

CAUSAL INFERENCE ON DOTA 2

1. Dota 2

- Dota 2 is a Multiplayer Online Battle Arena (MOBA)
- 123 possible heroes in 2 teams of 5 -> 10^{14} possible combinations
- Many items to choose from
- Focus on the hero 'Slark' and the item 'Hurricane Pike'
- OpenDota API provides all match data

2. Front-Door Adjustment

- Causal inference method that uses a mediator to determine the causal effect of a treatment
- Nullifies confounders
- Front-Door Criterion:
 1. Mediator intercepts all paths from treatment to outcome
 2. No backdoor path from treatment to mediator
 3. All backdoor paths from mediator to outcome are blocked by treatment

3. Methodology

- Data gathered from OpenDota API
- Labelled on the following attributes: 'Slark picked', 'Game won' and 'Enemy bought Hurricane Pike'
- Each match gives 2 data points since each perspective is its own data point
- Manual implementation and Ananke package for front-door adjustment

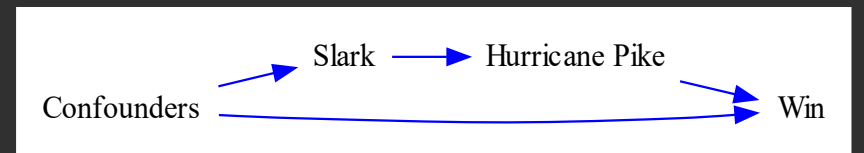


Figure 1: Causal DAG of picking Slark

4. Results

- Results are obtained by running the code from the manual implementation and the Ananke package
- Stelios Avgousti's (a group-mate) results were also included

	Win	Hurricane Pike	Total
Slark Picked	3946	1682	8213
Slark Not Picked	117017	42728	233713
Total	120963	44410	241926

Table 1: Frequencies in the data-set

Method	ATE	95% CI
Manual implementation	-0.00246	[-0.00346, -0.00148]
Ananke (Primal-IPW)	0.0098	[0.0060, 0.0139]
Ananke (Dual-IPW)	0.1961	[0.1170, 0.2740]
Ananke (APIPW)	0.1961	[0.1153, 0.2694]
Ananke (Eff-APIPW)	0.1961	[0.1137, 0.2745]
Stelios' results	-0.01119	NA

Table 2: Average treatment effects

5. Discussion

- Results are very diverse, with different possible interpretations
- Manual implementation and Primal IPW:
 - Come close to the 'true' value from Stelios' results
 - OR are statistically insignificant
- Other IPW versions are very large, which seems unlikely considering the number of heroes in the game and Slark's win-rate (48,0%)
- Results might be so different because:
 - Simplified representation of the game
 - Overfitting on the data
 - Not suitable for this scenario
- Condition 1 not fully met since there are other mediating variables, example being other counter-items.

6. Conclusion

- Front-door adjustment is not a very suitable method for determining the casual effects of picking a hero on the outcome of the game
- Different interpretations already suggest that there are no clear one-sided answers, which makes the method unreliable for this scenario
- The method might work better if the data-set was more representative of the game, but some things such as player skill level are unmeasurable
- Applying front-door adjustment on other, simpler scenarios might give more accurate results