

The Three-Way Duel

Solution

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Deliberately miss on the first turn. This gives C a winning probability of $13/40 = 32.5\%$.

Use the puzzle's game interpretation: a hit removes its target from the game, and the goal is to be the last player remaining. Hits are independent; A hits with probability 1, B with $1/2$, and C with $1/4$.

While all three remain, A prefers to remove B, the more accurate opponent. B prefers to target A: removing C instead would leave A to remove B with certainty on the next turn. Thus C can let the two more accurate players deal with each other.

First calculate the two-player contests

If C faces B and C goes first, let p be C's chance to win. C wins immediately with probability $1/4$. If both miss, which has probability $(3/4)(1/2) = 3/8$, the same situation starts again. Therefore

$$p = \frac{1}{4} + \frac{3}{8}p, \quad p = \frac{2}{5}.$$

If B goes first instead, B must miss before C gets that chance, so C's winning probability is $(1/2)(2/5) = 1/5$. Against A, C wins with probability $1/4$ if C goes first, and with probability 0 if A goes first.

Now compare C's first moves

Deliberately miss. B acts next. With probability $1/2$, B hits A, leaving C to go first against B. Otherwise B misses and A removes B, leaving C to go first against A. Thus

$$\Pr(\text{C wins}) = \frac{1}{2} \frac{2}{5} + \frac{1}{2} \frac{1}{4} = \frac{13}{40}.$$

Aim at A. With probability $1/4$, C hits A, but then B goes first in the B–C contest. With probability $3/4$, C misses and reaches the situation after a deliberate miss. The total is

$$\frac{1}{4} \frac{1}{5} + \frac{3}{4} \frac{13}{40} = \frac{47}{160} = 29.375\%.$$

Aim at B. Hitting B leaves A to go next against C, so C then loses. Missing again leads to the deliberate-miss situation. The total is

$$\frac{1}{4}(0) + \frac{3}{4} \frac{13}{40} = \frac{39}{160} = 24.375\%.$$

A mixture of these first moves cannot beat the best one. Deliberately missing is best. Once only two players remain, C should aim at the opponent rather than keep missing.

History and sources: [companion history PDF](#).