fedele mastroscusa

About magic squares

edizioni tahoka
a. D. mmiii

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TUTTI I DIRITTI RISERVATI

The main question about magic squares, as it seems, is their building and their development through the ages. A next question points at their actual use, here and there, now and then. At the outskirt of the subject lies something else, a sub-subject which can be picked and worked up. Such a sub-subject, so far as it is known by the writer of this paper, was never hinted at, and therefore bears no name: after its displaying, if ever, it will be named, be it worth surviving.

On these premises, let's wander cautiously through the wonderland of magic squares. Let's write the 3rd order magic square (A) – the simplest and commonest one – and let's side it with two same built mates (B) and (C).

A

8	1	6
3	5	7
4	9	2

B

26	5	20
11	17	23
14	29	8

C

42	7	32
17	27	37
22	47	12

being the sum of their elements:

$$S\,A = 45$$
$$S\,B = 153$$
$$S\,C = 243$$

Each m. s. is defined by three parameters: **n**, **b**, **d**: order, base, ratio. Usually **b**, i.e. the starting number, is **1**, and so is **d**, but nothing forbids to get **b**, **d** ? R, and further on **b**, **d** ? C.

It is obvious to fill the square (a magic square is to be seen) but a translation into formulae, i.e. dropping lattice and numbers and working up formulae, is an easier and more immediate method to skip from one to another, so only the resulting one will be dressed.

$$M\ ?\ \ {}_{b}Q^{n}_{d}\ \ ?\quad S\,M = n^2 \cdot [b + (n^2 - 1)/2 \cdot d]$$

Referring to the former magic squares

$$A\ ?\ \ {}_{1}Q^{3}_{1}\ \ ?\quad S\,A = 9 \cdot (1 + 4 \cdot 1) = 45$$

$$B\ ?\ \ {}_{5}Q^{3}_{3}\ \ ?\quad S\,B = 9 \cdot (5 + 4 \cdot 3) = 153$$

$$C\ ?\ \ {}_{7}Q^{3}_{5}\ \ ?\quad S\,C = 9 \cdot (7 + 4 \cdot 5) = 243$$

Operating D = A + B; E = C - B

D

34	6	26
14	22	30
18	38	10

E

16	2	12
6	10	14
8	18	4

S D = 198

S E = 90

Translating into the above stated formula

$${}_{1}Q^{3}_{1} + {}_{5}Q^{3}_{3} = {}_{6}Q^{3}_{4}\ ;\quad {}_{7}Q^{3}_{5} - {}_{5}Q^{3}_{3} = {}_{2}Q^{3}_{2}$$

Verifying

$${}_{6}Q^{3}_{4}\ \ ?\quad S\,M = 9 \cdot (6 + 4 \cdot 4) = 198$$

$${}_{2}Q_{2}^{3} \quad ? \quad SM = 9 \cdot (2 + 4 \cdot 2) = 90$$

hence $${}_{b}Q_{d}^{n} \pm {}_{r}Q_{s}^{n} = {}_{b\pm r}Q_{d\pm s}^{n}$$

formula for the algebraic sum of the <u>same built</u> m. s. As for the multiplication it is easy to get

$$M \,?\, {}_{b}Q_{d}^{n} \quad ; \quad kM \,?\, {}_{kb}Q_{kd}^{n}$$

Another obvious feature is

$${}_{b}Q_{d}^{n} = {}_{r}Q_{x}^{n} \quad ; \quad {}_{b}Q_{d}^{n} = {}_{x}Q_{s}^{n}$$

$${}_{7}Q_{2}^{5} = {}_{3}Q_{x}^{5} \; : \; {}_{7}Q_{2}^{5} \quad ? \quad SM = 25 \cdot (7 + 12 \cdot 2) = 775$$

$${}_{3}Q_{x}^{5} \quad ? \quad SM = 25 \cdot (3 + 12 \cdot x) = 775$$

$x = (775/25 - 3)/12 = 2.333...$:

$${}_{3}Q_{2.(3)}^{5} \quad ? \quad SM = 25 \cdot [3 + 12 \cdot 2.(3)] = 775$$

Likewise it is easy to jump from an order to another:

$${}_{b}Q_{d}^{p} = {}_{r}Q_{x}^{q} \quad ; \quad {}_{12}Q_{3}^{7} = {}_{54}Q_{x}^{5}$$

$${}_{12}Q_{3}^{7} \quad ? \quad SM = 49 \cdot (12 + 24 \cdot 3) = 4116$$

$${}_{54}Q_{x}^{5} \quad ? \quad SM = 25 \cdot (54 + 12 \cdot x)$$

$x = (4116/25 - 54)/12 = 9.22$

Verifying $\quad {}_{54}Q^{5}_{9.22}$? $\quad SM = 25 \cdot (54 + 12 \cdot 9.22) = 4116$

The strict purpose of this paper is to supply a new approach to magic squares, by changing order, base, ratio (would we now go farther, we' d reach $f\,(x, y, z) = x^2 \cdot [y + (x^2 - 1)/2 \cdot z]$, whose subset J can be mapped into magic squares)

$$J \;?\; {}_{y}Q^{x}_{z} \;; \quad y, z \;?\; R; \;\; 2 < x \;?\; N$$

A magic square, because of its lattice balanced in rows columns diagonals, is at first sight readable as a set of interlocked loads, any loads. By the way, we can't help recalling that magic squares are the forlorn children of archetypes (in the 7th Book of his *Archidoxis Magica* Paracelsus handed down the manufacturing of 7 seals with 7 m. s. – from the 3rd order to the 9th one – for conjuring the 7 gods, and planets and metals).

Here and now, we emphasize that our civilisation, as a civilisation of patterns (the very ideologies, which people are so proud of, aren't but blurred patterns), is due to make room for magic squares: tomorrow or day after tomorrow, or next week.

Further examples may be worked out. Let's have

$$ {}_{x}Q^{5}_{y} \;?\; \quad SM = 852; \;\; 25 \cdot (x + 12 \cdot y) = 852;$$

$x + 12 \cdot y = 34.08$: let $x = 1.08$; $y = 33/12 = 2.75$; then

${}_{1.08}Q^{5}_{2.75}$? $\quad SM = 852$ as it may be easily verified

let's go on: $\quad {}_{1.08}Q^{5}_{2.75} = {}_{1.08}Q^{4}_{y} = {}_{x}Q^{4}_{2.75}$

$16 \cdot (1.08 + 7.5 \cdot y) = 852; \qquad 16 \cdot (x + 7.5 \cdot 2.75) = 852;$

$y = 6.6956$; $x = 32.6225$; $\quad {}_{1.08}Q^{4}_{6.6956} = {}_{32.6225}Q^{4}_{2.75}$

As for $_{1.08}Q^{5}_{2.75} = {}_{1.08}Q^{4}_{6.6956}$ let's map their magic squares:

45.08	64.33	1.08	20.33	39.58
61.58	12.08	17.58	36.83	42.33
9.33	14.83	34.08	53.33	58.83
25.83	31.33	50.58	56.08	6.58
28.58	47.83	67.08	3.83	23.08

105.420	14.992	8.036	84.552
28.904	63.684	70.640	49.772
56.728	35.860	42.816	77596
21.948	98.464	91.508	1.080

From these above worked examples we get a new way for changing a set of balanced loads into equivalent sets, as it may be requested for an actual application, whichever may it be.

Morano, August 21st, 1997; rev. Sept. 13th 2003

-2	-7+5i	-2i
-1-i	-3+i	-5+3i
-6+4i	1-3i	-4+2i