Should PGA TOUR Golf Professionals consider their Adversary's Strategy in Match Play?

Introduction

► Data-driven decision-making is key in professional sports

► Golf is a non-reactive sport that allows both adversary-dependent and independent decisions

► Two types of plays – Stroke & Match

► We focus on putting in this study

► Putting constitutes half of all strokes. Professionals generally take two putts to hole out.

Medal | Stroke Play
Golfer vs All Other Golfers in the Field
Lowest Total Score Wins

Match Play
Golfer vs Golfer
Most Holes Won Wins

Problem Statement

► In a given situation, should a golfer putt aggressively or conservatively? A classic risk-reward scenario –

▷ Aggressive – Higher chance of holing first putt, but, if missed, the second putt could be tricky

▷ Conservative – Less chance of holing the first putt, but second putt is almost a certainty

► Our goal is to analyze whether including the adversary's statistics and position has a strong impact on the strategy and expected advantage on a hole in Match Play.

► Factors considered – Distance to the Hole, Golfer and Adversary's Statistics, Leaderboard (Relative Standing), Stroke/Match Play

► Factors not considered – Environment (e.g., Weather, Surface, Slope, Green Speed), Psychological (e.g., Pressure Situations)

Methodology

► We model golfers' putting performances as statistical distributions – we assume a golfer makes (Gaussian) directional and distance control errors when aiming at a target.
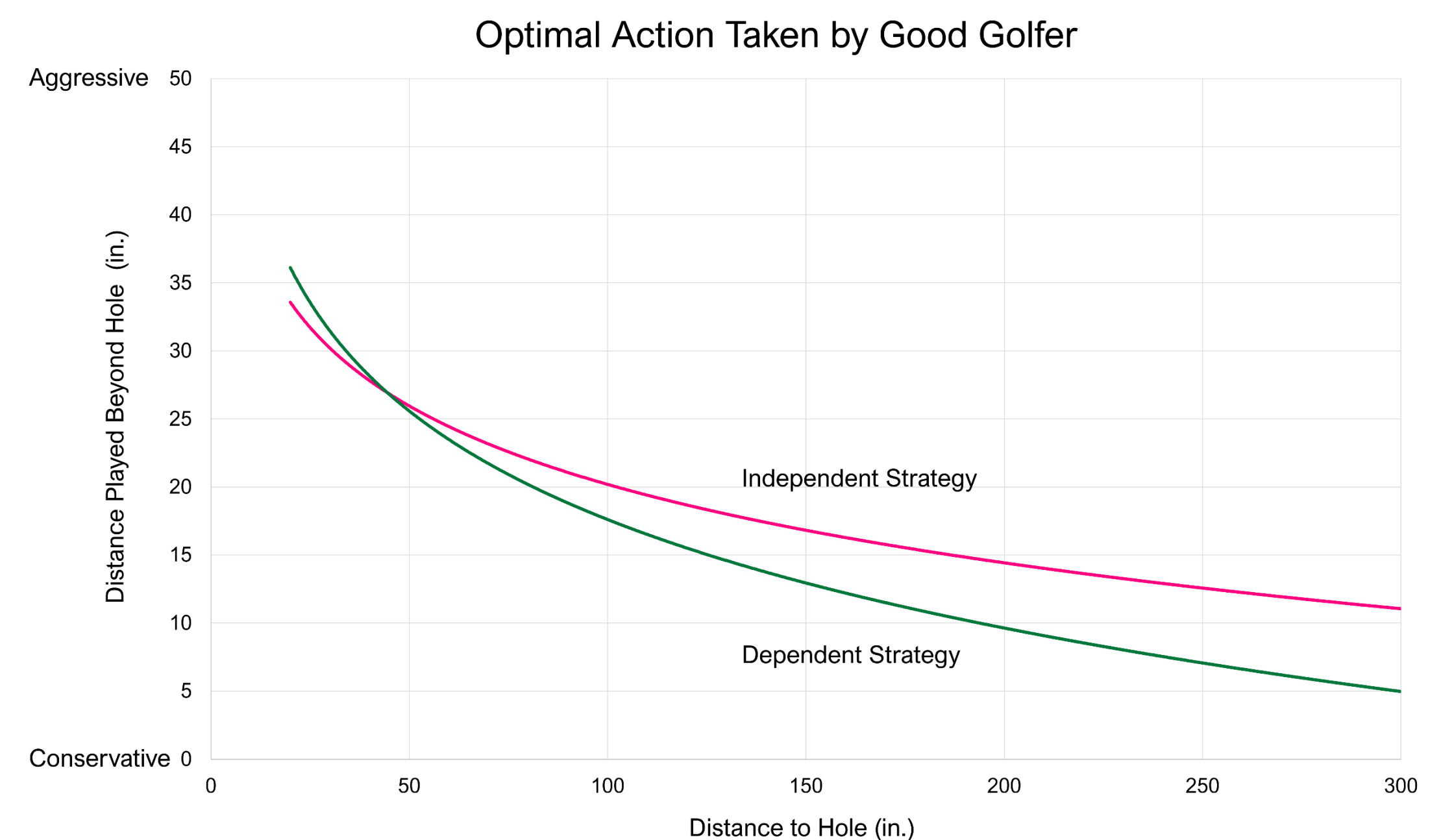
Distance Dispersion
Angle Dispersion
Ball
Hole
Targeted Distance
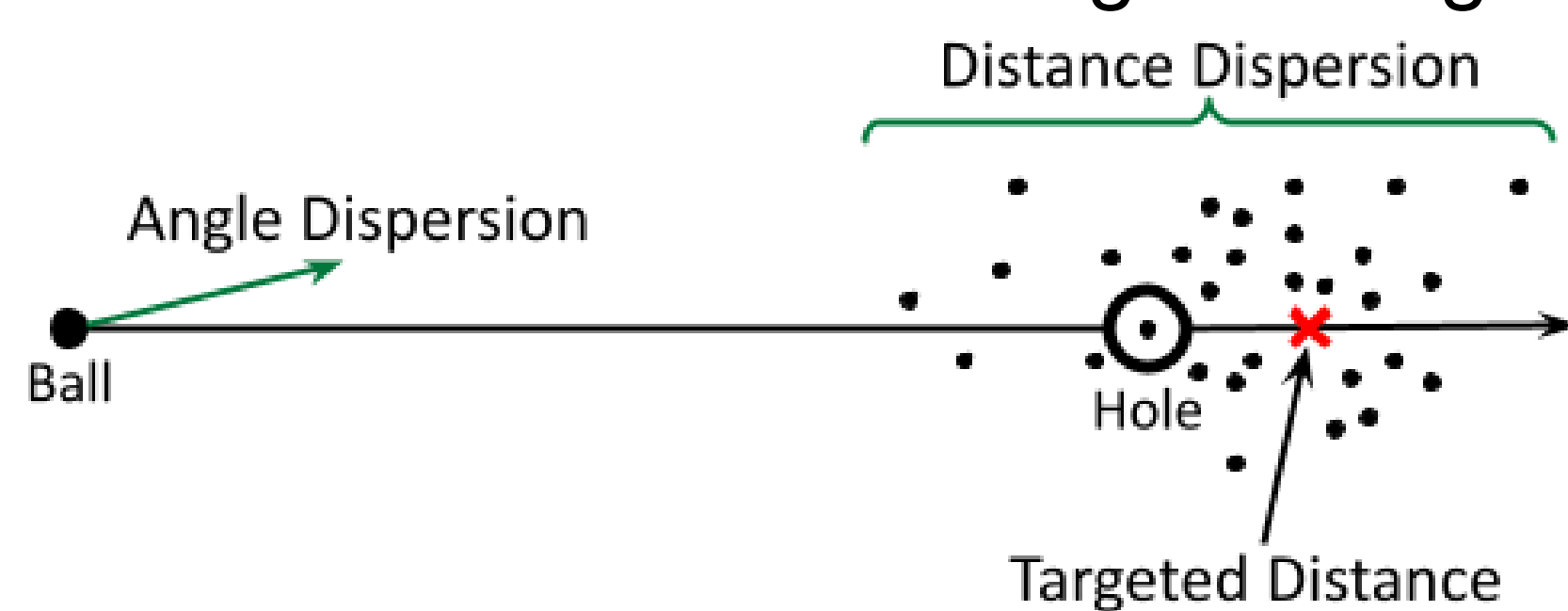
► We use Markov Decision Process and two-player turn-based stochastic models to determine the optimal dependent and independent actions.

PGA TOUR's ShotLink Database → Statistical Tools → R Program
Markov Decision Process Models → Python Program
R Program → Python Program
Statistical Tools → R Program
Python Program → Match Type?
R Program → Value Iteration & Policy Iteration Methods → Optimal Action
Python Program → Strategy Iteration & Policy Evaluation Methods → Optimal Action

► We first validate our model using our own data and then test extensively using the PGA TOUR's ShotLink database, containing a season's worth of data on professional golfers.

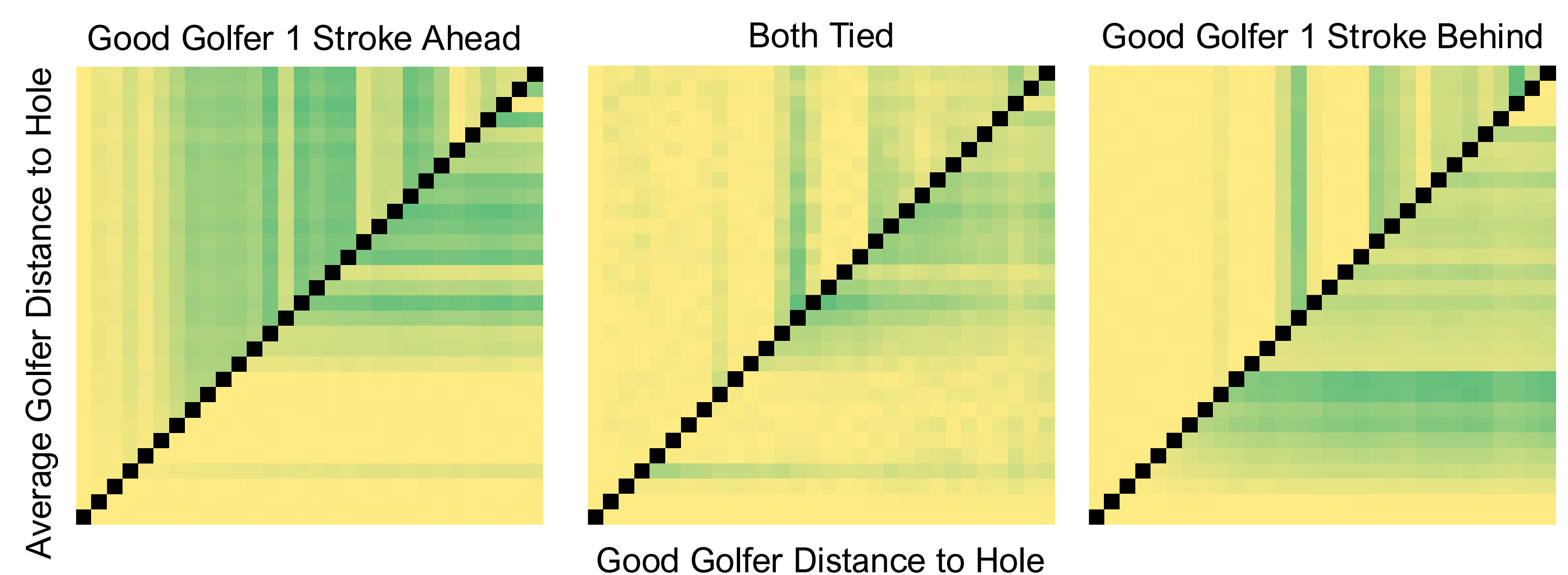► We compare the performances of the dependent and independent strategies in match play.
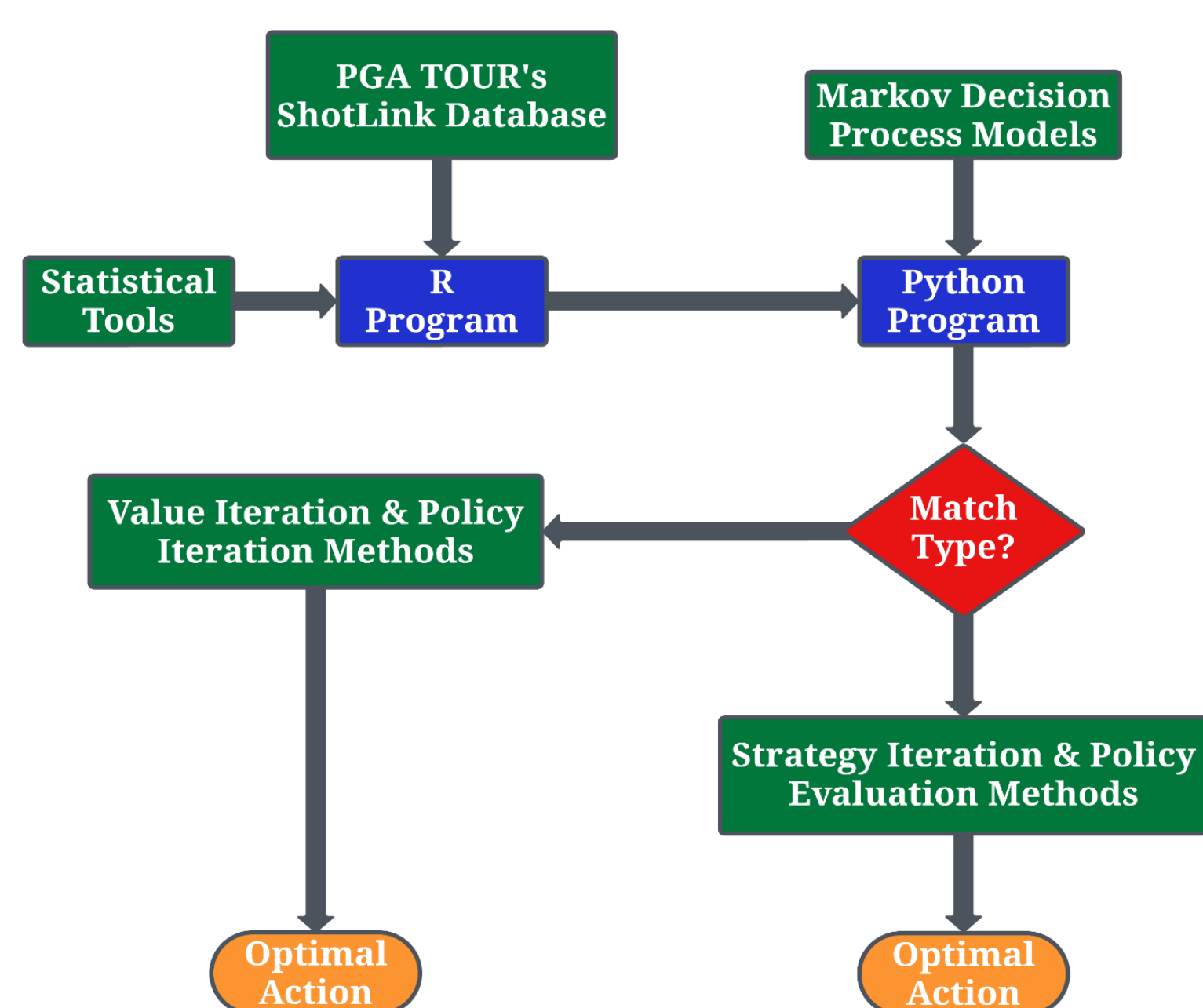
Results

► Preliminary analysis shows the optimal actions are different when adversaries potential actions are considered.

Optimal Action Taken by Good Golfer
(y-axis: Distance Played Beyond Hole (in.), Aggressive 50 to Conservative 0; x-axis: Distance to Hole (in.), 0 to 300)
Independent Strategy
Dependent Strategy

► We report below the expected point benefit in a game between a good golfer and an average golfer. The more vivid the green is, the higher the benefit in playing the dependent strategy (compared to the independent strategy).

▷ Greatest advantage is 0.04 points

Good Golfer 1 Stroke Ahead | Both Tied | Good Golfer 1 Stroke Behind
(y-axis: Average Golfer Distance to Hole; x-axis: Good Golfer Distance to Hole)

► Overall, the typical benefit is 0.007 points per hole, which would result in a total of 0.119 points gained for an 18-hole course.

Conclusions

► Our preliminary analysis shows there is a slight overall advantage in using the adversary-dependent strategy in match play. The advantage, however, grows as the distance grows.

► A higher advantage may be realized if

▷ The putting distance is increased. We limit this work to 25 feet due to exponential run-time (7 feet took 3 minutes but 25 feet took 8 hours).

▷ Non-putting shots are considered

► We would, therefore, advise professional golfers to focus on the independent strategy for at least mid-range putting

Future Works

► Extend the work by including factors that were not considered in the problem statement

► Include golf shots other than putting

► Apply this framework to other sports (e.g., Tennis, Darts)

References

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► Pope, Devin G., & Schweitzer, Maurice E. (2011). *Is Tiger Woods Loss Averse? Persistent Bias in the Face of Experience, Competition, and High Stakes.* American Economic Review, 129-157.

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