Newsletter No. 39 **November 2004**

In the last issue we suggested, in passing, that some people might think deterministic modelling is more authentic that stochastic modelling. Let's put that to the test. Suppose you wish to know the proportion of time given over to advertising on T.V. A deterministic approach might be to choose a day (or some other random time period) and armed with a stopwatch time the duration of the adverts. It is then a simple matter to express the total time spent on advertising as a proportion of the total number of hours programmes are transmitted. Some would say that this is not totally deterministic since sampling is required but it's close enough to make the point. A stochastic (probabilistic) approach might be to note what is showing every time you switch on the TV. Is it an advert or not? From this you can determine, with sufficient data, a reasonable estimate of the proportion of time spent on TV advertising. For example, if there is an advert showing 20% of the occasions you switch on, then you could conclude that 20% of TV time is spent on advertising. What do you think? Why not try a little experiment and see what happens when you compare methods?

In some situations we don't have the luxury of both approaches to solving a problem. For example, suppose you wish to know the number of fish in a pond that are of a certain species. You suspect there are about 1000 fish in the pond but it is not possible for you to catch them all to answer the question. One way might be to catch 20 and note how many are of the required species. Do this a few times and average the results to get a measure of the proportion of the species you are interested in out of the 20 caught. Simply multiply up by 50 to get an idea of how many fish of the required species are in the pond. I hasten to add here, for fear of offending any statisticians who might be reading this, that the method outlined is only that - an outline. It is surprising how useful stochastic approaches to problem solving can be, given appropriate statistical safeguards to methodology and so on.

> *A witty statesman said you might prove anything by figures but a judicious man looks at statistics, not to get knowledge, but to save himself from having ignorance foisted on him.*
>
> **Thomas Carlyle**

As the year is coming to an end and we're all looking forward to the holidays, like last year we've included a selection of activities, puzzles or whatever, just for fun. We've called them Christmas Crackers and you'll find the answers at the end of the newsletter.

Have a safe summer. We look forward to sharing ideas with you in 2005, our next issue is scheduled for February.

First Christmas Cracker

Find the next word in the sequence:

AID, NATURE, DEGREE, ESTATE, COLUMN, SENSE, …..

(Answers below, in Afterthoughts)

What's new on the nzmaths site this month?

Two staff seminars related to the 400 Problem have been added in the help centre. We have about 15 new units written and nearly ready to be added to the website. These should be added by the end of November. There will also be 7 new numeracy equipment animations added to the site within the next few weeks.

Second Christmas Cracker

WHAT IS MID YEAR?

2005 NZAMT Conference

NZAMT9, with its theme "Thinking Outside the Square", will be the ninth biennial conference of the New Zealand Association of Mathematics Teachers. The conference will be held in September 2005 in Christchurch. The dates are Tuesday 27th September to Friday 30th September; this is in the first week of the spring holiday. The venue is Christ's College which offers a unique combination of excellent facilities coupled with a superb central city location.

The Thinking Outside the Square theme is a rich metaphor for much of what we anticipate will happen at the conference. On one level it relates to Christchurch, with the conference being held, just outside Cathedral Square. However it also is an apt description of people learning from each other and thinking about how they might do things differently.

The programme will offer a mix of plenary and workshop sessions as well as opportunities to socialise with other mathematics teachers. There will be an NZAMT9 website (nzamt9.org.nz) operating later this year and this will have up to date conference information including the facility to register in 2004 as well as the opportunity to offer workshops.

There are currently ten invited speakers who have been confirmed for the conference and some brief notes about each of them follow.

Keynote Speakers:

Claudi Alsina - Professor **of Mathematics, Barcelona, Spain**
Claudi comes to us highly recommended as a very entertaining speaker. Derek Holton, who has heard him twice, describes Claudi as one of the funniest plenary speakers he has listened to. Claudi has published 20 books and more than 150 papers and ends his talks with statements like "We do maths with our brain but we must teach it with our heart".

David Clarke - Professor of Mathematics Education, Melbourne
David is Director of the International Centre for Classroom Research at the University of Melbourne, Australia. His major areas of research activity include international comparative studies of classroom teaching and learning, assessment, professional development, and the application of state-of-the-art technology to educational research. Dr Clarke co-ordinates the Learner's Perspective Study - an international collaborative project studying well-taught mathematics classrooms in 14 countries.

Clio Cresswell - Visiting Fellow, University of New South Wales
Clio has established a diverse career as a mathematician, author, writer and presenter. Her latest book is titled Mathematics and Sex and she features regularly on television, radio and in the press. Her varied experiences and eclectic outlook on life means Clio easily comes up with quirky and fresh approaches to most topics. Combined with her bubbly personality, she is captivating, intellectually stimulating and thoroughly entertaining.

Don Fraser- Professor of Mathematics, University of Toronto, Canada
Don has spent many years teaching elementary and high school pre-service mathematics education. He is in high demand as a keynote speaker at maths conferences of elementary and high school teachers across North America – from small towns to New York City. Don's publications include 'Newspaper Math', 'Yesterday's Sport To-Day's Math', 'Mathemagic' and 'Taking the Numb Out of Numbers'. He is recommended for his positive approach to teaching children as well as his practical teaching ideas, warmth, enthusiasm, common sense and delightful sense of humour.

Gillian Heald - Co-director Unlimited paenga tawhiti, Christchurch
Gillian 'retired' in July 2002 after 13 years as principal of the highly regarded Rangi Ruru Girls' School in Christchurch. Prior to that position, she was Head of Mathematics at the Christchurch College of Education after 12 years teaching Mathematics and Computer Studies at Christchurch Boys' High School. Currently Gillian is a part-time Co-director of the newly established Unlimited paenga tawhiti, which is a state secondary school in the centre of Christchurch city, based on Discovery Learning principles. This she describes as an exciting and challenging new direction, with moments reminiscent of being a first-time principal and/or a year one teacher! She has even had the chance to get back in the classroom again and teach some mathematics.

John Mason - Director, Centre for Mathematics Education, Open University , England
John Mason has been teaching mathematics ever since he was fifteen. After a BSc and MSc in mathematics at the University of Toronto and a PhD in combinatorial geometry at the University of Wisconsin (Madison) he joined the Open University and led the implementation of George Polya's ideas through the design of the first Open University summer schools in mathematics. He was the lead author of 'Thinking Mathematically', the recent book 'Fundamental Constructs in Mathematics Education' and of a host of materials for the professional development of teachers of mathematics.

Ian Stewart - Professor of Mathematics, University of Warwick, England
Ian Stewart is an active research mathematician with over 150 papers published or in press. His books include 'Does God Play Dice?', 'Nature's Numbers', 'The Science of Discworld I and II', 'Flatterland', 'The Annotated Flatland' and 'What Does a Martian Look Like?' He also writes science fiction ('Wheelers and Heaven'). He has appeared on numerous radio and television programmes. His popularisations of science have been recognised by the award of the Royal Society's Faraday Medal, the Gold Medal of the IMA, and the Public Understanding of Science and Technology Award of the AAAS. He delivered the 1997 Royal Institution Christmas Lectures on BBC television.

Invited Speakers:

Mary Barnes - University of Melbourne
Mary is well known for her innovative ideas about teaching calculus and in particular her series of books 'Investigating Change'. She has been to previous NZAMT conferences and has just completed some interesting research on Collaborative Learning in Secondary classrooms.

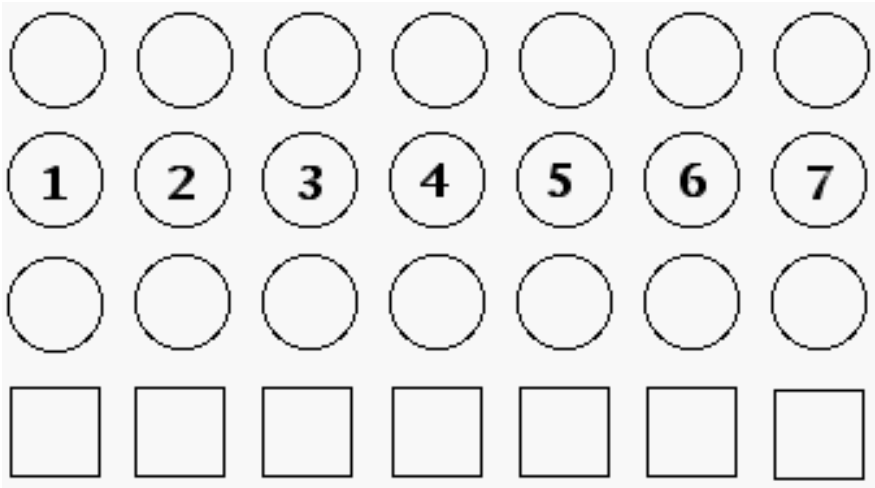
Douglas Butler – ICT Training Centre, Oundle School, England
Douglas is well known for his work with the Auto graph software, which he will be able to demonstrate at the conference. He will also offer a general overview of ICT for mathematics teaching - web resources (Java/flash), using data, hyperlinks and Unicode symbols, and also secondary lesson plans using dynamic software. Douglas will also give workshops on making Word mathematically friendly and finding and managing great web material for mathematics.

Anthony Harradine - Director, Noel Baker Centre, Adelaide
Anthony’s presentation at NZAMT8 was one of the highlights of the Hamilton conference and he has recently completed a series of workshops throughout New Zealand exploring some of the ways of using graphics calculators. Anthony’s ideas are refreshingly innovative and his work at The Noel Baker Centre has involved him in a range of developments including the very successful census online project.

[Just a footnote to say that there will be something at this conference for everyone, whether you teach at primary, intermediate, secondary, or tertiary levels. If you have never been to a maths conference before, then start with this one!]

Solution to October's problem

October's problem was as follows: Your task, should you accept it, is to find a permutation of the numbers one to seven with the property that when placed in both the first and third rows, the seven column totals are all perfect square numbers.



The prize this month goes to eight students from a Year 8 class at Gisborne Intermediate (Robert Bracken, Olivia Davidson, Kimberley Freeman, Anita Geuze, Alex Green, Luke Jenkins, Josh Savage, and Tomas Parker). We think that all of the people who sent in answers to this, the winners included, did it by trial and error. But there is a way to do it that ensures that you get the one and only answer. It's a bit sophisticated but it shows an interesting use of algebra. Here it is.

The maximum possible total in any column of three circles is three 7s, or 21. The minimum is three 1s, or 3. Thus the possible square numbers which can be placed in the square boxes are 4, 9 and 16.

Suppose the number of 4s is x, the number of 9s is y and the number of 16s is z.
Since there are seven totals in all, $x + y + z = 7$ **(e1)**

The total of the three rows is $3 \times (1 + 2 + 3 + 4 + 5 + 6 + 7) = 84$, hence,
$4x + 9y + 16z = 84$ **(e2)**

In **(e2)**, 84, 4x and 16z are multiples of 4. Therefore 9y is also a multiple of 4 and hence, since 9 is not, y must be a multiple of 4.

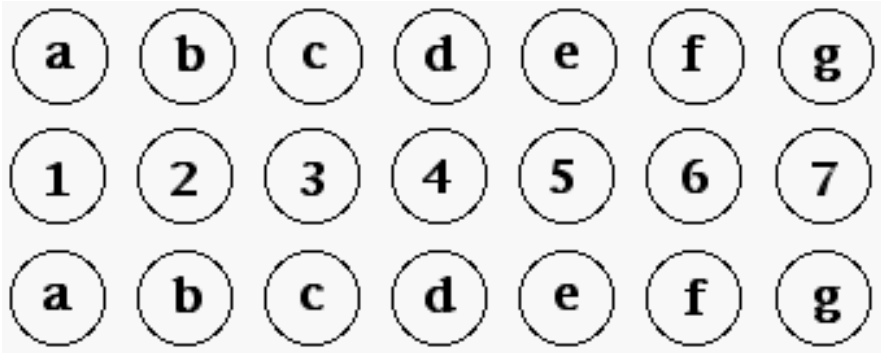
Since **(e2)** contains 9y and all of x, y and z are positive integers (or zero), y can only be 0 or 4 otherwise the left hand side exceeds 84 or **(e1)** does not hold.

Assuming $y = 0$: **(e2)** gives $4x + 16z = 84$ or $x + 4z = 21$ while **(e1)** gives $x + z = 7$. Solutions to these two simultaneous equations are not whole numbers, hence $y \neq 0$.

Then $y = 4$ and **(e2)** gives $4x + 36 + 16z = 84$ or $x + 4z = 12$ and **(e1)** gives $x + z = 3$. Solving these last two equations simultaneously gives $x = 0$ and $z = 3$.

Thus the square numbers which are sums of the seven columns consist of four 9s and three 16s.

Let the required permutation of the numbers 1 to 7 be a b c d e f g, then from the diagram it can be seen that:



The vertical sums are: $2a + 1$, $2b + 2$, $2c + 3$, $2d + 4$, $2e + 5$, $2f + 6$ and $2g + 7$, of which $2a + 1$, $2c + 3$, $2e + 5$ and $2g + 7$ must be odd, i.e. the square number 9. These give $a = 4$, $c = 3$, $e = 2$ and $g = 1$.

Likewise, $2b + 2$, $2d + 4$ and $2f + 6$ must be even, i.e. 16, giving $b = 7$, $d = 6$ and $f = 5$.

Thus the required permutation is 4736251.

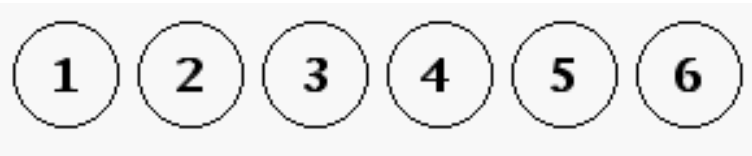
Third Christmas Cracker

It goes without saying that mathematics always has more meaning if it is taught in context. The context does not have to be practical applications but may be aspects of its history. Every teacher of mathematics should be familiar with the broad outlines of the developments of the subject s/he teaches and some of its historical personalities. Here's a little quiz to test your knowledge.

1. Who was the last notable mathematician of the Alexandrian school?
2. What is the all-time best-seller of maths' textbooks ever written and who wrote it?
3. Which early Greek mathematician wrote 'The Method' which only came to light in 1906? Some of his other titles were; 'On Spirals', 'On the Measurement of the Circle' and 'On the Sphere and Cylinder'.
4. Guess the number of books and mathematical memoirs written by Euler.

5. Who first denoted the circle ratio by the letter π and who gave it his stamp of approval?
6. What is Goldbach's conjecture?
7. What was the bill entitled 'Introducing a new Mathematical Truth', House Bill No. 246, presented to the Indiana House of Representatives in 1897 and passed unanimously on its first reading? It was passed for further consideration on its second reading but has not been on the agenda since.
8. Who 'invented' the method of fluxions and by what name is it better known?
9. Which mathematician died in a duel in 1832?
10. Which mathematician died of cold in Sweden in 1649?

This Month's Problem



We can arrange all of the permutations of the numbers 1, 2, 3, 4 in 'numerical order' as follows:

1234;	1243;	1324;	1342;	1423;	1432;	2134;	2143;
2314;	2341;	2413;	2431;	3124;	3142;	3214;	3241;
3412;	3421;	4123;	4132;	4213;	4231;	4312;	4321.

If all of the 720 permutations of the digits one to six were arranged in numerical order from lowest to highest, what would be the 465th ? The arrangement shown above is the first in the sequence.

We will give a petrol voucher to one of the correct entries. Please send your solutions to derek@nzmaths.co.nz and remember to include a postal address so we can send the voucher if you are the winner.

Afterthoughts

First Christmas Cracker:

First AID, second NATURE, third DEGREE, …, etc. hence; seventh HEAVEN.

Second Christmas Cracker:

1499 (Roman numerals)

Third Christmas Cracker:

1. Hypatia better known for her gender and manner of death than her mathematics (she was hacked to death by a Christian mob in 415 CE).
2. The 'Elements' by Euclid. It has never been out of print since it was written, c. 300 BCE. There have been over 1000 editions since the invention of the letterpress in the 15th century.
3. Archimedes.
4. 886. Euler averaged 800 printed pages a year, all of high quality. In addition he wrote an estimated 4000 letters to famous mathematicians of his day of which 2791 have been preserved.
5. William Jones (1675 - 1749) in his book 'A New Introduction to Mathematics'. Euler gave it his stamp of approval.
6. Every even number is the sum of two primes. No counter-example has ever been found. The conjecture was first made in a letter to Euler in 1742.
7. The author of this bill was Edwin J. Goodman MD who wanted to simplify calculations involving π. Among other things the bill ruled that $\pi = 3$.
8. Isaac Newton, the differential calculus.
9. Evariste Galois.
10. René Descartes.

If you want to check up on the answers to Christmas Cracker No. 3, go to the website http://www-groups.dcs.st-and.ac.uk/~history/Mathematicians. You should find a whole lot of other interesting and surprising facts there too.