Predicting Dota 2 Balance Outcomes

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What is Dota 2?

- Very popular 5v5 team PC game in the MOBA genre

- For each game, each team bans 5 heroes and selects 5 heroes

- Heroes are targeted according to perceived strength and synergy

- Periodic "Balance Patches" are released to address strength disparities
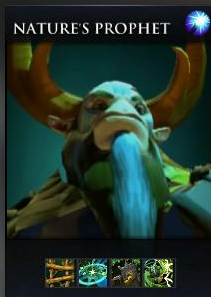
Choosing a question

Some ideas:

- Recommending "last pick" heroes
  - Difficult to evaluate
- Predicting game outcomes after X minutes
  - Difficult to gather data
- Identifying unbalanced heroes before updates are released (!)
  - Not a priori clear that available data will have predictive power

Core research goal

Build features to predict the effect of a balance patch on hero selection in professional play

HERO	P+B	PICK	BAN	WIN	LOSE	WIN%	P+B %	
	468	76	**392**	43	33	56	98.5	
	463	**257**	206	132	125	51	97.4	
	443	168	**275**	95	73	56	93.2	
	432	211	221	94	117	44	90.9	
	415	157	**258**	81	76	51	87.3	
	415	217	198	120	97	55	87.3	▲1
	402	**238**	164	123	115	51	84.6	
	384	**227**	157	115	112	50	80.8	
	379	215	164	114	101	53	79.7	▲1
	313	119	194	63	56	52	65.8	▲1
	301	65	236	34	31	52	63.3	▲1

Patch 6.85

HERO	P+B	PICK	BAN	WIN	LOSE	WIN%	P+B %	
	426	95	**331**	49	46	51	86.9	
	402	140	**262**	79	61	56	82.0	▲1
	395	**218**	177	97	121	44	80.6	
	380	117	**263**	75	42	64	77.5	▲1
	374	**261**	113	136	125	52	76.3	
	328	143	185	86	57	60	66.9	▲1
	327	127	200	63	64	49	66.7	▲1
	323	153	170	66	87	43	65.9	
	319	165	154	82	83	49	65.1	▲1
	309	145	164	71	74	48	63.0	▲1
	295	**199**	96	85	114	42	60.2	▲1

Patch 6.86

Data sourcing

Aggregated historical data on professional games
• hero pick/ban%
• hero win rates
• same-team hero pairings
• head-to-head records

Hero and patch info
• raw text of patch notes
• hero roles
• hero item builds

Individual game info
• hero skill builds
• hero item purchases

Nyx Assassin
- Nyx Impale duration increased from 1.27/1.77/2.27/2.77 to 1.6/2.0/2.4/2.8
- Spiked Carapace cooldown reduced from 23/20/17/14 to 22/18/14/10
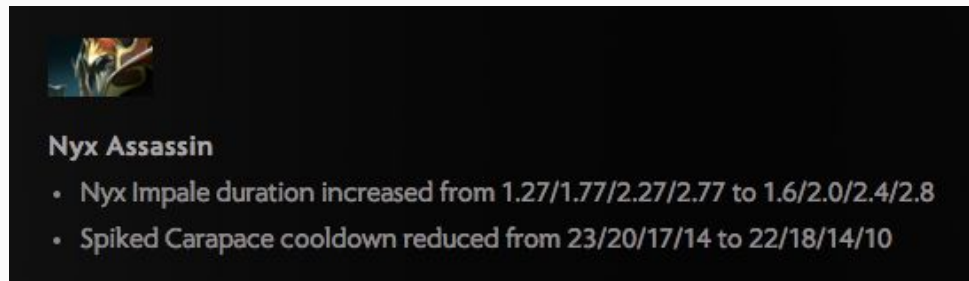
- Over the past 10 patches, there have been about 1200 hero changes

- I labeled 100 as positive or negative and predicted the rest

Challenges:

- "Increased" is not always positive

- Most changes are numeric

- Language used in writing patch notes has changed since 2012

Hero interactions

• Unchanged Heroes can still benefit significantly from improvements to synergistic partners

• Similarly, Heroes can benefit or suffer from changes to their "counterpicks"

Modeling

- Target: post-patch pick+ban rate (%) for each hero in professional games

- Core features:
  - previous pick+ban rate (%)
  - previous winrate (%)
  - probability that changes made to hero will improve hero (from NLP)
  - number and average size of numeric changes (from NLP)
  - weighted measure of +/- change to hero's common pairings
  - weighted measure of +/- change to hero's common opponents

- Model: Gradient Boosting Regressor

Regression

stochastic gradient boosting regressor
least absolute deviation loss

Patch 6.86 Hero Drafting
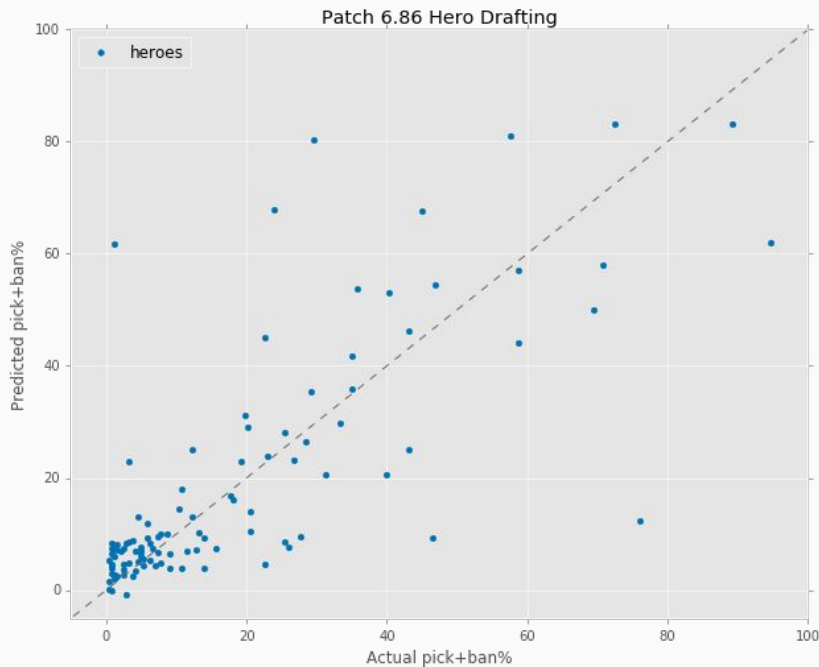
- Patch 6.86: 25% reduction in MSE over baseline
- Noticeable "class" imbalance
- High variability among frequently-picked heroes

Classification

stochastic gradient boosting classifier
exponential loss, 0.05 learning rate,
100 estimators

ROC curve for classification of Patch 6.86
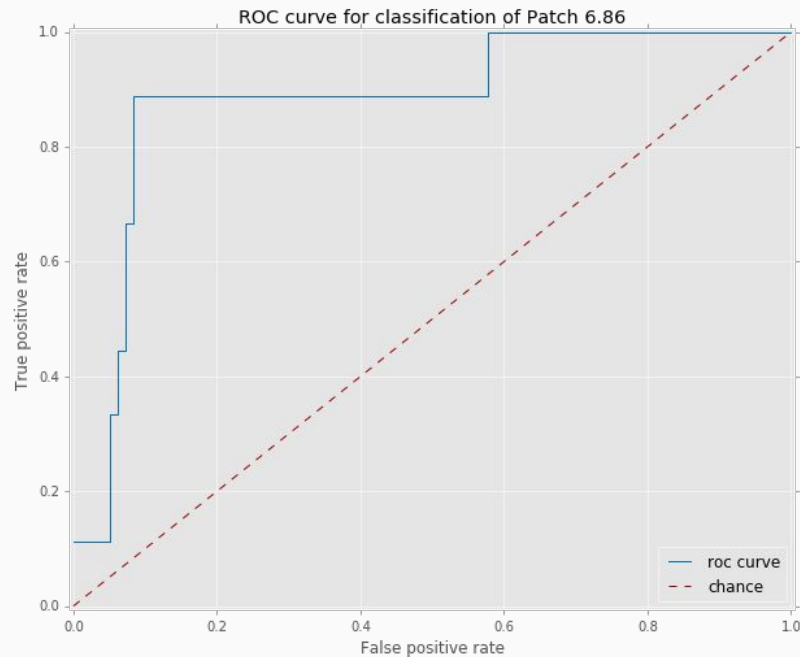
- New target: binary prediction of pick+ban rate > 50%?
- Evaluate based on ROC AUC score
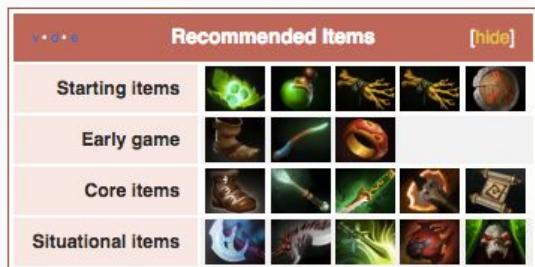- Patch 6.86: AUC score of 0.87

Classification

stochastic gradient boosting classifier exponential loss, 0.05 learning rate, 100 estimators

Classification of Pick+Ban Rate > 50%
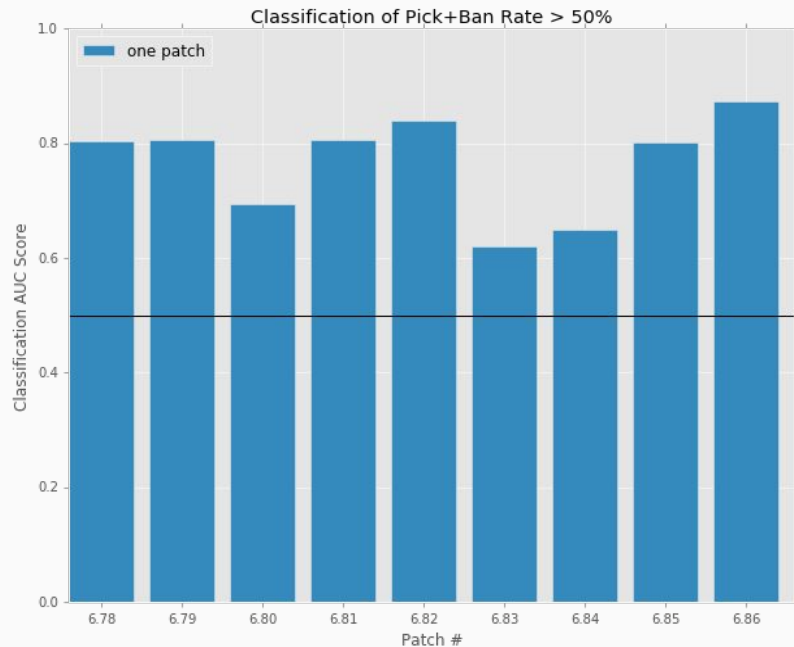
- New target: binary prediction of pick+ban rate > 50%?
- "One-patch-out" modeling
- Average AUC score (all patches) of 0.77

Next steps

- Hero-item interactions (another round of NLP!)

- Hero distance from overall metagame trend (cosine similarity?)

- Scrape/NLP player attitudes to identify untapped potential in advance

Thank you!

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github.com/shime-saba/moba_balance_prediction