



Adjunct Professor Sharleen Forbes Statistics New Zealand & School of Government, Victoria University



### **Overview**

- 1. The influencers
  - a. Academics
  - b. New Zealand Statistical Association (NZSA)
- 2. Statistics Education Research
- 3. Changes: in what and how we teach in real world data
- 4. Emergence of data visualisation as a teaching, analysis and presentation tool.

# 1a. The Influencers - in the beginning:

#### ➢ Professor James Campbell: 1906-1994

#### (professor of mathematics (statistics) at Victoria University)

Actively promoted:

- mathematics/statistics as a field of research and practice involved in consultancy work
- participation of women in mathematics/statistics
- inaugural President of the New Zealand Statistical Association (1948)
- instrumental in David Vere-Jones Rhodes Scholarship to Oxford and Moscow



J.T. Campbell, professor of mathematics, 1954. Dominion collection, ATL F145666 1/2 Statistics

'special feature of statistics...breaks away from the vision of mathematics as a male-oriented subject' (Vere-Jones, 1995)

### 1a. The early days



• Geoff Jowett and his instruments for *playing with data* 



Dr. G. H. Jones

- Shove-halfpenny experiment
- to show variation
- Sampling bottles
- Galton Board (Quincunx)
- –binomial/ normal approximation
- 1947 consultant statistician at Sheffield University - 'practical experimentation as a teaching method in statistics'
- 1964 Professor of Statistics at Otago University/ proposes statistics syllabus for lower & upper 6<sup>th</sup> form
- 1971- UE & upper 6<sup>th</sup> form Additional Mathematics contains statistics 'turning point for statistics in secondary schools'
- Stan Roberts (1920 1999)
- 1953 Director of DSIR Applied Mathematics Division
- 1964 Speaker at secondary school teachers conference
- 1960s -70s Science Fairs, school & maths assoc visits, DOE Bulletins
- NZSA Secretary (1951-53, 1970-72) and Treasurer (1979-73)
- 1999 First recipient NZSA Campbell Award



### 1a. Professor David Vere-Jones

Possibly the single greatest influence on the New Zealand statistics education

#### University Entrance Board

Convenor, Mathematics Steering Committee (1978 -85) Subject convenor, member National Consultative Comm. on Maths (-2004-)

1980 -Mathematics with Statistics replaces Additional Mathematics

- Promoted statistics education as a field of research and practice
- 16 Papers (1967-2001 Russia, NZ and international), NZSA Prof Campbell Award (2009)
- Royal Society and MORST reports (Mathematics in New Zealand: Past, Present and Future - 1998)
- 1981-83 NZSA President

#### International involvement

- ISI Council Member 1984-7, Chairman of Education Committee
  1987-91
- IASE Interim Executive President (1991-1992) David Moore first president 1993
- ICOTS ICOTS III International Program Coordinator, Editor of Proceedings 1991

2009 NZSA Campbell Award



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"* (Vere-Jones, 1995, p.13). 5

## 1b. New Zealand Statistical Association



2012

### NZSA Education Subcommittee(1987-now)

Jean Thompson 1991-93 NZSA President



1994 1990 NZSA Children's Census at ICOTS III in Dunedin

Changes in statistics in schools:

– Mathematics with Statistics paper introduced (1980)

new emphasis on statistics in curriculum

– new Mathematics and Statistics curriculum for all school levels (2007) "Statistics is the exploration and use of patterns and relationships in data" (MOE, 2007) 6 2. Statistics education research

 (a) - Victoria University of Wellington

 First Mathematics with Statistics Examiners (1980-89)
 Project in Mathematics with Statistics introduced

Education Research: (1987-2000) EIME: Equity in Mathematics Education Mathematics for All? 1990..... The testing of Girls in Mathematics. 1993.... Impact of assessment mode and context. Participation and achievement differences.

Measuring students' education outcomes: Sex and ethnic differences in mathematics, (Forbes, 2000).

Statistics education research
 (b) - Auckland University (1999? – now)
 Statistical literacy

 'Building students' inferential reasoning: Statistics curriculum Levels 5 and 6'
 (Chris Wild, Maxine Pfannkuch, et al)

New content and pedagogy in schools (PPDAC - Problem, Plan, Data, Analysis, Conclusion)

 Informal inference TRLI project (Pfannkuch, Wild, Arnold, Regan et al) Years 9-10

- Bootstrapping TRLI project *"Bootstrapping statistical inference reasoning"* (Pfannkuch, Wild, Forbes, Harraway, et al) Year 13

- Randomisation - as above Year 13

#### CensusAtSchools project – Collection and use of data ADTEARCA ADTEARCA (child of the 1990 NZSA Children's Census)



# Analysis of data - "How to make the call" by School level

Thanks to Prof. Chris Wild, Department of Statistics, University of Auckland

**Curriculum Level 6:** distance between medians as proportion of "overall visible spread"



Exercise: Is median of boys bigger than that of girls using this rule?

## 3. Changes in what and how we teach



- School Learning outcomes Critical statistical thinking
  - Use PPDAC cycle (Problem, Plan, Data, Analysis, Conclusion Wild & Pfannkuch)
  - Analyze and make judgments from problems
  - Understand uncertainty
  - Understand sample data from a population
  - Create sensible graphs
- First-Year University Teaching style changing at some universities
  - Increasingly lectures not the only (or primary means of engagement)
  - Some universities have online weekly tutorials
  - Electronic submission and marking of assignments (e.g in Moodle)
  - Use of the internet and/or social media in classes (e.g. YouTube clips of examples) e.g. TV3 item on dairy prices: Friday1st April 2011

http://www.3news.co.nz/Consumer-Green-Party-want-official-dairy-inquiry/tabid/367/articleID/204065/Default.aspx

- Use of visualisation tools (e.g. iNZSight)
- First-year University Assessment at some universities
  - Electronic submission and marking of assignments (e.g in Moodle)
  - Multi-choice final exams
- Post-first year university
  - Mathematical and applied statistics

### 3. Changes in real world data



- Greater access to and use of administrative data
  - Health and education data (even with privacy restrictions)
  - Supermarket scanner data
- Increased access to geographic data
  - GIS information more readily available
- Still a place for surveys and statistical experiments
  - But increased use of qualitative (e.g. satisfaction type) surveys
  - Randomised control trials (to investigate causality)

Increased use of social media and data visualisation tools

# 4. Emergence of data visualisation(a) as a teaching tool



- Use of data visualisation to teach statistical concepts
  - Readily available free simulation tools (iNZSight)
  - New forms of dynamic and interactive graphics (Gapminder)
  - Crossing subject boundaries
  - Increased use of maps (geo-visualisation and geo-statistics

Gapminder/Trendanalyser Combines geography, history,

demography, econometrics and social data (Creator: Hans



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#### 4. Emergence of data visualisation **Consumers Price Index: September 2012 quarter**

# (b) in practice Consumers Price In Embargoed until 10:45am – 16 October 2012

#### **Key facts**

In the September 2012 guarter compared with the June 2012 guarter:

- The consumers price index (CPI) rose 0.3 percent.
- The main upward contribution came from the food group (up 1.1 percent), reflecting seasonally higher vegetable prices.
- Housing and household utility prices rose 0.8 percent, reflecting higher local authority rates, rentals for housing, and purchase of newly built houses.
- The miscellaneous goods and services group rose 1.1 percent, reflecting higher prices for dwelling insurance.
- The main downward contribution came from the transport group (down 1.1 percent), reflecting lower prices for second-hand cars, domestic air fares, and petrol.

From the September 2011 quarter to the September 2012 quarter:

The CPI increased 0.8 percent. This is the smallest annual movement since a 0.5 percent • increase for the year to the December 1999 guarter.

The CPI measures the rate of price change of goods and services purchased by New Zealand households. Statistics NZ visits 3,000 shops around New Zealand to collect prices for the CPI and check product sizes and features.





Source: Statistics New Zealand

#### SOME EXAMPLES (i) Presenting the **CPI** - now

Geoff Bascand

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### (i) Presenting the CPI – the near future The Price kaleidoscope www.destatis.de

#### showing what the weights do

Price change: 1.0%

Price change: 1.3%

Education 0.7%

Price change: 0.0%

Restaurants and hotels 4.4%

Tuition fees, adult education centres, nursery school attendance, etc. Price change: 0.6%

Recreation and culture 11.6%

computers, media, leisure goods, etc.

#### Price Kaleidoscope

within that category of goods have changed.

Miscellaneous goods and services 7.4%

#### DISTATIS wissen.nutzen. The inflation rate in August 2010 was 1.0%. The rate of price increase does not only depend Price change on same month a year earlier August 2010 on how prices change. The weights with which the price trends of the individual goods and services are reflected in the consumer price index are also important. more cheaper expensive The size of each section represents the weight. The colour shows how the prices -24% -12% -6% -2% 0% 2% 6% 12% 24% Food and non-alcoholic beverages 10.4% Price change: 2.4% Personal care, personal effects, social protection, insurance and bank services, etc. Alcoholic beverages, tobacco 3.9% Price change: 0.3% Vegetables Weight: 1.1% Price change: 9.5% Clothing and footwear 4.9% Price change: 0.3% Housing, water, electricity, gas

Communication 3.1% Telecommunication, postal and courier services. relevant equipment and its maintenance Price change: -1.8%

Package tours, cultural services, consumer electronics.

#### Transport 13.2%

Purchase and operation of vehicles, transport services etc. Price change: 1.8%

#### Health 4.0%

Price change: 0.6%

Further information Basket of goods and services and weighting pattern Price monitor Personal inflation calculator

#### Furnishings, household equipment and routine maintenance of the house 5.6%

Rents and imputed rents for owner-occupied

housing, running costs, household energy, etc.

Furniture, household appliances, interior fittings, goods and services for household maintenance etc. Price change: 0.0%

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and other fuels 30.8%

Price change: 1.2%

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Statistics

#### (ii) Showing the time dimension: e.g. The 'momentum' effect in demography Animated population pyramids









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Statistics

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# (iii) Integrating maps, graphs and analysis

Free downloadable software - GeoVista (with Auckland 2006 Census data)



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### 5. Final comments

# Common treads



- Academics and applied statisticians working together with teachers
- NZSA acts as a unifier and influencer in school statistics education
- Emphasis on 'playing with the data' in statistics education

#### In a new world with

- different modes of teaching and assessment, emphasis on concept rather than mathematics
- new collaborations (across university, government and university, etc.)
- use of visualisation rather than mathematisation, free of 'the tyranny of the computable' Cobb (2007)
- growing importance of time and place (geography) in data
- links between problem criticality and statistical significance (and confidence), Decision-making in the context of real questions.

#### 5. Final comments



Are we up to the challenge of

# a return to the view of statistics espoused by Laplace

' common sense reduced to numbers' (cited in Vere-Jones, 1995)??

# **Questions and comments**

Contact <a href="mailto:sharleen.forbes@stats.govt.nz">sharleen.forbes@stats.govt.nz</a>

Thank you