Decision impact in MOBA games

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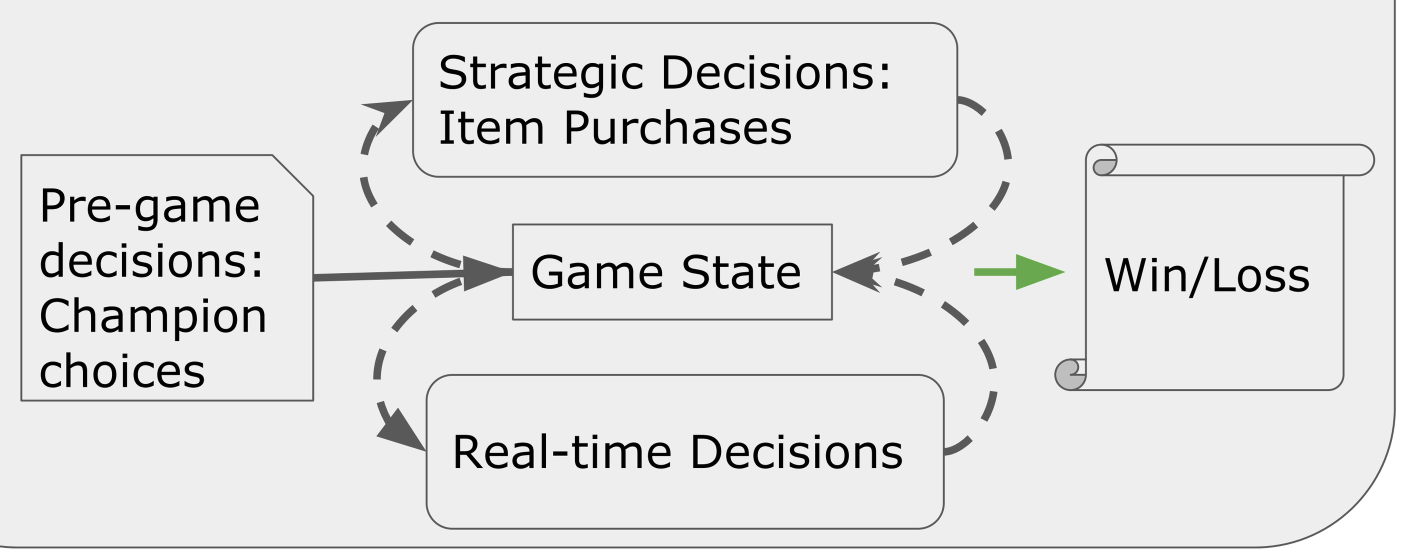
Problem

- Many factors in determining game outcomes
- How to quantify impact of the strategic choices?



Data

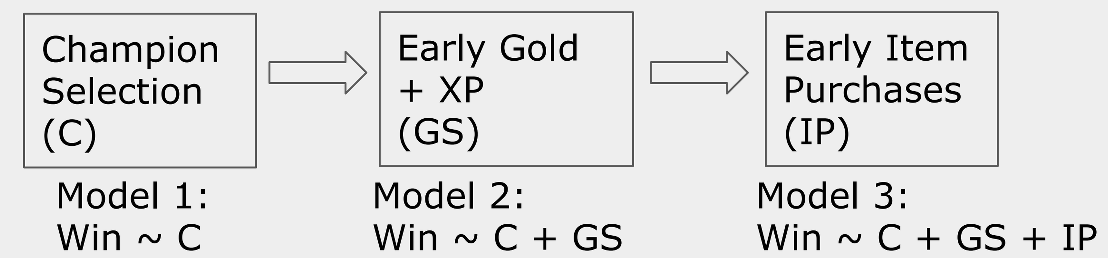
- 12,000 silver-league (mid-level) online matches
- For each match, 10 players, pick 1 randomly
- Game features:
  - Allied / Enemy Champions: 1-hot encoded
  - Player Item purchases: 1-hot
  - Player Gold, XP at 5 and 10 min: cumulative
    - Meant to capture "game state"
- Data format:

champion 1 is ally	champion 1 is opponent	item 2 purchased	gold @ 5 min
0	1	1	863

Results

- Item choice as a whole has subtle effects
  - Logistic, SVM w/ Kernels, Decision trees **overfit** and **do not benefit** from decision data once game state data is included
  - Game is **"well-balanced"** by designers
- When we narrow the focus to specific items and control for correlations we begin to see **modest causal effects.**

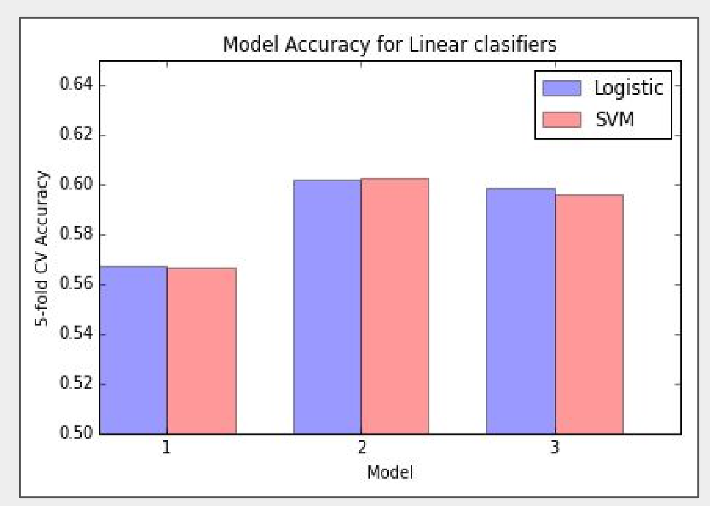
Early Game Decision Making

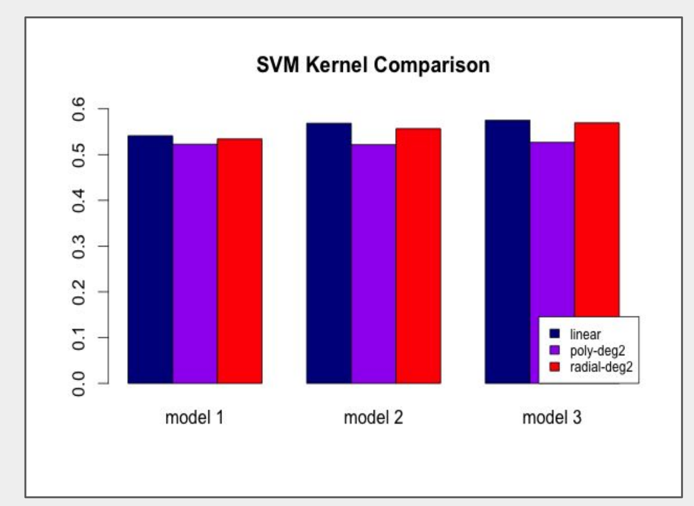


- Increase in information => Increase in accuracy
- **Item Impact ≈ (Model 3 Acc.) - (Model 2 Acc.)**

Linear Classifiers

- Logistic Regression: L2 regularization
- SVM: Linear, Poly-Deg2, RBF kernels. Linear wins





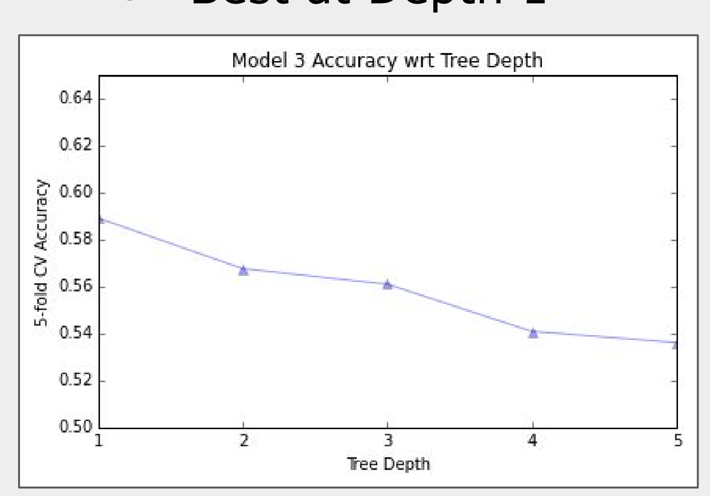
- **Item Impact: Not noticeable, even with kernel**
  - Predictive Delta ≈ -.003

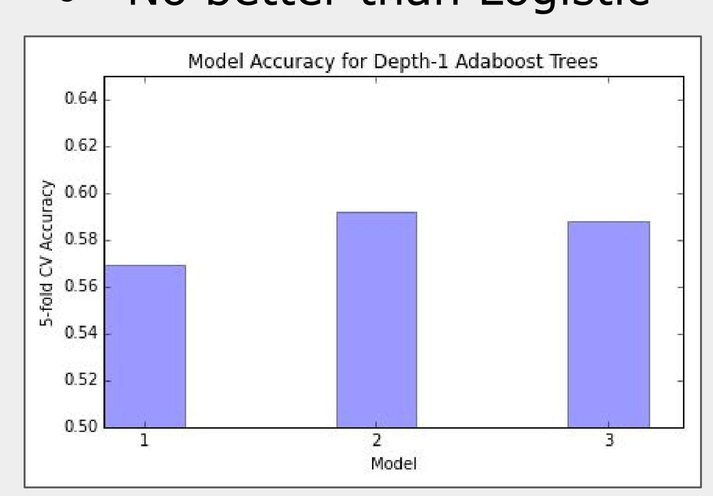
Decision Trees

- Hypothesis: interdependence between features
  - Some items context-specific

Random Forest Overfit:
- Best at Depth 1

Depth 1 AdaBoost Trees:
- No better than Logistic





Causal Modeling

- Correlation ≠ Causation:
  - Winning teams buy expensive items
  - Expensive items may not help much in general

Model Estimated	True Model	
$Y \sim X + e$	$Y \sim X + Z + e$	Y: game result X: items Z: game state e: error term

- OLS assumes: X (item choice) orthogonal to e
- Game state Z affects both X and Y
- e is correlated with X (choice of items is endogenous)
  - **Biased estimates for effect X has on Y**

Propensity Score Matching

- Propensity score: $p(x=X|Z)$
- Each sample is paired with counterfactual with similar propensity
  - In paired data, Z is no longer correlated with X

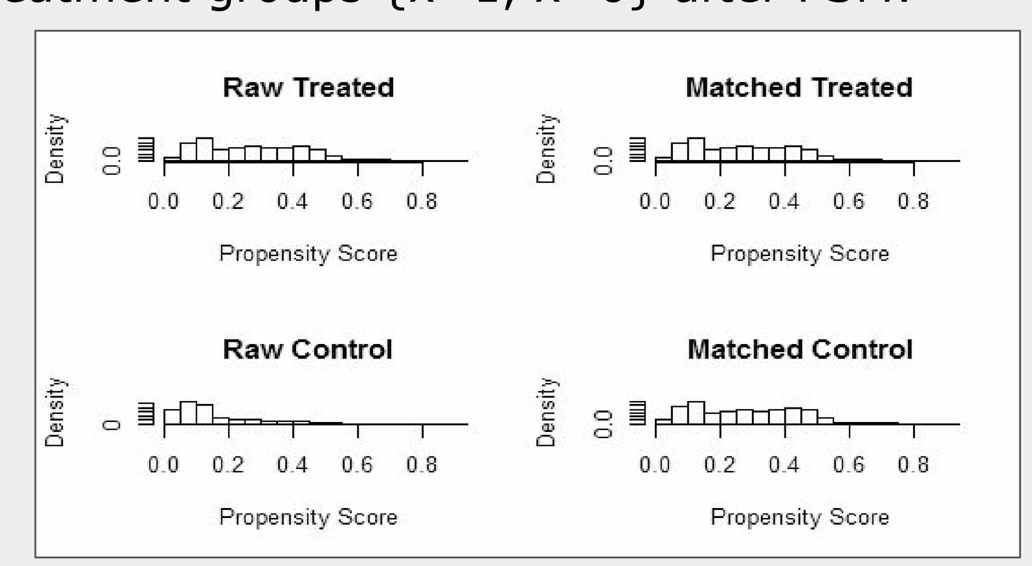
Representative (Unmatched) Data

Game ID	Mejai Purchase	Team Gold Differential	Propensity Score
32	1	+5284	.56
93	1	+2745	.42
420	0	-340	.15
96	0	-3890	.02

Matched Data

Game ID	Mejai Purchase	Team Gold Differential	Propensity Score
32	1	+5284	.56
742	0	+5350	.57
420	0	-340	.15
278	1	-328	.15

- Distribution of propensities are similar across treatment groups {x=1, x=0} after PSM:



Results (Lift %)	Propensity Matching	Unmatched OLS
Upgrading boots	2.37	4.99
Mejai's Soulstealer	8.51	13.12

- Matching reduces apparent effect of item to more realistic but significant values