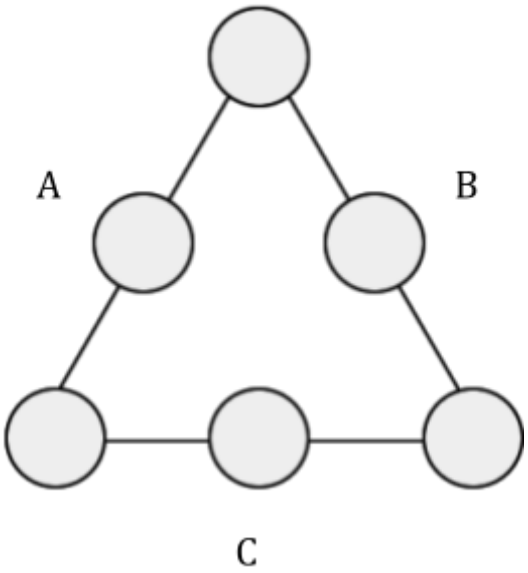
Magic Squares

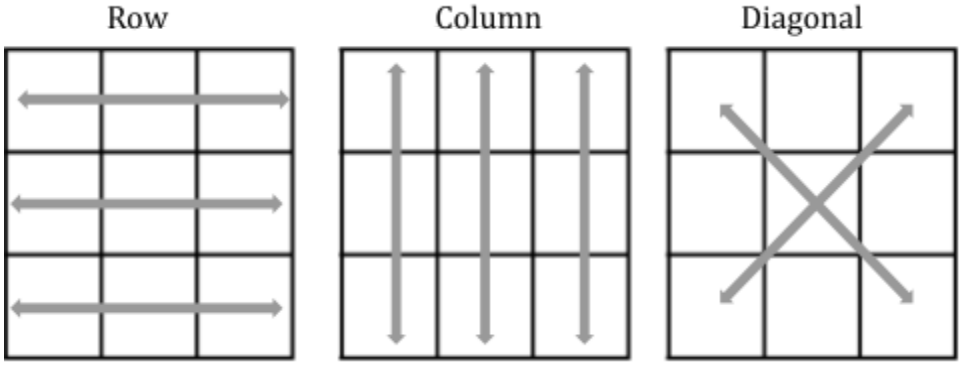
A Number Puzzle

1. The numbers 1, 2, 3, 4, 5, 6 are placed in the diagram, one in each circle. The numbers along side A add up to 13, the numbers along side B add up to 13, and the numbers along side C add up to 6. What number is in the topmost circle?

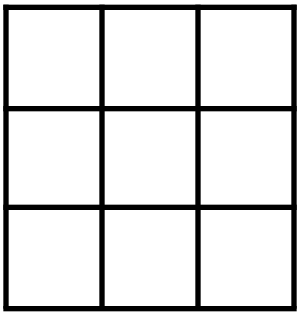


Magic Squares

A Magic Square is a square grid with the property that the numbers in each row, column, and diagonal add up to the same number (the *magic number*). It turns out that this is possible in the 3 x 3 case.



1. Can you place the numbers 1 - 9 in a 3 x 3 grid so that each row, column, and main diagonal add up to the same sum? (Hint: try using 15 as your *magic number*)

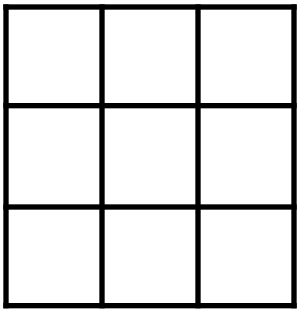


2. How many solutions can you find? Try listing all of them out.

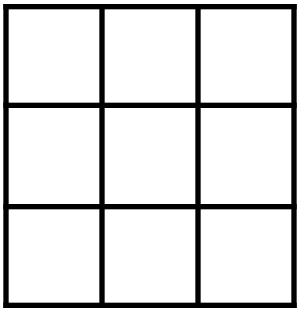
3. What patterns do you see in a magic square? What stays the same in your solutions? What kinds of transformations can you make to get from one solution to the next?

Building More Magic Squares

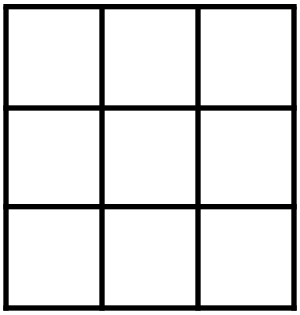
1. Now instead of the numbers from 1 - 9, try using the numbers 2 - 10. Is it still possible to make a magic square? Try guessing the *magic number* before building out your square!



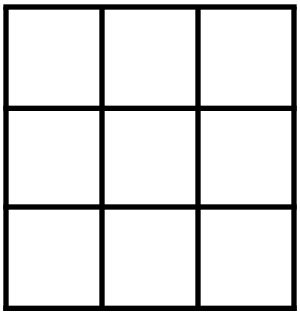
2. Can you build a magic square out of the numbers: -4, -3, -2, -1, 0, 1, 2, 3, 4? What would be the *magic number*?



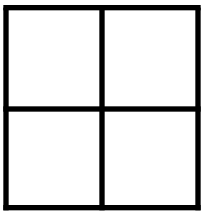
3. What about with the first 9 even numbers? Odd numbers?



4. Can you make a magic square with any 9 consecutive numbers? What *magic sum* would you use?



5. Is a magic square possible with a 2 x 2 grid?



6. Are there larger magic squares?

Latin Squares

Here is another kind of square called a Latin Square. In a 3 x 3 Latin Square, each row and column contains the numbers 1,2,3 exactly once. One example is to the side - see if you can find more.

1	2	3
2	3	1
3	1	2

1. Below is an example of 4 by 4 Latin Square, where each row and column contains the numbers 1, 2, 3, 4 exactly once. There are no repeat numbers within a row or column. What should the number in the shaded box be?

			1
	2		
1			4

2. Try making your own Latin Square!

Sources

- Richard Kalman and Nicholas J. Restivo, MOEMS Contest Problems Volume 3
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- AIMC. https://aimathcircles.org/issue-51-magic-squares-redux/
- AIMC. https://aimathcircles.org/issue-49-magic-squares/
- Sarah Flannery and David Flannery, In Code: A Mathematical Journey (2002).
- Magic Square. https://mathworld.wolfram.com/MagicSquare.html
- Latin Square. https://archive.lib.msu.edu/crcmath/math/math/l/l101.htm