A magic square in Ramanujan's Honour

In recent months, a Power-Point presentation file on a fourth-order magic square has been doing the rounds on the internet. It is titled "Ramanujan's magic square" and it is written in a rather dramatic style. We give the gist of its content below, and then we ask you to account for the observed properties of the square using the theorems about fourth-order magic squares established elsewhere in this issue. (In some cases, we do not use the theorems themselves but extensions of those results. We ask you to prove the extensions for yourself.)

The square uses Ramanujan's birthday (December 22, 1887) to fill the cells in the top row (by now, you should know how to construct fourth-order magic squares with any given top row).

The author now asks: "What's so great in this?" and proceeds to answer the question himself or herself (as is usual with many such mails, one does not quite know whether the author is a man or a woman—or indeed who the author is at all!).

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The first point that the author makes is that the row sums are all equal to 139, and so are all the column sums and the sums of the two main

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diagonals. (Please check for yourself that this is so.) This, of course, merely affirms that the structure is a magic square.

But now follow several other points of interest:

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The sum of the four corner elements of the square is the same number (note the numbers in the cells coloured red), i.e., 22 + 87 + 11 + 19 = 139.

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The sums of the numbers in the two sets of like-coloured cells are again the same number (139).

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The sums of the numbers in the two sets of like-coloured cells here are yet again the same number (139).

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The sum of the numbers in the four central cells is 139.

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

The sums of the numbers in these like-coloured 2 × 2 blocks are all 139.

22	12	18	87
88	17	9	25
10	24	89	16
19	86	23	11

And so also in these two coloured 2 × 2 blocks.

We invite the reader to relate all these observations with the theorems we have proved about fourth-order magic squares, and then to appreciate for himself or herself that every fourth-order magic square has these very same properties. And that is truly magical indeed.

The COMMUNITY MATHEMATICS CENTRE (CoMaC) is an outreach arm of Rishi Valley Education Centre (AP) and Sahyadri School (KFI). It holds workshops in the teaching of mathematics and undertakes preparation of teaching materials for State Governments and NGOs. CoMaC may be contacted at shailesh.shirali@gmail.com.