula in New Zealand is that statistics teachers, statistics education researchers and other academic statisticians worked together with Ministry of Education officials on their development and implementation. There is not a global consensus on what should or should not be in the school curriculum. It seems likely that there will always be national differences, but it is hoped that the New Zealand experience can help inform the development of curricula in other countries.

As stated earlier, New Zealand is a small country (in population terms) providing opportunities for interactions and relationship building between individuals. The strength of the interconnectedness between individuals, both across time and between geographic locations, is another feature of statistics education in New Zealand. The professional organisation for statisticians, NZSA, has also played a major role in the dissemination and discussion of new ideas and material at its national conferences and also through the actions and consistent lobbying of its Education Committee over several decades.

New Zealanders have also been active contributors internationally, being particularly influential in IASE, both in terms of their contributions to the administration of the organisation and as active participants in the conferences (both ICOTS and IASE Roundtables) that IASE has hosted. They have also made major contributions to the international body of statistics education research. In addition, there is a pool of younger New Zealand statistics educators to continue this influence into the future. Statistics education is alive and well in New Zealand, but an on-going issue is how much influence it will have on tertiary statistics education or statistical practice in general. Perhaps the tertiary curricula and the pedagogy used to teach it, particularly in the first and second years of university, is now the greater challenge for us all.

## Acknowledgements

This paper is based on a short paper developed for, and presented at, the joint International Association for Statistical Education (IASE) and International Association of Official Statistics (IAOS) satellite conference in Macao in 2013.

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