

MATHEMAGIC ON THE MOTORWAY

Carol Knights and Mike Ollerton discover that being stopped on a motorway can lead to a magical experience.

So there we were, stuck on the M6 between Birmingham and Manchester, travelling from one 'Bowland' venue to another. Mike said something ridiculous about Chichester being in Kent, and somehow we ended up at Mike Askew. Making a connection, Carol vaguely remembered an ATM conference opening address at Ripon in 1994 (she doesn't get out much!) where Mike Askew had presented the following piece of *Mathemagic*...

| | | | |
|---|----|----|----|
| 5 | 1 | 6 | 9 |
| 3 | -1 | 4 | 7 |
| 9 | 5 | 10 | 13 |
| 1 | -3 | 2 | 5 |

- In the square grid above, choose a number, circle it and then cross out all other numbers in the same column as it, and then cross out all other numbers in the same row as it.
- From the remaining numbers, choose another, circle it and repeat the crossing out process.
- And another.
- You should only have one number left, circle it.
- Add the four circled numbers together.

What happens if you choose a different starting number?

Magic!

No peeping! Don't read beyond this bit if you haven't tried it.

The square grid is constructed as follows:

Choose any values for $a, b, c, d, w, x, y,$ and z .

| | a | b | c | d |
|-----|-------|-------|-------|-------|
| w | $a+w$ | $b+w$ | $c+w$ | $d+w$ |
| x | $a+x$ | $b+x$ | $c+x$ | $d+x$ |
| y | $a+y$ | $b+y$ | $c+y$ | $d+y$ |
| z | $a+z$ | $b+z$ | $c+z$ | $d+z$ |

The 'squareful' of magic is the 4-by-4 addition table without the a, b, c, d, w, x, y, z values around the edges.

For a particular 'squareful', why do you always get the same total?

How are these 'squareful' totals connected to your initial values?

So once we'd got that one sorted, Mike posed a question about using products rather than sums. After exploring some maximum and minimum value sums of 'squareful' products we decided there was nothing particularly special about them – assuming we follow the same choosing and crossing out process.

However, we then posed this new problem: ... how many different combinations of products would there be?

We suspected that factorials would be involved,

so we tested it on a 3-by-3 grid and decided there would indeed be 6.

The example we used was:

| | | | |
|---|---|----|----|
| | 1 | 3 | 7 |
| 2 | 2 | 6 | 14 |
| 5 | 5 | 15 | 35 |
| 8 | 8 | 24 | 56 |

After a little more thought, we came up with the following piece of magic that you might like to try out: Find all 6 'squareful' product combination totals and add them together.

Just to start you off (in case we're not clear)...

In the grids below, the shaded numbers denote

the 'circled' ones.

You might ask your pupils, or audience, to generate the square initially; you then instantly work out the sum of all 6 totals, write it down, and place it in a sealed envelope. Your audience, or class, can then work through identifying all 6 combinations and their totals, and then add the totals together.

You will then magically reveal what their final total is.

But firstly you're going to need to work out how it's connected to your starting numbers. Mike won't let me tell you!

Answer – well this is the ATM so we would not wish to pose the problem and give the answer as well. However, if anyone would like to offer their answer on the ATM website...

www.atm.org.uk/forum.

Carol Knights lectures at the Mathematics Centre, University of Chichester and Mike Ollerton is a freelance consultant.

Squareful product combination 1

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

Totals: 67

Squareful product combination 2

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

61

Squareful product combination 3

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

Squareful product combination 4

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

Squareful product combination 5

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

Squareful product combination 6

| | | |
|---|----|----|
| 2 | 6 | 14 |
| 5 | 15 | 35 |
| 8 | 24 | 56 |

Totals:

The attached document has been downloaded or otherwise acquired from the website of the Association of Teachers of Mathematics (ATM) at www.atm.org.uk

Legitimate uses of this document include printing of one copy for personal use, reasonable duplication for academic and educational purposes. It may not be used for any other purpose in any way that may be deleterious to the work, aims, principles or ends of ATM.

Neither the original electronic or digital version nor this paper version, no matter by whom or in what form it is reproduced, may be re-published, transmitted electronically or digitally, projected or otherwise used outside the above standard copyright permissions. The electronic or digital version may not be uploaded to a website or other server. In addition to the evident watermark the files are digitally watermarked such that they can be found on the Internet wherever they may be posted.

Any copies of this document MUST be accompanied by a copy of this page in its entirety.

If you want to reproduce this document beyond the restricted permissions here, then application MUST be made for EXPRESS permission to copyright@atm.org.uk

*This is the usual
copyright stuff -
but it's as well to
check it out...*



The work that went into the research, production and preparation of this document has to be supported somehow.

ATM receives its financing from only two principle sources: membership subscriptions and sales of books, software and other resources.

Membership of the ATM will help you through

*Now, this bit is
important - you
must read this*

- Six issues per year of a professional journal, which focus on the learning and teaching of maths. Ideas for the classroom, personal experiences and shared thoughts about developing learners' understanding.
- Professional development courses tailored to your needs. Agree the content with us and we do the rest.
- Easter conference, which brings together teachers interested in learning and teaching mathematics, with excellent speakers and workshops and seminars led by experienced facilitators.
- Regular e-newsletters keeping you up to date with developments in the learning and teaching of mathematics.
- Generous discounts on a wide range of publications and software.
- A network of mathematics educators around the United Kingdom to share good practice or ask advice.
- Active campaigning. The ATM campaigns at all levels towards: encouraging increased understanding and enjoyment of mathematics; encouraging increased understanding of how people learn mathematics; encouraging the sharing and evaluation of teaching and learning strategies and practices; promoting the exploration of new ideas and possibilities and initiating and contributing to discussion of and developments in mathematics education at all levels.
- Representation on national bodies helping to formulate policy in mathematics education.
- Software demonstrations by arrangement.

Personal members get the following additional benefits:

- Access to a members only part of the popular ATM website giving you access to sample materials and up to date information.
- Advice on resources, curriculum development and current research relating to mathematics education.
- Optional membership of a working group being inspired by working with other colleagues on a specific project.
- Special rates at the annual conference
- Information about current legislation relating to your job.
- Tax deductible personal subscription, making it even better value

Additional benefits

The ATM is constantly looking to improve the benefits for members. Please visit www.atm.org.uk regularly for new details.

LINK: www.atm.org.uk/join/index.html