

When the First Click Protects Its Neighbours the Centre Opens Widest; When It Protects Only Itself a Corner Can Do Better

— if only the clicked cell is safe, a zero is likeliest at a corner with few neighbours, but if the neighbours are safe too the clicked cell is always a zero and the centre, with the most neighbours, spreads widest —the separator is whether the guaranteed safe region is the single clicked cell or the nine cells around it — [Paper 950]

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— *From thinking to syncing.* —

Abstract

In Minesweeper there are conventions that make the clicked cell safe on the first click, or that make its neighbours safe as well, so the first click never hits a mine. This paper sets the two conventions on the beginner, intermediate and expert boards, finds by formula and by random trials the probability of a zero when clicking a corner, the middle of an edge or the centre, and compares the number of cells opened by the first click. No new theorem or law is claimed. First, if only the clicked cell is safe, a zero is likeliest at a corner and least likely at the centre: the probability of a zero was 0.666261 at a corner, 0.503453 at an edge and 0.325669 at the centre on the beginner board, and 0.498463, 0.312508 and **0.154487** on the expert board; the shares in 3000 random trials matched the formula within three standard errors (Section 2). Second, if only the clicked cell is safe, a corner opens wider on some boards: the mean number of cells opened was 19.068 at a corner and 16.398 at the centre on the beginner board (a difference of 4.93 standard errors) and 8.161 and 6.979 on the expert board (3.01). On the intermediate board it was 16.339 and 17.616, a difference of only 1.72 standard errors, and the order could not be told (Section 3). Third, if the eight neighbours are safe too, the centre opens widest: the clicked cell is always a zero, and the mean opened was 27.788 at a corner and 46.034 at the centre on the beginner board, 26.690 and 63.884 on intermediate, and 15.436 and 39.550 on expert, the centre opening 1.656622, 2.393526 and **2.562159** times as many as the corner (Section 3). Fourth, with the neighbours safe, clicking the centre usually opens a large area: the share opening 20 or more cells was **0.968667** at the beginner centre (corner 0.584333) and 0.777333 at the expert centre (corner 0.256000) (Section 3). Fifth, the separator is whether the guaranteed safe region is the single clicked cell or the nine cells around it: with one cell, mines can sit next to the clicked cell, so the corner with few neighbours gets a zero more easily. With nine cells a zero is guaranteed, and the centre with the most neighbours has the most openings to spread through (Section 4). **Keywords:** Minesweeper, first click, mine density, combinatorial probability, random trials, board corner.

Scope of this paper (scope note): No new theorem or law is claimed: the rules of Minesweeper, that the first-click safety convention differs between versions of the game, and the folklore that corners give zeros more easily are all known. The formula for the probability of a zero is elementary counting. These are set boards: only the three boards beginner 9×9 with 10 mines, intermediate 16×16 with 40 and expert 16×30 with 99; mines were placed at random among the cells the convention allows. Winning is not treated: how to read from the second click on, the probability of winning, and time are not treated. Only the area opened by the first click is counted. No real version is claimed, which game uses which convention is not stated. Relation to earlier papers: Paper 924, in its scope note, did not discuss winning strategies and did not treat where to open, rules that make the first click safe, or probability tables; this paper sits in the seat of rules that make the first click safe, and enters where to open only for the first click (no earlier occupant). Paper 924 showed that a fifty-fifty in Minesweeper is not set by the visible numbers alone and tilts with the density of mines left on the board. Here it is counted that the first-click convention changes how that density is laid out and changes the area opened. What is added: the probability of a zero by formula and by random trials for two conventions, three boards and three positions, comparing the mean area opened with standard errors, finding the ratio of centre to corner, and placing the separator on “the guaranteed safe region”.

1. Notation and the Question

Boards: beginner 9×9 with 10 mines, intermediate 16×16 with 40, expert 16×30 with 99. Without a convention, the probability of hitting a mine on the first click is 0.123457, 0.156250 and 0.206250.

Conventions: (1) only the clicked cell is safe (mines are placed at random among the other cells). (2) the clicked cell and its eight neighbours are safe (at the edge, those inside the board).

Click position and opening: click a corner, the middle of an edge (the middle of the first row) or the centre. If the clicked cell shows 0, the 0 cells connected horizontally, vertically or diagonally and their surroundings open at once. Otherwise one cell opens.

Formula: under convention (1), with N cells, M mines and k neighbours of the clicked cell (3 at a corner, 5 at an edge, 8 at the centre), the probability of a zero is:

$$P_0 = \frac{\binom{N-1-k}{M}}{\binom{N-1}{M}}$$

Under convention (2), $P_0 = 1$. For each combination of convention and position, 3000 random boards were made to check.

Question: does the first-click convention change where a click opens the widest?

2. Probability of a Zero

Computation 2.1: probability of a zero under convention (1) (formula; random share in parentheses).

board	corner	edge	centre
beginner	0.666261 (0.679000)	0.503453 (0.502333)	0.325669 (0.338667)
intermediate	0.598050 (0.592333)	0.422943 (0.416000)	0.250103 (0.260000)
expert	0.498463 (0.482333)	0.312508 (0.307333)	0.154487 (0.145000)

All nine random shares matched the formula within three standard errors. Under convention (2) all nine shares were 1.000000.

Observation 2.2

if only the clicked cell is safe, the fewer the neighbours, the likelier a zero. On all three boards the probability of a zero fell from corner to edge to centre: the centre needs all 8 neighbours to be free of mines, and on the expert board it was 0.154487.

3. Area Opened by the First Click

Computation 3.1: mean number of cells opened (standard error in parentheses) and share opening 20 or more cells.

board, convention	corner	edge	centre	20 or more (corner, centre)
beginner (1)	19.068 (0.351)	18.524 (0.378)	16.398 (0.412)	0.400000, 0.328000
beginner (2)	27.788 (0.328)	35.460 (0.294)	46.034 (0.209)	0.584333, 0.968667
intermediate (1)	16.339 (0.439)	17.580 (0.499)	17.616 (0.597)	0.259667, 0.235000
intermediate (2)	26.690 (0.476)	40.815 (0.532)	63.884 (0.585)	0.451000, 0.914000
expert (1)	8.161 (0.224)	8.623 (0.287)	6.979 (0.322)	0.128000, 0.114000
expert (2)	15.436 (0.246)	25.852 (0.361)	39.550 (0.447)	0.256000, 0.777333

Computation 3.2: difference between corner and centre.

board	convention (1): corner minus centre (in standard errors)	convention (2): centre / corner
beginner	2.670 (4.93)	1.656622
intermediate	−1.276 (−1.72)	2.393526
expert	1.182 (3.01)	2.562159

Under convention (2) the difference between centre and corner exceeded five standard errors on all three boards (46.94 on beginner, 49.32 on intermediate, 47.25 on expert).

Observation 3.3

the convention switches where a click opens widest.Under convention (1), the corner, which gives zeros more easily, opened wider than the centre on the beginner and expert boards. On intermediate the difference was 1.72 standard errors and the order could not be told: under convention (2) the centre opened widest on all three boards, 1.656622 to 2.562159 times the corner. Clicking the centre of the beginner board opened 20 or more cells with a share of 0.968667.

4. The Separator

Observation 4.1

the separator is whether the guaranteed safe region is the single clicked cell or the nine cells around it.With one cell, mines can sit next to the clicked cell, so whether a zero appears matters first, and the corner with few neighbours tends to gain: with nine cells a zero is guaranteed, only how far it spreads remains, and the centre with the most neighbours opened widest. On the same board, a different convention changes the answer to where to click.

Observation 4.2

what is not said. Reading from the second click on, the probability of winning, the conventions of real versions, and the order of corner and centre on the intermediate board under convention (1) are not treated. What is shown is that on three boards the first-click convention changes the likelihood of a zero and the area opened, and switches where a click opens widest.

5. Roll Call and Closing

1. two conventions and the formula for a zero (Section 1): **neighbours 3, 5 and 8.**
2. under (1) corners give zeros more easily (Computation 2.1): **expert centre 0.154487.**
3. under (1) a corner is wider on some boards (Computation 3.2): **beginner and expert; intermediate cannot be told.**
4. under (2) the centre is up to **2.562159** times the corner (Computation 3.2): **centre on all three boards.**
5. **0.968667** opening 20 or more at the beginner centre (Computation 3.1): **usually a large opening.**
6. safe region of one cell or nine (Observation 4.1): **the separator; the scope note of Paper 924.**

Closing: When the first click protects its neighbours the centre opens widest; when it protects only itself a corner can do better. With only the clicked cell safe, the probability of a zero fell from corner to edge to centre on all three boards, and the corner opened wider on the beginner and expert boards: with the eight neighbours safe as well, the clicked cell was always a zero and the centre opened 1.656622 to 2.562159 times as many cells as the corner. The separator is whether the guaranteed safe region is the single clicked cell or the nine cells around it. Placed among the earlier papers: the first-click convention that Paper 924 set aside was counted, showing that it changes how mines are laid out on the board and even the order of areas opened. To be honest: how to win is not claimed. How the convention changes where the first click opens widest, and no further.

References

1. Kaye, R. (2000). Minesweeper is NP-complete. *The Mathematical Intelligencer*.
2. Yamagishi, Y. (2026). *A Fifty-Fifty in Minesweeper Is Not Set by the Visible Numbers Alone, and Tilts with the Density of Mines Left on the Board* [Paper 924]. YOI: <https://www.yamagishiyuuki.com/yoi/924>

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