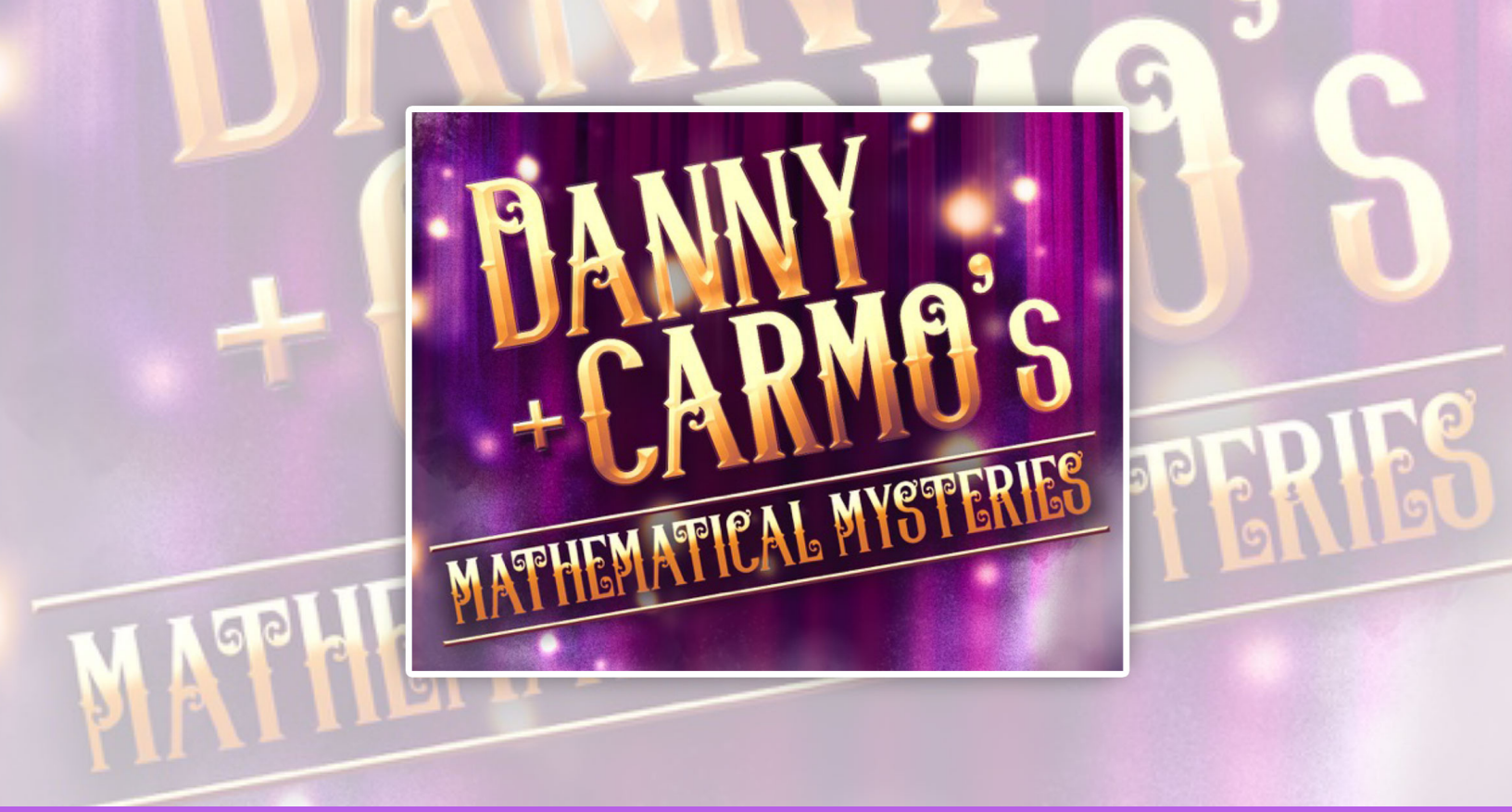


cahootsni

Friday, February 1, 2019
10am

Young Auditorium
UNIVERSITY OF WISCONSIN–WHITEWATER

HORIZONS

PERFORMANCE GUIDE

Welcome!

Young Auditorium, located on the University of Wisconsin - Whitewater campus, welcomes you to the school-day performance of *Danny Carmo's Mathematical Mysteries*, produced by Cahoots NI. This performance guide provides information, discussion topics, activities, and resources to use both before and after the performance. The materials are designed to help you integrate the show with learning objectives in many areas of the curriculum. We look forward to seeing you at Young Auditorium!

Online - www.youngauditorium.com/education
Email - horizons@uww.edu
Reservations - 262-472-4444
Questions or comments? - Shannon Dozoryst, dozoryss@uww.edu or 262-472-1432

Danny Carmo's Mathematical Mysteries
Teacher's Notes

Prepare to be amazed, dazzled & bewildered by Cahoots NI's mind-blowing production Danny Carmo's Mathematical Mysteries- a spectacular show where Math, Theatre and Digital Technology collide to create a fun and interactive performance proving that understanding Math can be fun!

Meet Danny Carmo-it's not so long ago that he thought school and, in particular, math wasn't for him. He was more interested in dreaming about a future on the stage and perhaps the big screen- all he ever wanted to be was a famous magician! But when he knuckled down to learn all the tricks of the trade he realised that Math was not only essential…it was the SECRET to a whole load of magic!

These notes can be used alongside the Danny Carmo's Mathematical Mysteries handbook, which every pupil attending the show will receive. Inside you will find lots of mathematical tips, tricks and activities to enhance your experience when using the book back at the classroom after the show.

Danny Carmo has toured across Ireland and America to great success in previous production Lights! Camera! Math with teachers noticing the benefits of the book's lasting legacy:

"I have used the book in various ways. Sometimes I perform a trick, we talk about why it might work and then look at the Maths connected with it. We then try variations. At other times I get individuals to prepare, perform and explain a trick…Skills such as calculating, Mental Maths, communicating, estimating, looking for patterns etc. are all addressed in this book and in such a way as to keep the pupils interest and to give them an incentive to complete a challenge. Thank you for a great resource."

We hope you enjoy the show and continue to enjoy solving mathematical mysteries!

X Marks the Spot

In this trick, a volunteer is asked to think of a number between 5 and 25 and then take that number of steps in an counterclockwise direction along a path of coins. The volunteer then takes the same number of steps in a clockwise direction. The performer turns over the last coin the volunteer lands on to reveal that it is marked with an X; the other coins are turned over to show they are not marked. The trick provides a novel illustration of the difference between clockwise, counterclockwise and simple arithmetic.

This is a very simple trick mathematically. It is simply a matter of counting the same number twice, once in each direction but, at the end, instead of going back down the tail to end up at the start (which wouldn't be much of a trick!) the count is completed by continuing around the circle.

The Human Calculator

This trick again requires the help of an audience volunteer and involves the performer correctly predicting the sum of five 5-digit numbers. The key to this trick is a purely mathematical phenomenon and no sleight of hand is needed.

Pupils will find this illusion draws on an ability to add large numbers together carefully and helps demonstrate that even apparently random numbers are governed by mathematical theory when considered together. To be able to perform this trick, children will need fast and accurate mental arithmetic to generate the magician's numbers. Pupils could also be asked to explain how this works mathematically.

The Sword Box Illusion

This is a trick that relies solely on the numbers to achieve its magical effect. Four pupils each choose a number from a selection of 16 laid out in a grid or matrix. Numbers positioned in the same row and column as the chosen number are eliminated. Ultimately, four numbers are left on the grid and these will always add up to 34. This trick helps build confidence in working with number grids and recognizing the differences between rows and columns.

Pupils could try this with a grid of the numbers 2 to 17 instead of 1 to 16. They will find that the total at the end is 38. Children could also be asked what they think the result would be if the grid ran from 3 to 18. They should try to figure this out without going through the procedure. There are two mathematical formulas that the students can try out here. The first being; the smallest and largest number in the grid can be doubled and then added together: $(3 \times 2) + (18 \times 2) = 42$ or the second formula, add the smallest and largest numbers and then double the sum: $(3 + 18) \times 2 = 42$.

In All Probability

This game introduces the children to the complex world of probability.
Probability can be expressed using fractions, percentages or decimals and is calculated by considering the number of ways something can happen versus the total number of outcomes. Even though it seems that the odds are in the students' favor every time, the odds are actually two and a half to one against them. This means that if you play this game over and over, you will win most of the time. The children should be encouraged to explore why this is the case. The basic principle is that it is the cumulative probability of turning over 3 picture cards that is important.

Check out this helpful website for more on probability:
www.mathsisfun.com/definitions/probability

The Magic Square

A Magic Square is simply an arrangement of numbers in a square grid so
that the sum of numbers in every row, column and diagonal is the same. Experimenting with these grids helps pupils to understand the difference between rows, columns and diagonals. It also encourages children to experiment with different combinations of numbers.

In the book, it mentions that there are 8 possible variations of the illustrated square. Pupils could be asked to find as many of these as possible and may also wish to explore different ranges of numbers and bigger grids.

The Hologram Illusion

This trick requires the help of a volunteer who has to think of a number between 0 and 9 and then arrange a selection of numbers to make a sum. Using digital root theory, the numbers are added together to produce a total that is the same as the number chosen by the volunteer at the beginning of the trick. The Hologram Illusion highlights the difference between rows and columns, as well as the importance of being able to add numbers quickly and correctly without writing them down.

Check this out for more on digital root theory:
www.nrich.maths.org/5524

The Fraction Engine

The story of the 17 camels shows the importance of understanding fractions and how they combine together.

The eldest son was to get 1/2 of the camels.
The middle son was to get 1/3 of the camels.
The youngest son was to get 1/9 of the camels.

To add these fractions together, the concept of the Lowest Common Denominator (LCD) has to be understood. In this case, the LCD is 18 so 1/2 + 1/3 + 1/9 becomes 9/18 + 6/18 + 2/18 = 17/18.

The Magic Store

This trick is all about adding sums of money together and reacting to the different choices made at each stage of the trick. The children should be encouraged to make up a set of menu cards as in the book and to perform the trick for each other. They should also explore the various paths through the cards to understand why the result is always $21 or $22.

The Magic of Time

This trick may be used to introduce children to some elementary algebra. At the end of the trick, the number we end up with is always a multiple of 9. Let's say that the number of objects removed is represented by the 2-digit number xy. This may be re-written as 10x + y. The calculation in the trick may therefore be written as (10x + y) – (x + y) = 9x so the answer is always a multiple of 9.

The Magic of 1089

In this trick, the spectator is asked to think of a 3-digit number and to carry out a number of manipulations and basic operations to end up with a final number. This result has been predicted. This is an automatic mathematical trick with the result always being 1089.

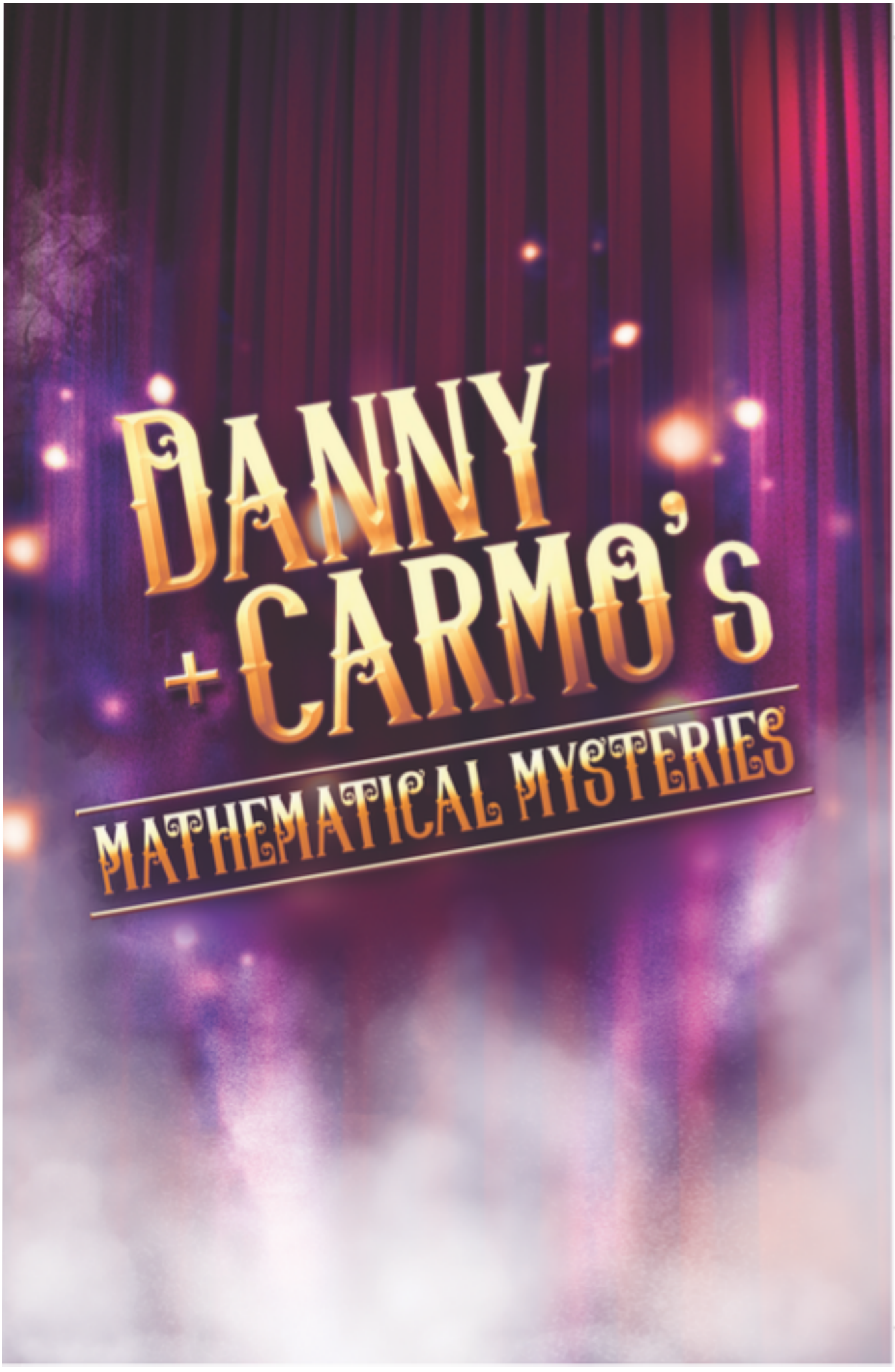
The mathematical basis of this trick depends on the idea of place value. So a number e.g. 642 may be written as 600 + 40 + 2.
Reversing the digits gives 246 or 200 + 40 + 6.

Subtracting the smaller number from the larger number gives 642-246 = 396, a multiple of 99.
Whatever number is chosen, the result is always a multiple of 99.

The possible values are 99*, 198, 297, 396, 495, 594, 693, 792 and 891.
(* If the result is 99, it should be written as 099.)

The middle digit of all these numbers is always 9 and the first and last digits of each add up to 9. Adding such a number and its reverse gives a number with a 9 in the hundreds place (i.e.900), 9+9 in the tens place (i.e.180) and 9 in the units place (i.e. 9).

900 + 180 + 9 = 1089.


DANNY
+CARMO'S
MATHEMATICAL MYSTERIES

DANNY CARMO

Hi! It's Danny Carmo here! The fact that you are reading this book probably means that you have seen my show. I really do hope you enjoyed it. It's not so long ago that I thought school and, in particular, maths wasn't for me. I was more interested in dreaming about a future on the stage and perhaps the big screen - all I ever wanted to be was a famous magician! However, when I knuckled down to learn all the tricks of the trade I realised that Maths was not only essential...but was the SECRET to lots of incredible magic!

In this book, you will find the secrets to many of the tricks that you saw in the show. You will not need any elaborate apparatus to perform them and I hope that they will inspire you to delve deeper into this wonderful world of mathematical magic.

Danny Carmo

cahootsni
world class children's theatre

Cahoots NI is at the forefront of Northern Irish theatre and is the leading professional theatre company producing work for children.

Since beginning operations in November 2001 Cahoots NI has produced original, boldly innovative work for children, some staged in conventional theatre venues and some in purpose-designed sites or specific locations, including schools and healthcare settings. Its work concentrates on combining the visual potential of theatre with the age-old popularity of magic and illusion.

For more information, please visit the company's website:

www.cahootsni.com

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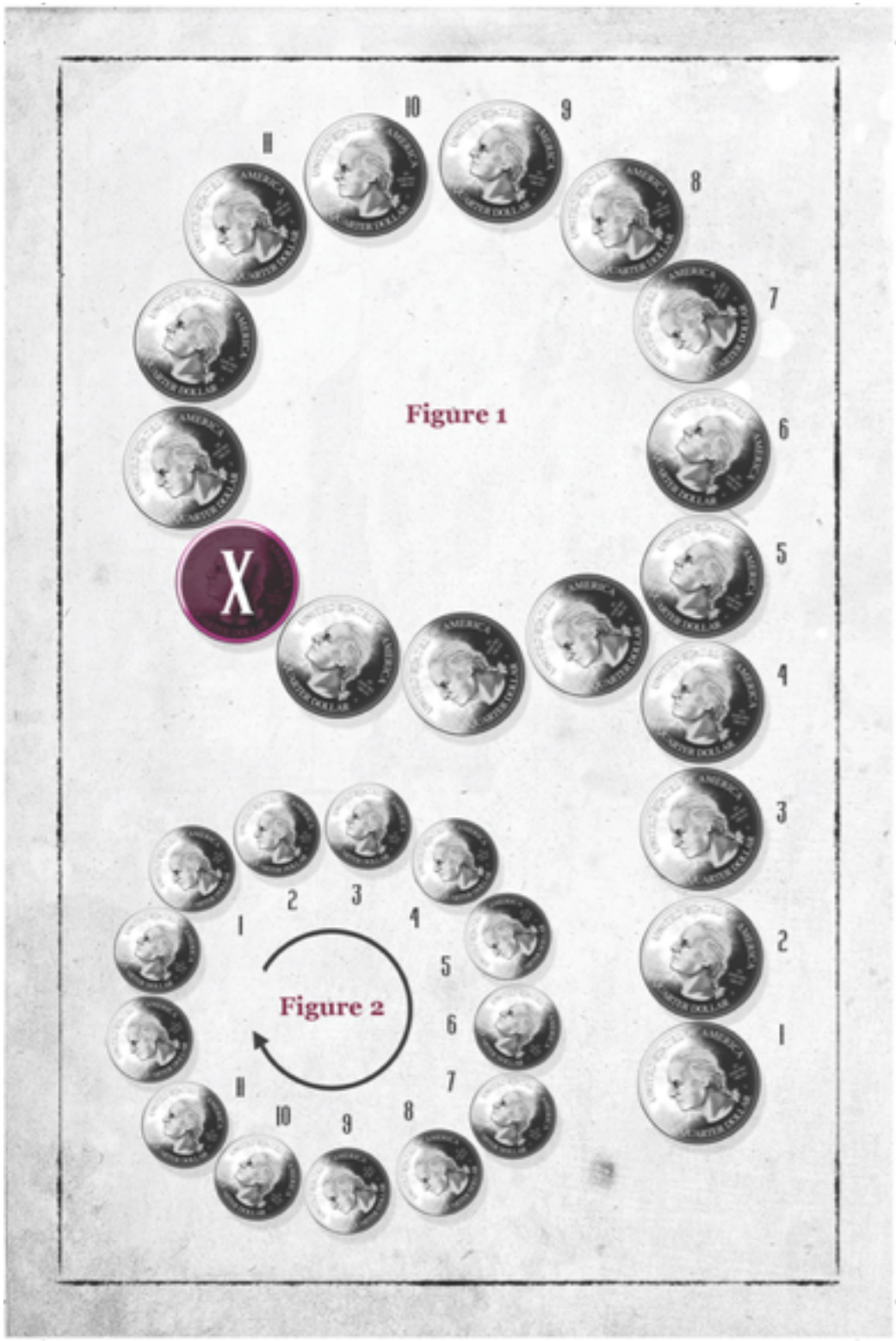

X MARKS THE SPOT

This is one of my favourite tricks. In the show, a random number was selected. This number was used to select a vinyl LP record. This LP was the only one marked with an X. I'm sure you'll agree, it looked totally impossible and yet the secret is very simple.

You can dress this trick up to be a very elaborate mystery like I did in the show, but I will explain it using coins. You will need between 12-20 coins, preferably all the same but it doesn't really matter. On one of these coins attach a small sticker to 1 side and mark it with an X. The coins must be laid out as shown in figure 1 just like the number 9 – Figure 1. Note the position of the coin with the sticker underneath.

Ask a friend to name a number between 5 - 25. Ask your friend to place their finger on the coin at the end of the tail and start counting to their selected number. They should continue counting in an anti-clockwise direction until they reach their chosen number. Now ask them to count the number again in a clockwise direction but this time ignoring the tail of the 9 (see figure 2). Have them turn over the coin they land on. It will be the marked coin. Quickly turn over all the other coins to show that they are unmarked.

THE HUMAN CALCULATOR

I think I bamboozled everyone at the show with this mind-boggling calculation. Here's what happened. Five, 5-digit, numbers were selected by the spectator and me. The numbers were added to create a final total. Amazingly, I had predicted the total.

This is a very clever mathematical trick.The method is based on a very simple formula using the number 2. Give a piece of paper and a pen to a friend and ask them to write down any random 5-digit number, for example, they may write 45789.

The prediction you create is based on this number. Subtract 2 from the last digit and place the number 2 in front of the first digit. In our example the prediction number is 245787. Write this down and leave it to one side.

Ask your friend to write another 5-digit number underneath the first. Now you write a 5-digit number underneath. Each digit you write must total 9 when added to the digit above.

Ask your friend to write another 5-digit number below yours.

Finally, you write one last number in exactly the same way as before ensuring each digit totals 9 when added to the digit above.

Ask your friend to calculate the total. Reveal that your prediction matches the total.

Note: if the last digit in the first number is either 0 or 1, subtract 2 from the last 2 digits, that is, 357830 would give you a prediction of 2357828 (30 - 2 = 28).

THE SWORD BOX ILLUSION

I just love this illusion. I'm sure you remember it. Nicola entered the Cabinet of Doom and 4 random numbers were selected on the front of the cabinet. Swords replaced the discarded numbers. Nicola survived and the total of the selected numbers had been predicted correctly.

Believe it or not this trick can't go wrong. To understand it, draw a grid with 4 rows and 4 columns and fill in the numbers as in Figure 1. You will also need a prediction which states 'I predict that your total will be 34' – it must always be 34.

You ask the first person to select a number from the grid, e.g. they may select 7. Circle the number selected (see figure 2). All the numbers in the same row and column as the selection are now eliminated. Draw a line through these numbers so they can no longer be selected. (see figure 3).

Ask the second person to select another number from the grid, e.g. they may select 9. Circle the number selected. All the numbers in the same row and column as the selection are now eliminated. Draw a line through these numbers so they can no longer be selected (see figure 4).

Ask the third person to select a number, e.g. they may select 14. Circle the number selected. All the numbers in the same row and column as the selection are now eliminated. Draw a line through these numbers so they can no longer be selected (see figure 5).

Only 1 number remains. In our example it is 4. Circle this number (see figure 6). Now add the 4 circled numbers together and they will match your prediction, 34!

IN ALL PROBABILITY

Here is one of my favourite magic tricks that uses probability to the advantage of the magician. It is done in the form of a game that appears to be very fair but that, in actual fact, is very much in your favour.

Take 5 picture playing cards and 2 spot playing cards and have your friend mix them so that neither of you knows where any card is. Now have the cards laid out face-down on the table. You then bet that your friend will not be able to turn over 3 picture cards in 3 goes. You point out that the odds are in your friend's favour by saying:

The odds that the first card you turn over will be a picture card are 5 chances out of 7.

If you get one, the chances of turning over a second are 4 out of 6.

And then it is 3 out of 5 to turn over the third picture card.

So the odds are with you all the way.

Your friend will be very keen to try this out, but they usually fail to turn over 3 picture cards in a row. Even though your words of assurance make it sound as though the odds are in their favour every time, the odds are actually two and a half to one against them! This means that if you play this game over and over, you will win most of the time.

THE MAGIC SQUARE

I think that this is one of the highlights of my show.

A Magic Square is an arrangement of numbers in a grid so that the sum of numbers in every row, column and diagonal is the same. Let's look at a Magic Square with 3 rows and 3 columns using the numbers 1 to 9.

The sum of all the numbers from 1 to 9 is 45 and, since there are 3 rows, the sum of any row must be one third of 45 i.e. 15. So the sum of the 3 numbers in any row, column or diagonal must be 15. There are 8 possibilities:

1 + 5 + 9, 1 + 6 + 8, 2 + 4 + 9, 2 + 5 + 8, 2 + 6 + 7, 3 + 4 + 8, 3 + 5 + 7 and 4 + 5 + 6

The 3 by 3 Magic Square has 3 rows, 3 columns and 2 diagonals which also makes 8. The number that appears most often in the sums above is 5 - it appears in 4 of the sums so it must be placed in the centre box (or cell) because this is the only one that is contained in 4 sums i.e. 1 row, 1 column and 2 diagonals.

Each corner cell is included in the sums for 1 row, 1 column and 1 diagonal. The numbers that appear 3 times in the sums are the even numbers 2, 4, 6, and 8 so these are placed in the corners.

The remaining numbers 1, 3, 7 and 9 are put in the last 4 empty cells. These only occur in 2 sums, 1 row and 1 column.

THE HOLOGRAM ILLUSION

I really do hope you liked the trick where a number from 1 to 9 is selected and then chosen numbers appear in a small empty box. The numbers were randomly arranged to make a sum that was then reduced to a single digit. This digit was the same as the original chosen digit – Magic!

So how did I do this feat of mathematical wizardry? The answer is surprisingly simple. Unknown to the audience, there are actually 10 numbers that can be produced from the box but normally only 9 are shown. The secret is knowing which to leave behind.

Once the spectator chooses a number, it is subtracted from 9 creating a 'secret number'. All of the numbers are produced from the box except the 'secret number'. The spectator arranges the number into rows and columns creating a sum.

The individual digits of the total are then added together and this process is repeated until you are left with a single digit. For example, if the total is 1166 this would equal 14 which in turn equals 5.

If you follow these instructions it will always work out.

Note: One very important point, if the spectator selects the number 9, then all 10 numbers would be removed from the box. Enjoy!

I'm sure you'll remember this illusion for a very long time. It also shows the importance of understanding fractions. Here is a story that illustrates how useful this knowledge can be.

THE 17 CAMELS

Once upon a time in a faraway land, there lived an elderly nomad. He had lived a long and happy life but the time came when he knew he was about to die. The old man had three sons and wanted to distribute his possessions among them before he died. He had 17 camels.

As his death drew close he gathered his three sons around him to inform them of their inheritance.

THE FRACTION ENGINE

The eldest son was to get 1/2 of the camels, his middle son a 1/3 and his youngest a 1/9.

Then he died in peace, his duty done.

They sincerely wanted to honour their father's wishes and also wanted all of their inheritance. But how, they wondered, could they possibly divide 17 camels in accordance with their father?

Is it impossible? - Can you find a way to distribute the camels?

Here's what happened.

There lived a wise man in a cave, so the 3 sons took their problem to him. The wise man thought for a while and, after a long silence, said that he could not help. However, the wise man offered them a camel that he no longer needed. The boys accepted the extra camel with gratitude. As they were preparing to leave, the eldest brother realised that; as they now had 18 camels, they were able to honour their father's wishes.

The eldest son could now have 1/2 of the 18 camels = 9

The middle son could now have 1/3 of the 18 camels = 6

The youngest son could now have 1/9 of the 18 camels = 2

Imagine their surprise when they discovered that their inheritance came to exactly 17 camels. They now had one extra. So they gave the wise man his camel back. He accepted it with a twinkle in his eye.

Single Sided Card

STARTER	
A. Prawns:	$3.00
B. Melon:	$4.00

Double Sided Cards

Side A		Side B	
SOUP		**SOUP**	
A. Chicken:	$2.00	A. Tomato:	$1.00
B. Beef:	$3.00	B. Leek:	$2.00
MAIN COURSE		**MAIN COURSE**	
A. Turkey:	$14.00	A. Stew:	$13.00
B. Steak:	$15.00	B. Ham:	$14.00
DESSERT		**DESSERT**	
A. Jelly:	$2.00	A. Cake:	$1.00
B. Eclairs:	$3.00	B. Pie:	$2.00
TOTAL		**TOTAL**	
$21.00		**$22.00**	

THE MAGIC STORE

This trick was all about buying. Even though the helper who came up had a perfectly free choice of items to buy, I somehow had predicted what the total would be. Here is a trick that you can do that works in the same way. You lay a prediction envelope on the table. You explain that you are going to let them choose a starter, soup, main course and dessert. The total price is calculated and when the prediction is opened, it is correct.

To do this trick, you need to make up some menu cards as shown on the opposite page. The starter card is printed only on one side but the other 3 are printed on both sides. You also need a two-sided prediction as shown. This should be put in an envelope.

Put the 4 menu cards in one of your pockets so that you know which way they are facing and set the prediction on the table in front of some friends.

Take out the starter card and ask one of them to choose a starter. Write down the cost of the starter and note whether it is Item A or B. If the starter choice is A, bring out the soup menu with side A showing and if the starter choice is B, bring it out with side B showing.

Now repeat the above for the soup, main course and dessert.

Put the menu cards away being careful not to show that 3 of the cards are double-sided.

Now add up the 4 prices. The total will always be $21 or $22. All that remains to be done is to bring out the prediction with the correct side showing and take a well-earned bow!

STEP 1: PICK A NUMBER BETWEEN 10 AND 50

37 — A

STEP 2: ADD BOTH NUMBERS

3 + 7 =

10 — B

STEP 3: SUBTRACT B FROM A

37 - 10 =

27

THE MAGIC OF TIME

This has always been one of the most popular tricks in my show. It's the one where a watch is borrowed, vanished and ends up inside a randomly selected magic wand. The method of selecting the wand seems totally fair, but all is not what it appears!

In the show I used a bucket filled with sponge balls, but to understand the secret you can use any objects as long as you have about 50 of them. Paper clips or coins are a good substitute.

Put these into a container and reach in and take a handful. Now count these. Let's say you have taken 23. Write down 23 on a piece of paper. Now add the 2 digits of your number together. 2 + 3 equals 5. Write that down below the 23 and subtract it from it. You get 18.

Here's another example. Let's say you grabbed 35 objects. Write down 35 and subtract from it 8 (8 is 3 + 5). You end up with an answer of 27.

These 2 answers are multiples of 9. Regardless of how many objects you take, the final result of the calculation will be a multiple of 9. You will remember that each magic wand had 4 numbers on it. The 4 numbers on one of them were 9, 18, 27, 36. All I had to do was to make sure the watch ended up in that wand!

STEP 1: PICK ANY 3-DIGIT NUMBER

316

STEP 2: REVERSE THIS NUMBER

613

STEP 3: SUBTRACT THE SMALLER NUMBER FROM THE LARGER

613 - 316 =

297

STEP 4: REVERSE THIS NUMBER AND ADD THEM BOTH TOGETHER

297 + 792 =

1089

THE MAGIC OF 1089

This is one of my favourite, any place, any time tricks. It is particularly good because it is self-working. All you have to do is follow the instructions. Because you know the answer in advance, you can use this knowledge in many different ways e.g. you could use 1089 to choose a word from a book (Word 10 on Page 89) and you have predicted the word.

Have a friend write down a 3-digit number. Have them reverse the order of the digits and subtract the smaller number from the larger number.

Now have them reverse the answer and add this to the answer. The diagram opposite makes this very clear. The answer will always be 1089!

If the answer to the first part of the calculation is 99, have your friend put a zero in front so that it becomes 099. This is the only exception.

Here are a couple of interesting facts. If you look at the answer to the first part of the calculation, the centre digit will always be 9 and the first and last digits will add up to 9. You can use this information to check quickly that your friend has done the subtraction correctly.

MY NOTES

MY NOTES

MY NOTES

MY NOTES

DANNY CARMO

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I hope you have enjoyed the tricks in this book and that you will try them on all of your friends and family. If, like me, you would like to explore this fascinating subject more, there are lots of places you can look. Here are a few of my favourite books that are all readily available.

Self-Working Number Magic
by Karl Fulves

Mathematics, Magic and Mystery
by Martin Gardner

Mathematical Wizardry
by Harry Lorayne

Mathemagic
by Royal Vale Heath

Mathematical Magic
by Bill Simon

I hope you get many hours of enjoyment out of mathematical magic.

Until the next time...

Danny Carmo

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