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# Magic Squares

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## Magic Squares

For $n \geq 2$, let $A$ be set of $n^2$ elements and $l$ an $n$-ary relation defined on $A$. As a generalization of the XVIth-XVIIth century magic squares, we present the magic square of order $n$. This is square array of elements of $A$ arranged so that $l$ applied to all rows and columns yields the same result.

If $A$ is an arithmetic progression and $l$ addition, then many such magic squares are known. The following appeared in Durer's 1514 engraving, "Melancholia"

| | | | |
|---|---|---|---|
| 16 | 3 | 2 | 13 |
| 5 | 10 | 11 | 8 |
| 9 | 6 | 7 | 12 |
| 4 | 15 | 14 | 1 |

Questions:

1) Can you find magic square of order at least three or four where $A$ is a set of prime numbers and $l$ is addition?

2) Same question when $A$ is a set of square, cube or other spacial numbers such as the Fibonacci, Lucas, triangular or Smarandache quotients. Given any $m$, the Smarandache Quotient $q(m)$ is the smallest number $k$ such that $mk$ is a factorial.

A similar definition for the magic cube of order $n$, where the elements of $A$ are arranged in the form of a cube of length $n$.

3) Study questions similar to tose above for the cube. An interesting law may be

$$l(a_1, a_2, \ldots, a_n) = a_1 + a_2 - a_3 + a_4 - a_5 \ldots$$

# References


[1] F.Smarandache, "Properties of the Numbers", University of Craiova Archives, 1975. [See also the Arizona State Special Collections, Tempe, AZ., USA].