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National Newsletter: Mathematics and Statistics

Information and resources for middle leaders in secondary schools | Term 4 2012

Greetings to everyone for term 4 and thinking ahead to 2013.

So far this year middle leaders and teachers in most regions will have had the opportunity of attending realignment workshops involving pathways, literacy, L2 and L3 achievement standards.

The next series of workshops is going to focus on the new statistics concepts of randomization and resampling using INZight, time series and statistical literacy. This work will continue into 2013 with a similar series of regional workshops. Input from teachers is valuable for informing content so please contact your regional facilitator with useful suggestions.

Statistics Road Show

Presenters from Auckland and around NZ will be running one-day statistics-focused workshops in Wellington, Christchurch and Dunedin during the last week of November. Dates are: Auckland (Stats Day) 22 November; Christchurch 27 November; Dunedin 28 November and Wellington 1 December. They will cover all the level 3 Statistics standards.

University of Auckland facilitators will be running a series of workshops on the same topics for Taranaki Maths Association in New Plymouth on 13 November; Manawatu Maths Association, Palmerston, North on 14 November; and Wairarapa Maths Association, (venue to be decided) on 15 November.

Update: Online forum

The online Professional Learning Communities for secondary mathematics teachers is the first place to go if you have questions around NCEA: <http://www.nzmaths.co.nz/plc>

There has been an increase in teachers answering questions on the forum. There has also been some good discussion around controversial issues. Please be aware that the facilitators have editing rights to help ensure the blog remains respectful to all. We are very liberal and will support free speech but when an incorrect or biased view is written it may be deleted. We do not apologise for this but feel a backstop is needed to maintain integrity. We will also remove material that is no longer needed or is duplicated so that the size of the content is manageable. Please keep using this forum and please share moderation feedback that improves assessment and learning, and discussion of good approaches that have improved results.

Note: Effective resources and school-produced moderated assessments can be sent to the NZAMT Resource Manager.

National contact details

Northland

Sandra Cathcart
The University of Auckland
Whangarei
Phone: 027 555 4660
s.cathcart@auckland.ac.nz

Auckland

Brenda McNaughton
The University of Auckland
Phone: 027 555 4679
b.mcnaughton@auckland.ac.nz

Marion Steel
The University of Auckland
Phone: 021 988 754
m.steel@auckland.ac.nz

Waikato, Bay of Plenty, Gisborne, Hawkes Bay

Jim Hogan
The University of Auckland, Taupo
Phone: 027 461 0702
j.hogan@auckland.ac.nz

Taranaki, Manawatu, Wairarapa, Wellington

Derek Smith
Phone:
Te Tapuae o Rehua, Wellington
Please contact Derek via Karen or Noel below until email is set up.

Nelson, Christchurch, West Coast

Karen Barks
Te Tapuae o Rehua, Nelson
Phone: 027 405 6725
karen.barks@canterbury.ac.nz

Otago, Southland

Noel Johnston
Te Tapuae o Rehua, Dunedin
Phone: 021 277 6664
noel.johnston@otago.ac.nz

The computer revolution, statistics - and the future

Many HODs have asked why there is such a push for statistics in the new curriculum. The answer is straightforward - computer technology. Never before have we been able to access and process data like we can now. The computer is another 'wonder of the world' alongside landing on the moon, the www, Skylab, GPS, Hubble, the Higgs discovery, and many other creations and achievements of mankind. Wow - and most of this recently.

There have been disasters. The 1987 and 2008 global financial crashes are examples of bad design, poor management and human greed. The final impact of these is pending. Haste and speed got confused.

The Central Limit Theorem dominated statistics and inference in the pre-computer era. Large-scale data computation took too long. The first 24 hour numerical weather forecast took 24 hours to produce and along with being immediately out of date, was wrong. The CLT became the cornerstone.

The 21st century ushered in laptop supercomputers. The computer I write on has a 2.4Ghz dual processor CPU and is immensely more powerful than the 8bit 8k computer I first owned in 1984. Data storage, processing power, internet access are now a past problem and fibre internet speed is coming!

Thankfully, the NZ Statistics Association and others saw fit to influence the development of the New Zealand Curriculum and equate Statistics and Mathematics in name and deed. A raft of new standards designed to assess new progressions in statistics and probability has been created. Where did these ideas being assessed come from? Is "bootstrapping" a new idea? What is randomisation? What use is resampling?

The computer allowed many of these ideas to flourish and replace traditional methods of data analysis. Computer simulation allowed many old problems to be solved in new ways and some for the first time. The 'Four Colour Map Problem' only has a computer-based solution that exhausted all possibilities to the contrary. In research today resampling, randomisation, 'bootstrapping', 'jack knifing' and other techniques have become the norm. Traditional confidence intervals are in the process of being replaced. What we once understood as a formal inference is being replaced with another version that is easier to understand and use.

The computer made resampling 10,000 times feasible. The computer has made reallocating data randomly 10,000 times a doddle. Simulate the toss of a die 100,000 times and see how the chance of 'head' wobbles. Big numbers and huge data sets need better understandings. Secondary education lives in the future because that is where our students will soon be working. The NZC is modern, futuristic, envied by some, and as teachers we should be proud and thankful we are also working in the future.

An implication is that every secondary student studying mathematics and statistics needs access to the latest software and fast computer technology. A priority for our schools is to make this access possible.

Written by Jim Hogan in response to questions about the changing statistical approaches.

Reminder: BOPMA Conference

November 23, 2012
Tauranga Polytech

Reminder: Otago Statistics Conference

November 29-30, 2012

NZAMT Conference



NZAMT's conference in 2013 is in Wellington, 1-4 October so please put this in your diary now. This event is an excellent professional development opportunity to present a workshop to your colleagues. Have a go! Make it your inquiry.



Farewell Anne Lawrence

All the best Anne and a big vote of thanks on behalf of all teachers for the work you have done for the mathematics community in NZ over an extended period of time. Your knowledge and enthusiasm has been appreciated by all of us.

Anne is studying postgraduate statistics at Massey in Palmerston North. She says it is refreshing to be a student again, although warns she is fast developing the student habit of needing to be shouted regular cups of coffee to keep the brain fired up. She is enjoying using statistics in the field and has already completed a project analysing DOC data around stoat capture in the Oroua Valley.

Now that Anne is no longer a facilitator, she plans to put more time into other occupations including resource development and textbook writing. She also plans to take advantage of good weather and get into the hills for R&R on a regular basis.

Statistics: the researcher perspective with comments about the changes in Statistics

Maxine Pfannkuch and Ross Parsonage

Currently statistics teaching is entering a very interesting period because statistical practice is changing from normal-based methods to computer-based methods, which for many reasons are superior.

Technology has unleashed access to computing power that can cope with unthinkable and tedious amounts of computation necessary to produce confidence intervals and tests of significance using new methods such as bootstrapping and randomisation. These methods, although algorithmically simple, are powerful: more exact than normal-based methods as they do not rely on normal distribution assumptions - they are distribution free - and in the case of randomisation do not rely on sample size assumptions.

Even more importantly, the same thinking can be applied across a wide range of seemingly different situations. "The new methods set us free from the need for Normal data or large samples. They also set us free from formulas. They work the same way (without formulas) for many different statistics in many different settings. They can, with sufficient computer power, give results more accurate than those from traditional methods" (Hesterberg, Moore, Monaghan, Clipson & Epstein, 2009, p. 16-2). The range and effectiveness of these new methods are so great that they are "rapidly becoming the preferred way to do statistical inference" (Hesterberg et al., 2009, p. 16-2).

Brad Efron, currently Professor of Statistics at Stanford University, produced a landmark paper on the bootstrap method in 1979 that has revolutionized the practice of statistics. Since the advent of Efron's paper, well over 1000 papers have been written justifying the theoretical basis for the bootstrap (Efron, 2000).

Efron noted: "it has taken me a long time to get over the feeling that there is something magically powerful about formulas ... and to start trusting in the efficacy of computer-based methods like the bootstrap for routine calculations" (p. 1295).

Since the bootstrap method is capable of generating bootstrap distributions for summary statistics such as medians, quartiles, measures of spread, and correlations, it goes far beyond the scope of classical mathematical methods simple enough to be commonly taught. Cobb (2007) and Efron lament that the bootstrap, which has had a major effect on the practice of statistics is not part of the introductory statistics curriculum.

With computing power now available to students, the time is ripe to introduce students to the bootstrap method and correct the mismatch between statistical practice and the introductory curriculum.

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Problems

1. Find the sum of

$$\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{98} + \sqrt{99}} + \frac{1}{\sqrt{99} + \sqrt{100}}$$

The answer is the biggest single digit whole number, which may be surprising. This is a NZC Level 7/8 problem and might be a curiosity for your students.

2. I rather like the series $1 + \frac{1}{2} + \frac{1}{4} + \dots$ and so on to infinity. This is the same as standing 2m away from a wall and then halving the distance to the wall with every step you take and can be demonstrated in the classroom easily. Students from Year 7-13 of all abilities will appreciate the task and it will add something to their concept of infinity. The answer will appear just before you reach the wall.

3. This next problem is solved using clever mathematical thinking to show that the answer is indeed infinite. The problem is to add $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots 1/\text{infinity}$.

The numbers get smaller and smaller but not fast enough to be finite.

The series can be re-written as $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \dots$

using the $\frac{1}{4}$ to replace $\frac{1}{3}$ and $\frac{1}{8} + \frac{1}{8} + \frac{1}{8}$ to replace $\frac{1}{5} + \frac{1}{6} + \frac{1}{7}$ and so on.

I am replacing each fraction with a smaller one but you may notice I have now created a series $1 + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \dots$ and clearly this series, which is smaller than the problem I first described, has an infinite answer. The first problem then sums to a number larger than infinity!

Presenting this problem should cause a serious discussion of the size of infinity. Google "infinity and maths" and you will discover a large list of resources including Part 4 of the Story of Maths ...

<http://www.youtube.com/watch?v=FiuVG57S5yw>

Discussion of mathematics problems is a very rich source of understanding, interest and fun.

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INZight

INZight software is free and downloadable from <http://www.stat.auckland.ac.nz/~wild/iNZight/>

Make this a priority!

Senior statistics students will need access to fast computers in 2013 so that they can do resampling and randomisation repetitions thousands of times. Many mathematics departments have solved this problem by purchasing a COW or "computers on wheels". Software for the new statistics has been developed by the University of Auckland and is available free at <http://www.stat.auckland.ac.nz/~wild/iNZight/>

Please give priority to making sure mathematics departments can provide reliable computer access as needed for Year 13 students. All other students would benefit from learning programmes designed to use this technology in their statistics and mathematics studies.

National newsletters

These national newsletters are developed for every learning area by national co-ordinators from The University of Auckland and/or Te Tapuae o Rehua consortium (University of Canterbury, University of Otago and Te Runanga o Ngāi Tahu). For more information about Ministry-funded professional development for secondary middle leaders, visit this page on TKI:

<http://nzcurriculum.tki.org.nz/Ministry-curriculum-guides/Secondary-middle-leaders/Professional-learning-and-development>

Scholarship 2013

It is anticipated that Scholarship 2013 will look much like it does now. The specifications for 2013 will exclude new things such as Critical Path in Calculus. It is expected that questions will be very broad and based on Level 8 achievement objectives.

The link below gives more detailed information.

<http://ncea.tki.org.nz/New-Zealand-Scholarship>

Future in Tech

A variety of excellent resources are maintained on this website. Careers interviews, posters and fun.

<http://www.futureintech.org.nz/careers.cfm?categoryid=26>

ERO reports

Here are two recent reports of direct relevance to secondary and worth reading.

"Evaluation at a Glance: Priority learners in NZ Schools"
(August 2012)

"Literacy and mathematics Years 9-10 Using assessment information to promote success."
(July 2012)

These and all other reports can be downloaded from

[http://www.ero.govt.nz/National-Reports/\(year\)/2012](http://www.ero.govt.nz/National-Reports/(year)/2012)