

## NZ Maths Site Newsletter

November 2003

I was wondering, do you enjoy mathematics? Does anyone? I occasionally meet people who tell me that they were good at maths at school and they really enjoyed the subject but ask them if they do any now and they look at you with a perplexed expression. It's as though people don't do mathematics in real life. Everyone knows that mathematics has lots of applications but surprisingly few people actually make use of the maths they were taught in school, except in a very simplistic way.

For example, I was talking to someone recently about a new concrete driveway they had put in.

> "How did you decide how much sand and cement you would need?", I asked.
> "I just guessed a couple of metres and bought a dozen sacks of cement", he replied.
> "Was it enough?", I responded.
> "No, I had to buy some more"
> "Did you have enough then?", I asked.
> "Yeah, too much actually. I gave what was left over to my brother. He's building a barbecue."

There wasn't much maths used there, just trial and error.
Of course, a good number of professional mathematicians must enjoy the subject. About the same proportion as those who enjoy their work in other professions, I expect, but are there any others who enjoy maths and do it in their spare time? For relaxation perhaps, or mental stimulation like doing a crossword? Very few, I suspect. One of the most rewarding times I had as a head of department was when two others in my team were so involved with the subject they used to research it and DO it at home. Wow!

How would you feel if you were forced to do typing every day? Or car maintenance? When you were a pupil, how did you feel about being forced to study English or Workshop Technology? What did you think of teachers who forced you to leap over a vaulting horse in the gym? How about people persuading you to investigate mathematics every second?

Mmm! Maybe as teachers we could show a little more compassion towards our pupils and at least try to make the subject more interesting, bearing in mind that many of them don't want to be there. Maybe we could show our own enthusiasm, or pretend to if it's lacking, and ginger the lessons up with problem-solving exercises, which many people enjoy, or historical anecdotes at least. Just a thought.

Last year we were asked to find simple answers to carefully chosen questions. This year the questions aren't as nice, especially on Friday afternoons. Anonymous student

As the year is coming to an end and we're all looking forward to the holidays, in this issue 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 2004.

## What's new on the nzmaths site this month?

There are four new units available on the site this month, all in the Algebra strand. They are:
Fibbonacci I (Level 6)
Fibbonacci II (Level 5)
Linear graphs and patterns (Level 4/5)
Tukutuku Patterns (Level 4)

## First Christmas Cracker

Since it's coming up to the summer holidays and you'll have a bit of spare time we thought we'd include a simple word finder for you to try. There are at least 50 mathematical words hidden in this letter from Russ to Cindy. The usual rules apply and you can ignore any punctuation. See how many you can find.

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Hello Cindy,
    Thanks for the paper, I'm eternally grateful. Please
thank Dan Glenn for me (treat this piece of news with
discretion but Enoch, ordinarily a real inept fellow, has
proven not to be - he had dinner with us in Dec.) I'm also
after biographies in verse and plan enough for publication
in March.
    Brad, Ian and Ray have done their prelim. It's been,
in each case, a constant and costly exercise, venturing on
the absurd. It would be immodest of me to point out that
they claimed I annoyed them considerably when I assumed
they had failed. Such events occur very rarely.
    Regarding the end of year function, in a recent reply
from Todd, he seemed non-plussed and said he would bring
Jean and leave you behind. Exams are the main problem at
the moment. Don't gasp! He remembered you at the eleventh
hour! Remind Jean she arrived late last time.
    See you,
    Russ
```

(Answers below)

## There's no such thing as coincidence

Most of us are unaware of the level of coincidence that occurs in everyday events. For example, two New Zealanders meet in London and are amazed at the number of 'friends' they have in common. It has been calculated that in the U.S. if two people are selected at random the chance they know each other is about 1 in 100,000 but that they will have one 'friend' in common 1 in 100. The probability that they are connected by a chain of two intermediaries is actually better than 99 in 100. Think how much more likely this would be in New Zealand.

The birthday paradox is well known but many still find it unbelievable - for 23 people meeting at random the probability that at least two have the same birthday is slightly better than $1 / 2$.

Numerologists and their attendant mystics often see divine intervention in coincidences. Many make a good living predicting such things as "you'll meet a tall dark stranger" but others do it just for laughs. A fine example of the latter is the Wizard of Christchurch who has put out a six-page pamphlet entitled 'Why was he born so beautiful - a scientific demonstration of the Wizard's amazing powers' - all based on apparent coincidences in numbers.

There are, of course, many unexpected patterns in numbers. In an infinite string of random digits there will be an infinite number of patterns. In the known decimal representation of $\pi$ there are hundreds including, fairly early on, seven threes in a row - the probability of this occurring by chance is nearly one in ten million. If it is not specified in advance which pattern we are looking for there is a good chance we'll find something to impress our friends.

Let's try looking for some ourselves. Random letters don't often spell words so if we find any perhaps they will have been sent by some sort of divine being!

1. Write down the first letter of each number from 1 to 10. OTTFFSSENT
2. How about just the prime numbers?

TTFSETS
3. Or the first letter of each month?

JFMAMJJASOND
4. The colours of the spectrum?

## ROYGBIV

5. The first letter of the nine planets working outwards from the sun? MVEMJSUNP
6. Or even the first letter of each word in the last sentence of paragraph four from the above editorial?

## HAPPYTIMES

[Well, it is coming up to Christmas!]
Try generating random letters yourself and see how many words you can pick out. One way is to use the random number generator on your calculator. Number the letters of the alphabet from 1 to 26 and let $26 \times$ abc rounded up determine which one is chosen (abc are the random digits).

For example, for the digits 476,
$26 \times .476=12.376$ which gives 13 when rounded up, determining the letter N .
My first attempt at a string of such letters produced SPWAJQNYOSUGPLANTTSG

## New Zealand Teaching Fellowships

One of the good things about being a teacher is that you can get a year off with full pay to do something that you enjoy doing if it is related to science, technology or mathematics. For
some reason we find hard to fathom, only 9 teachers this year even applied for a Fellowship. In order to inspire you here is the list of maths projects that have been funded since 2000. They might give you some idea of the kind of thing that teachers have worked on in the past. Note that not all of these are secondary projects.

You can find out more about these Fellowships by contacting Peter Spratt at the Royal Society. His email address is peter.spratt@rsnz.org. He would be happy to give you more details of the projects below and the Fellowships, and to tell you if an idea that you had was likely to be worth pursuing and turned into an application. Note that you will need a host to support you. I'm sure that any university or crown research institute would be only too happy to help in this way.

## 2000

Kerri Spooner, Northcote College: Promoting successful mathematical group work in schools
Jeanette Trotman, Columba College: Graphics calculators at the interface between mathematics and science
Ro Bairstow, King's College: On-line Learning of High School Mathematics
Rosheen Gray, Senior College of New Zealand: Mathematics with the Graphic Calculator - Professional Development for Junior Secondary Mathematics Teachers

Karyn Woodruffe, Pakuranga College: Open Source Software: The implications and applications to New Zealand Education

2001
Nicole Roper, Diocesan School for Girls, Auckland: Investigating the mathematics behind applications with social impact

Lesley MacKintosh, St Mary's College, Wellington: Climate Research and the Web

## 2002

Geoffrey Ackerley, Ashburton College: Statistical applications in environmental issues
Steve Connor, St Bede's College: Mathematics and Statistics in Action
Jeremy Lane, Mangere College: The mathematics in Local Government with particular reference to town planning

Saraswathy Nataraj, Selwyn College: Exploring Mathematics in Indian Culture
Carolyn Vela, Maungawhau School: CAMPS- Collaborative Analysis of Mathematics Primary Software
Glennis Williams, Oxford Crescent School: Statistical Analysis
2003
Charles Darr, Hutt Intermediate School: Teaching Primary Mathematics: Using Research to Inform Practice

Gwenda Hill, The Taieri High School: Computer Aided Statistical Teaching
Megan Jowsey, Birkenhead College: Census at School New Zealand
Ramaiya Naidu, Sir Edmund Hillary Collegiate: Mathematics in Workplace Contexts \& Practices
Gillian Robinson, Wellington Girls' College: The impact of Weeds

A further Fellowship was awarded to a mathematics teacher for "The Mathematics, Scientific \& Technological developments involved in Forensic Science" but it was declined by the teacher because he accepted a position at another school.

Vicky Binedell, St Cuthbert's College: Developing Mathematical Models to Explain Marine Mammal Strandings

Fa'avesi Talamaivao, Western Springs College: Statistics in Training
Gillian Ruffles, Glenfield College: A Palimpsest
Karen Sturman, James Hargest High School: Sports Statistics

## Second Christmas Cracker

There are ten different letters used in the message MERRY XMAS TO ALL so each one could stand for a different digit from 0 to 9 . Your task, should you accept it, is to find which letter stands for which digit given that each of the four words represents a square number and, moreover, the sum of the digits of each word is also square.

## Solution to October's problem

We were asked to find how many numbers divide into 68274 with remainder nine. Another way of putting the problem is to find how many numbers greater than nine divide exactly into 68265.

Factorising tells us that $68265=3 \times 3 \times 5 \times 37 \times 41$ so the divisors greater than nine which divide exactly into 68265 are,
$37,41,3 \times 5,37 \times 41,3 \times 37,3 \times 41,5 \times 37,5 \times 41,3 \times 3 \times 5,3 \times 3 \times 37$, $3 \times 3 \times 41,3 \times 5 \times 37,3 \times 5 \times 41,3 \times 37 \times 41,5 \times 37 \times 41,3 \times 3 \times 5 \times 37$, $3 \times 3 \times 5 \times 41,3 \times 3 \times 37 \times 41,3 \times 5 \times 37 \times 41$ and $3 \times 3 \times 5 \times 37 \times 41$, that is 20 divisors in all.

Cathy Walker came up with the answers in this form:

| $1 \times 68265$ | $3 \times 22755$ | $5 \times 13653$ | $9 \times 7585$ |
| :--- | :--- | :--- | :--- |
| $15 \times 4551$ | $37 \times 1845$ | $41 \times 1665$ | $45 \times 1517$ |
| $111 \times 615$ | $123 \times 555$ | $185 \times 369$ | $205 \times 333$ |

She then showed her confidence by saying "Thus all of these (20) factors apart from 1, 3, 5, 9 will go into 68274 with remainder 9 - I think!!!"

## Third Christmas Cracker

What do you make of this piece of tortuous prose taken from a second-rate novel?

```
    I ... I want a gift, a present for me. So, so we all
decide, at this time obviously, to spread some spirit. It
develops an appetite. Yes, put a kettle on!
```

No idea? Don't give up. There are bound to be other clues here. I'm sure you'll get to the root of the problem, in fact you can count on it!

## Decimals (another fascinating item from John Stillwell)

Number words and number symbols are an interesting topic in the history of language and mathematics. Most languages reflect the practice of counting in groups of 10, due to the fact that we have 10 fingers. There are basic words for $1,2,3,4,5,6,7,8,9,10$, and combinations of these words (often with some irregularities) used for the numbers $11,12,13$, $\ldots, 99$. Usually there is a new word for 100 , then combinations are again used for the numbers from 101 to 999 , then there is new word for 1000 , and so on.

English is like this, more or less but with several irregularities: for example, where did 'eleven' for 'ten plus one' come from? A more regular example is
Cantonese, whose number words go as follows:

$$
\begin{aligned}
1=\text { yat } & 11=\text { sup yat } \\
2=\text { yee } & 12=\text { sup yee } \\
3 & =\text { saam } \\
4=\text { say } & 13=\text { sup saam } \\
5=\text { ng } & \cdot \\
6=\text { look } & \cdot \\
7=\text { chat } & \cdot \\
8=\text { baat } & \cdot \\
9=\text { gau } & 19=\text { sup gau } \\
10=\text { sup } & 20=\text { yee sup } \\
& 21=\text { yee sup yat } \\
& \cdot \\
& \cdot \\
& \cdot \\
& 43=\text { say sup saam } \\
& \cdot \\
& 99=\text { gau sup gau }
\end{aligned}
$$

At this point, a new word is introduced for 100 (baak). This is not strictly necessary - one could use 'sup sup' $(=10 \times 10)$ but, as in other languages, the fun of inventing new words continues for a while.

$$
\begin{aligned}
1,000 & =\text { chin } \\
10,000 & =\text { maan } \\
100,000 & =\text { sup maan } \\
1,000,000 & =\text { baak maan } \\
10,000,000 & =\text { chin maan } \\
100,000,000 & =\text { maan maan } \\
1,000,000,000 & =\text { yi (don't ask me why }) .
\end{aligned}
$$

This example shows how number words are outclassed by number symbols when large powers of 10 are involved and why we calculate with symbols rather than words. Thanks to
the invention of the zero symbol 0 , all numbers can be represented in a uniform way. Only 10 symbols are required (not including the comma, which is used only to make long numbers easier to read). Successive powers of 10 simply have extra zeros, and any number can be multiplied by 10 by tacking a zero on its right hand end.

The idea of using a zero symbol seems to have originated in India nearly 2000 years ago. From there it spread to the Arab world, and then to Europe through Fibonacci's Liber abacci (1202). Until the Indian-Arabic numerals were introduced, the only practical method of calculation was by the abacus.

The next important step was the introduction of decimal fractions, made by the Dutch engineer and mathematician Simon Stevin in 1585. His book De Thiende (The Tenth) covers the arithmetic of finite decimal fractions pretty much as schools do it today. He also makes the following brief and cryptic reference to infinite decimal fractions:

It happens also sometimes that the quotient cannot be expressed by whole numbers, as 0.4 divided by 0.03 in this sort, whereby appears that there will infinitely come 3 s , and in such a case you may come so near as the thing requires, omitting the remainder . . . because that imperfection . . . is more convenient than such perfection.

Stevin actually writes the answer as $13.333 \frac{1}{3}$, so he is perfectly exact, however he does not use any notation for infinite decimals, such as 13.333 ... Perhaps he realized that it would open a can of worms to say any more.

Infinite decimals are in fact infinitely more interesting than finite decimals, but I will content myself with just one remark. How do you answer the student who does not believe that

$$
0.9999 \ldots=1 ?
$$

The most convincing answer I know is to let

$$
\mathrm{x}=0.9999 \ldots
$$

Multiplying both sides by 10 gives

$$
10 x=9.9999 \ldots
$$

because multiplication by 10 shifts the decimal point one place to the right. Then we subtract x from 10x and the infinite decimals cancel out, leaving

$$
9 \mathrm{x}=9,
$$

and therefore $\mathrm{x}=1$.

## This Month's Problem

The 12 grandchildren got together to celebrate their grandfather's birthday. He was a retired mathematician with a poor memory who had trouble remembering their names, let alone their ages. They decided to give him a little conundrum to help him out.
"Our ages are all a different whole number of years", the eldest said.
"No age divides into any other", her brother piped up.
"And the ages of the oldest and youngest are as small as they can be," piped up his twin.
What were the ages of the 12 grandchildren?
Each month we 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.

## Answers to the Christmas Crackers

1. There are more than 50 mathematical words but only 50 different ones. They are: loci, perimeter, rate, set, angle, metre, pi, ten, chord, area, real, line, Venn, add, decimal, graph, sin, inverse, plane, arc, radian, ray, one, limit, nine, tan, cos, seven, even, surd, mode, mean, point, median, side, sum, event, curve, function, centre, odd, plus, ring, index, sphere, eleven, nth, hour, shear, times
[ $50=$ excellent, $45=$ good, $40=$ good enough, less than $40=$ have a happy New Year!]
2. $\quad 27556 \quad 3249 \quad 81 \quad 400$
3. The number of letters in the words between punctuation marks are the square roots of the whole numbers from one to ten, rounded to three decimal places (check the clues again!).
