HYPOTHESIS ON THE DETERMINATION OF A RULE FOR THE CROSS WORDS PUZZLES

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The problems of cross words are composed, as we know, of grids and definitions. In the Romanian language one imposes the condition that the percentage of black boxes compared to the total number of boxes of the grid not to go over 15%.

Why 15%, and not more or less? This is the question to which this article tries to answer. (This question is due to Professor Solomon MARCUS - National Symposium of Mathematiques "Traian Lalesco", Craiova University, June 10, 1982).

First of all we present here a table which shows in a synthetic manner, a statistics on the grids containing a very small percentage of black boxes (of [2], pp. 27-29):

THE GRIDS-RECORDS

Grid dimension	Minimum number of registered black boxes	Percentage of black boxes	Number of grids-records constructed until June 1, 1982
8x8	0	0.000%	24
9x9	0	0.000%	3
10x10	3	3.000%	2
11x11	4	3.305%	1
12x12	8	5.555%	1
13x13	12	7.100%	1
14x14	14	7.142%	1
15x15	17	7.555%	1
16x16	20	7.812%	2

In this table, one can see that the larger the dimension of the grid, the larger is the percentage of black boxes, because the number of long words is reduced.

The current dimensions for grids go from 10x10 to 15x15.

One can notice that the number of the grids having a percentage of black boxes smaller than 8 is very reduced: the totals in the last column represent all the grids created in Romania since 1925 (the appearance of the first problems of cross words in Romania), until today. It is thus seen that the number of the grid-records is negligible when one compares it with the thousands of grids created. For this reason, the rule that imposed the percentage of the black boxes, should have established to be greater than 8%. But the

cross words being puzzles, they must address to a large audience, thus one did not have to make these problems too difficult.

From which a percentage of black boxes at least equal to 10%.

They must be not too easy either, that is not to necessitate any effort from those who would compose them, from where a percentage of black boxes smaller than 20%. (If not, in effect, it becomes possible to compose grids wholly formed of words boxes of 2 or 3 letters).

To support the second assertion, one assumes that the average length of the words of a $n \times m$ grid with p black boxes is sensible equal to $\dfrac{2(n \cdot m - p)}{n + m + 2p}$ (from [3]. § 1, Prop. 4). For us, p is 20% of $n \cdot m$, therefore it results that

$$\frac{2(n \cdot m - \dfrac{20}{100} n \cdot m)}{n + m + 2\dfrac{20}{100} n \cdot m} \leq 3 \Leftrightarrow \frac{1}{n} + \frac{1}{m} \geq \frac{2}{15}.$$

Thus, for current grids having 20% of black boxes, the average lengths of the words would be smaller than 3.

Similarly at the beginnings of the puzzle of cross words the percentage of black boxes were not too large: thus in a grid from 1925 of 11x11, one counts 33 black boxes, therefore a percentage of 27.272% (from [2], p. 27).

While being developed, for these puzzles were imposed "stronger" conditions – that is a reduction in the black boxes.

For selecting a percentage between 10 and 20%, it is supposed that the peoples' predilection for round numbers was essential (the cross words are puzzles, no need for mathematic precision of sciences). That's why the rule of 15%.

A statistic (from [3], § 2), shows that the percentage of black boxes in the current grids is approximately 13.591%. The rule is thus relatively easy to follow and it can only attract new crossword enthusiasts.

To completely answer the proposed question, one would need to consider also some philosophical, psychological, and especially sociological aspects, especially those connected to the history of this puzzle, its ulterior development, and with its traditions.

REFERENCES

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