Best Possible Payoff Strategy for a Perfect Truel Game

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INTRODUCTION

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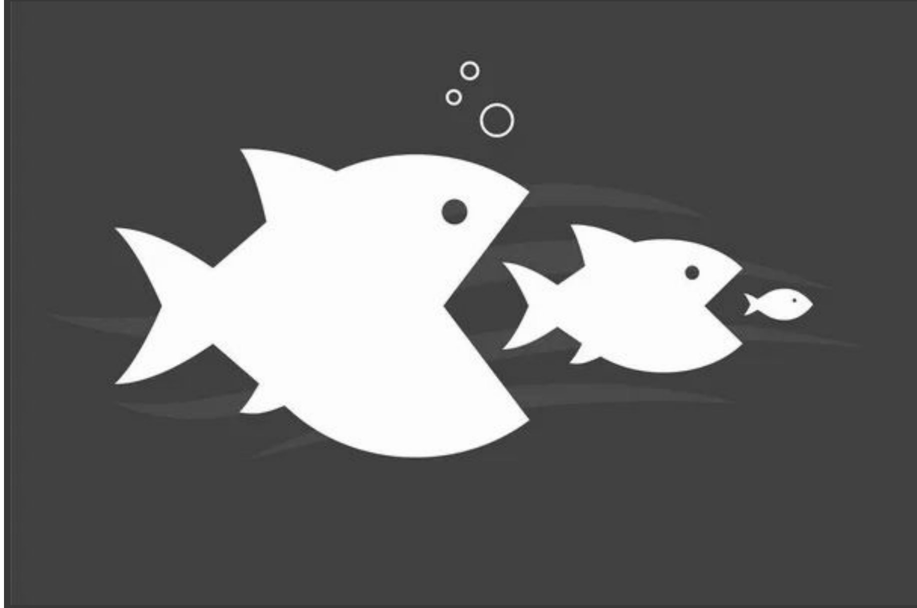
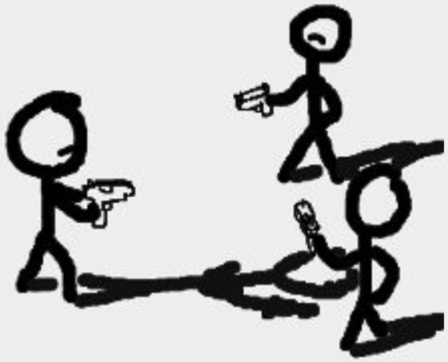
Survival of Fittest

The phrase "survival of the fittest" came from Darwinian evolutionary theory as a means to describe natural selection. This theory claims that the fittest in the struggle for life and reproduction increase in number, resulting in the design we observe in nature. In the early 1900s, the expression "survival of the fittest" was coined. The extinction of the dinosaurs is a classic example of a condition in which survival of the fittest does not always occur.



TRUEL



Truel refers to a sort of duel involving three opponents and allowing participants to fire at one another while maintaining their own lives.The outcome of the game is determined only by the truel's rules. In many instances, truels can have surprising outcomes, and the player with the highest marksmanship does not always have the best chance of survival. In certain instances, probability-based calculations may result in the unexpected occurrence of "survival of the weakest." Through our project, we intend to analyse the game and various strategies in order to provide players with the optimal payoff strategy profile.

MOTIVATION

Truel is one of the creative sorts of games, and it is extremely exciting. It really challenges the normal thinking of a human being and introduces the concept of "Survival of the Weakest". We believe that such kind of games forces one to think in a more inquisitive manner and analyses of such games can produce quite interesting results.

List of Outcomes

- The most effective payoff strategy for the real game, taking into account the variety of Players.
- Comprehensive Analysis of the Whole Game

ANALYSIS OF TRUEL GAME

Perfect Truel Game Strategies

Targeting the Strongest Opponent

The victor in a sequential truel is the player who is survives the game after three rounds of shooting has taken place. All the player take turns shooting at targets of their choosing, each having their respective Marksmanship.

It seems like a good strategy to use the enemy with the highest marksmanship as a target and fire at them.

However, success with this tactic is contingent on the shooter's sequence. The players' chances of winning are diminished if the shooting sequence is ill-advised.

Perfect Truel Game Strategies

Targeting an opponent versus abstention

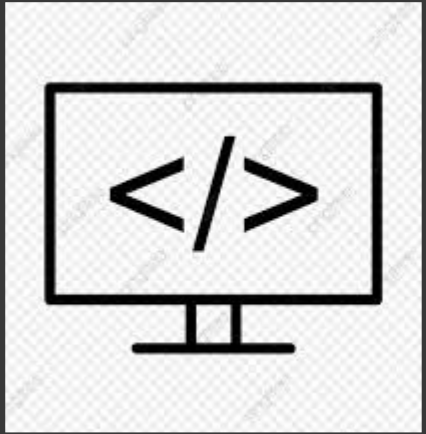
Despite common belief, Player with the weakest marksmanship(Player A) has a better chance of surviving if he shoots into the air during the first round, or while both of his opponents are still alive.

The reason for this is that stronger players, who both have superior accuracy than Player A, know that they are a greater threat to each other than A is. So, it appears they'd rather just keep shooting at each other until one of them dies.

So A will always be the last one standing when there are only two players left, and he will also be the first one to fire. That holds true regardless of the order in which shots are fired.

EXPLANATION

P(A hits) = 1
P(A misses) = 0
P(B hits) = 0.8
P(B misses) = 0.2
P(C hits) = 0.5
P(C misses) = 0.5



The probability that S survives when the current shooting order is ABC will be denoted by the notation P(S,ABC).

Shooting order:	Survival chance A:	Survival chance B:	Survival chance C:	Explanation:
AB	P(A,AB) = 1	P(B,AB) = 0	P(C,AB) = 0	A never misses.
AC	P(A,AC) = 1	P(B,AC) = 0	P(C,AC) = 0	A never misses.
BA	P(A,BA) = 1/5	P(B,BA) = 4/5	P(C,BA) = 0	P(A,BA) = P(B misses) × P(A,AB) = 1/5. P(B,BA) = P(B hits) + P(B misses) × P(B,AB) = 4/5.
BC	P(A,BC) = 0	P(B,BC) = 8/9	P(C,BC) = 1/9	P(B,BC) = P(B hits) + P(B misses) × P(C misses) × P(B,BC) = 4/5 + 1/5 × 1/2 × P(B,BC), which gives P(B,BC) = 8/9. P(C,BC) = P(B misses) × P(C hits) + P(B misses) × P(C misses) × P(C,BC) = 1/5 × 1/2 + 1/5 × 1/2 × P(C,BC), which gives P(C,BC) = 1/9.

Similarly we can find for CA and CB

The probability that S survives when the current shooting order is ABC will be denoted by the notation P(S,ABC).

Shooting order:	Survival chance when shooting at A:	Survival chance when shooting at B:	Survival chance when shooting at C:	Survival chance when missing deliberately:	Conclusion:
ABC	0	P(A hits) × P(A,CA) + P(A misses) × P(A,BCA) = 1/2	P(A hits) × P(A,BA) + P(A misses) × P(A,BCA) = 1/5	P(A,BCA) < 1/2 (since B will definitely shoot at A, because P(B,AB) = 0!)	So, A shoots B, which means that P(A,ABC) = 1/2, P(B,ABC) = 0, and P(C,ABC) = P(C,CA) = 1/2
BAC	P(B hits) × P(B,CB) + P(B misses) × P(B,ACB) = 16/45	0	P(B hits) × P(B,AB) + P(B misses) × P(B,ACB) = 0	P(B,ACB) = 0	Therefore, B shoots A, which means that P(B,BAC) = 16/45, P(A,BAC) = P(B misses) × P(A,ACB) = 1/10, and P(C,BAC) = P(B hits) × P(C,CB) + P(B misses) × P(C,ACB) = 49/90
CAB	P(C hits) × P(C,BC) + P(C misses) × P(C,ABC) = 11/36	P(C hits) × P(C,AC) + P(C misses) × P(C,ABC) = 1/4	0	P(C,ABC) = 1/2	So, C should miss deliberately (fire "into the air"), which means that P(C,CAB) = 1/2, P(A,CAB) = P(A,ABC) = 1/2, and P(B,CAB) = P(B,ABC) = 0

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Survival Chances

Shooting order:	Survival chance of A:	Survival chance of B:	Survival chance of C:
ABC	P(A,ABC) = 1/2	P(B,ABC) = 0	P(C,ABC) = 1/2
ACB	P(A,ACB) = 1/2	P(B,ACB) = 0	P(C,ACB) = 1/2
BAC	P(A,BAC) = 1/10	P(B,BAC) = 16/45	P(C,BAC) = 49/90
CAB	P(A,CAB) = 1/2	P(B,CAB) = 0	P(C,CAB) = 1/2
BCA	P(A,BCA) = 1/10	P(B,BCA) = 16/45	P(C,BCA) = 49/90
CBA	P(A,CBA) = 1/10	P(B,CBA) = 16/45	P(C,CBA) = 49/90
Total survival chances (sum of the probabilities divided by 6):	27/90	16/90	47/90

CONCLUSION

With truel, we have invoked a new thought of "Survival of the Weakest". This game is quite an interesting example as whatever may be the shooting order, for a range of marksmanship for the weakest player we observe that he/she has the highest chances of survival.

This game can further be expanded with addition of some new strategies which themselves will be challenging and interesting to solve.