
Predicting Pitcher Performance: Applications in Fantasy Baseball

Bear St. Michael

Problem Statement

- Fantasy Baseball Strategy: “Streaming” Pitchers
- Pick up a different player each night
- Players picked from “leftover” pool
- This makes prediction...difficult

MLB Probable Pitchers for Saturday, September 16, 2023

Giants (75-72) Preview Rockies (54-92) 2:10PM SFG Keaton Winn (#67, 25, RHP, 1-2, 3.55)	Red Sox (74-74) Preview Blue Jays (81-67) 3:07PM BOS Chris Sale (#41, 34, LHP, 6-4, 4.88) TOR Chris Bassitt (#40, 34, RHP, 14-8, 3.83)	Padres (70-78) Preview Athletics (46-101) 4:07PM SDP Matt Waldron (#61, 26, RHP, 0-3, 5.55) OAK Mason Miller (#57, 24, RHP, 0-2, 2.84)
Braves (96-51) Preview Marlins (76-72) 4:10PM ATL Jared Shuster (#65, 24, LHP, 4-3, 5.26) MIA Bryan Hoewing (#78, 26, RHP, 2-2, 4.04)	Rangers (82-65) Preview Guardians (70-78) 6:10PM TEX Dane Dunning (#33, 28, RHP, 10-6, 3.91) CLE Tanner Bibee (#61, 24, RHP, 10-4, 3.03)	Yankees (75-73) Preview Pirates (69-79) 6:35PM PIT Luis Ortiz (#21, 24, RHP, 4-4, 4.66)
Rays (92-57) Preview Orioles (91-56) 7:05PM TBR Tyler Glasnow (#21, 29, RHP, 9-5, 3.15) BAL Grayson Rodriguez (#30, 23, RHP, 5-4, 4.88)	Twins (78-70) Preview White Sox (56-92) 7:10PM MIN Pablo López (#21, 27, RHP, 10-7, 3.43) CHW Touki Toussaint (#47, 27, RHP, 3-7, 5.65)	Astros (83-65) Preview Royals (47-101) 7:10PM HOU J.P. France (#68, 28, RHP, 11-5, 3.61) KCR Cole Ragans (#55, 25, LHP, 6-4, 3.01)
Nationals (65-83) Preview Brewers (83-64) 7:10PM WSN Trevor Williams (#32, 31, RHP, 6-10, 5.44) MIL Corbin Burnes (#39, 28, RHP, 9-8, 3.47)	Reds (77-72) Preview Mets (68-79) 7:10PM CIN Andrew Abbott (#41, 24, LHP, 8-5, 3.64) NYM Tylor Megill (#38, 27, RHP, 8-7, 5.03)	Phillies (80-67) Preview Cardinals (65-82) 7:15PM PHI Ranger Suárez (#55, 27, LHP, 2-6, 3.93) STL Miles Mikolas (#39, 34, RHP, 7-11, 4.75)
Cubs (78-70) Preview D'backs (77-72) 8:10PM CHC Kyle Hendricks (#28, 33, RHP, 6-7, 3.71) ARI Zach Davies (#27, 30, RHP, 2-5, 6.81)	Giants (75-72) Preview Rockies (54-92) 8:10PM COL Kyle Freeland (#21, 30, LHP, 6-14, 5.07)	Tigers (68-79) Preview Angels (68-80) 9:07PM DET Sawyer Gipson-Long (#66, 25, RHP, 1-0, 3.60) LAA Tyler Anderson (#31, 33, LHP, 6-6, 5.36)

Goal

Train a neural network to predict pitcher performance based on that pitcher+opponent's performance leading up to that night

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The Data



- 1% of data = List of all pitchers (copy-pasted, not fancy)
- Other 99% = scraped
 - Pitcher Game Logs (one pitcher at a time, ~360 pitchers)
 - Team Game Logs (one team at a time, 30 teams)
 - Daily list of available pitchers (up to 30)

The Data

- Pro
 - Lots of data
 - Easy to scrape
- Con
 - Max request limit 20/minute
 - Insert `time.sleep(3.5)` into request loop
 - Explodes run time



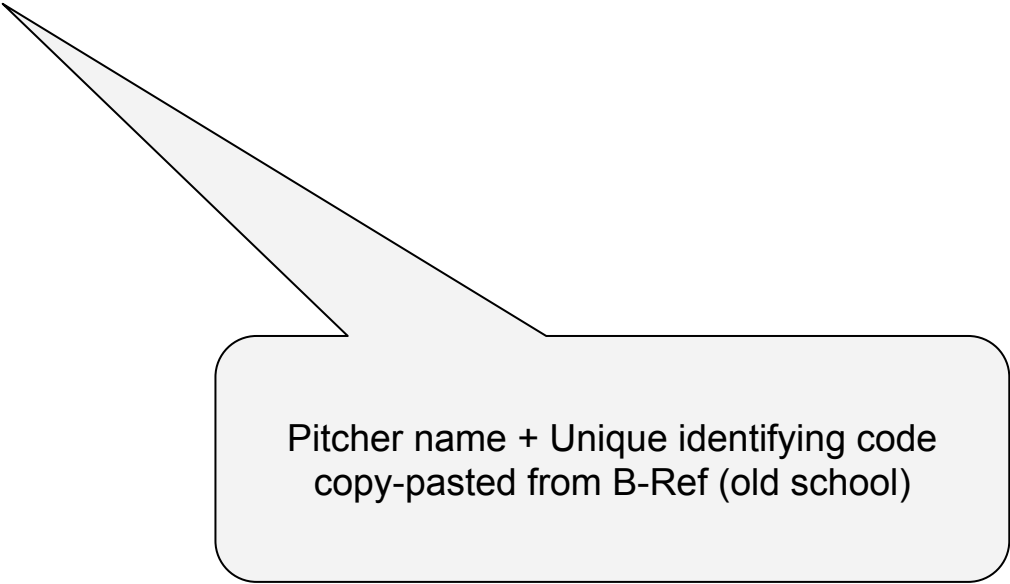
`HTTPError: HTTP Error 429: Too Many Requests`

Using this site → we can get data on...

--- 28.12 minutes ---

For every pitcher in MLB...

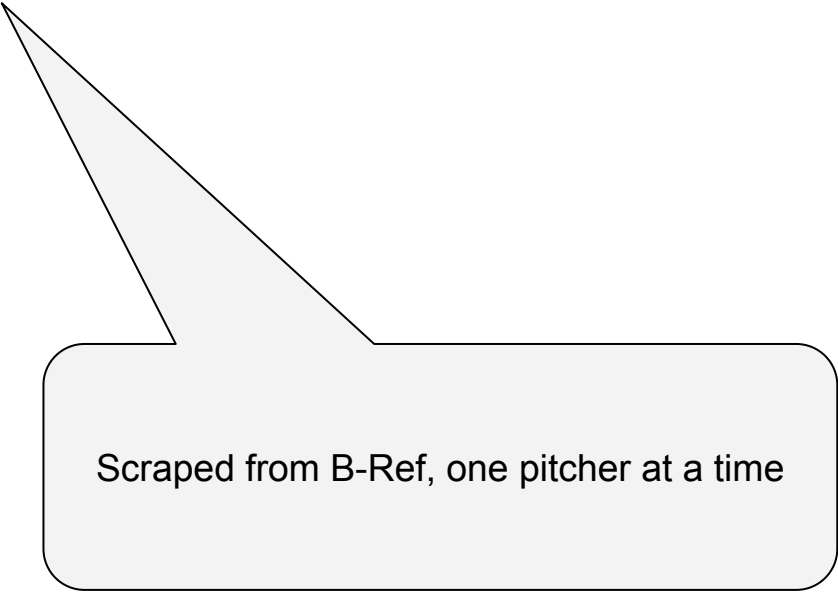
PITCHER



Pitcher name + Unique identifying code
copy-pasted from B-Ref (old school)

...for every start they made...

PITCHER	DATE



Scraped from B-Ref, one pitcher at a time

...how did they perform? Not *that* night...

PITCHER	DATE	PITCHER PERFORMANCE

...but *leading up* to that night.

PITCHER	DATE	PITCHER PERFORMANCE		
		Previous Game	Previous Few Games	Season to Date



Custom made from scraped PITCHER
game logs

Same for the scheduled opponent

PITCHER	DATE	PITCHER PERFORMANCE			OPPONENT PERFORMANCE	
		Previous Game	Previous Few Games	Season to Date	Preview Few Games	Season to Date



Custom made from scraped TEAM game logs

...and the Target = fantasy performance

PITCHER	DATE	PITCHER PERFORMANCE			OPPONENT PERFORMANCE		TARGET: Fantasy Points “Bucket”
		Previous Game	Previous Few Games	Season to Date	Preview Few Games	Season to Date	

“Fantasy Points” is not a standard stat.
Varies by league.
Custom calculated

...and the Target = fantasy performance

PITCHER	DATE	PITCHER PERFORMANCE			OPPONENT PERFORMANCE		TARGET: Fantasy Points
		Previous Game	Previous Few Games	Season to Date	Preview Few Games	Season to Date	

Pos	Pitchers		Opp	Status	Fan Pts
P	Mitch Keller PIT - P	☰	NYN	6:35 pm ☀	12
P	Merrill Kelly ARI - P	☰	CHC	8:10 pm 🌤	13
P	Jon Gray TEX - P	☰	@CLE	6:10 pm ☀	11
P	Johan Oviedo PIT - P	☰	NYN	6:35 pm ☀	8
P	Brandon Woodruff MIL - P	☰	WSH	7:10 pm 🌤	34

Fantasy points *is* a continuum.

That would make this a *regression* problem.

Projections like this are usually provided by the fantasy platform (Yahoo, ESPN, Sleeper, etc.).

...and the Target = fantasy performance

PITCHER	DATE	PITCHER PERFORMANCE			OPPONENT PERFORMANCE		TARGET: Fantasy Points “Bucket”
		Previous Game	Previous Few Games	Season to Date	Preview Few Games	Season to Date	

points < 0

0 <= points < 10

10 <= points < 20

20 <= points < 30

30 < points

Using a ***classification***
model

Classes = “buckets”

The Raw Data

PITCHER	DATE	PITCHER PERFORMANCE			OPPONENT PERFORMANCE		TARGET: Fantasy Points “Bucket”
		Previous Game	Previous Few Games	Season to Date	Preview Few Games	Season to Date	
Pitcher A	Date 1						
Pitcher A	Date 2						
...	...						
Pitcher B	Date 1						
Pitcher B	Date 2						

I can customize what parts of the model run

```
In [2]: # How much do you want to scale back this run? Pick a number between 0 (none) and 1 (all)
t = 1

# Do you want to scrape new data (y/n)? If so, it'll take approx t*35 minutes
update = 'y'

# How wide do you want the predicted performance buckets to be?
bucket_width = 12

# How many games do you want to include in a pitcher's "recent performance" (think, rolling avg)
N=5

# How many games do you want to include in an opposing team's "recent performance" (think, rolling avg)
M=30
```

I can then customize which stats I consider

PITCHER PERFORMANCE

```
stat_selector = {  
  'index': 0,  
  'Rk': 0,  
  'Gcar': 0,  
  'Gtm': 0,  
  'Tm': 0,  
  'Rslt': 0,  
  'Inngs': 0,  
  'R': 0,  
  'ERA': 0,  
  'FIP': 1,  
  'BF': 0,  
  'Pit': 0,  
  'Str': 0,  
  'StL': 0,  
  'StS': 0,
```

```
  'GB': 0,  
  'FB': 0,  
  'LD': 0,  
  'PU': 0,  
  'Unk': 0,  
  'GSc': 1,  
  'IR': 0,  
  'IS': 0,  
  'SB': 0,  
  'CS': 0,  
  'PO': 0,  
  'AB': 0,  
  '2B': 1,  
  '3B': 0,
```

```
  'IBB': 0,  
  'GDP': 0,  
  'SF': 0,  
  'ROE': 0,  
  'aLI': 0,  
  'WPA': 1,  
  'acLI': 0,  
  'cWPA': 0,  
  'RE24': 0,  
  'DFS(DK)': 0,  
  'DFS(FD)': 0,  
  'Entered': 0,  
  'Exited': 0,  
  'Outs': 0}
```

OPPONENT PERFORMANCE

```
opp_stat_selector = {'Rk': 0,  
  'Gtm': 0,  
  'Opp': 0,  
  'Rslt': 0,  
  'AB': 0,  
  'R': 1,  
  'H': 1,  
  '2B': 0,  
  '3B': 0,  
  'HR': 1,  
  'RBI': 0,  
  'BB': 1,  
  'IBB': 0,  
  'SO': 1,  
  'HBP': 0,
```

```
  'SH': 0,  
  'SF': 0,  
  'ROE': 0,  
  'GDP': 0,  
  'SB': 0,  
  'CS': 0,  
  'BA': 0,  
  'OBP': 1,  
  'SLG': 1,  
  'OPS': 0,  
  'LOB': 1,  
  '#': 0,  
  'Thr': 0,  
  'Opp. Starter (GmeSc)': 0}
```


The Neural Network

```
# Define the deep learning model
nn_model = tf.keras.models.Sequential()
nn_model.add(tf.keras.layers.Dense(units=22, activation="relu", input_dim = X_train.shape[1]))
nn_model.add(tf.keras.layers.Dense(units=18, activation="tanh"))
nn_model.add(tf.keras.layers.Dense(units=14, activation="relu"))
nn_model.add(tf.keras.layers.Dense(units=10, activation="tanh"))
nn_model.add(tf.keras.layers.Dense(units=len(bucket_labels), activation="softmax"))
```

- Potential Improvement
 - Build model using Keras Hyperparameter Auto-Tuner
 - Especially due to variable number of inputs/outputs

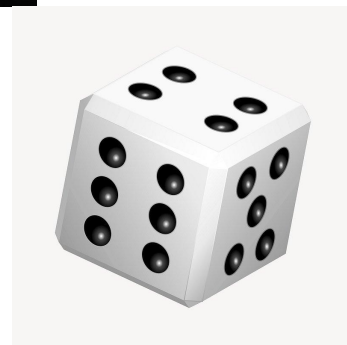
The Output

- Array of probabilities that pitcher performs in given bucket

	index	pitcher	code	.<=0	0<.<=10	10<.<=20	20<.<=30	30<.<=40
0	21	Lance Lynn	lynnla01	0.0	0.0	0.5	0.5	0.0
1	36	Jordan Montgomery	montgjo01	0.1	0.0	0.2	0.7	0.0
2	56	JP Sears	searsjp01	1.0	0.0	0.0	0.0	0.0
3	79	Brady Singer	singebr01	0.0	0.0	0.3	0.7	0.0
4	105	Zack Wheeler	wheelza01	1.0	0.0	0.0	0.0	0.0
5	122	Freddy Peralta	peralfr01	1.0	0.0	0.0	0.0	0.0

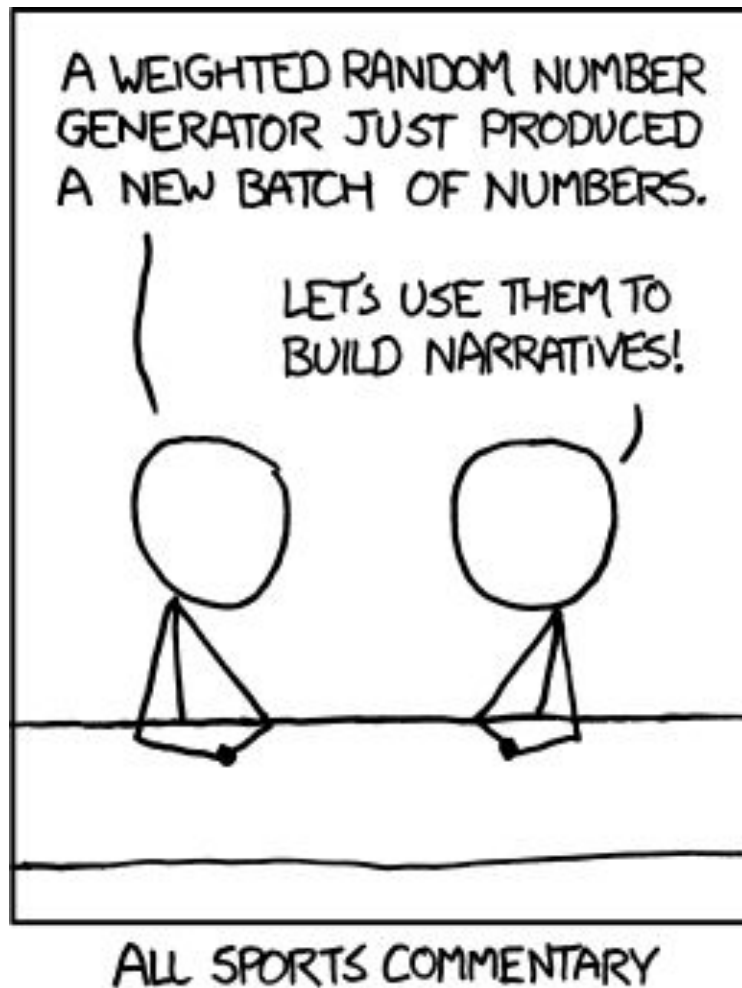
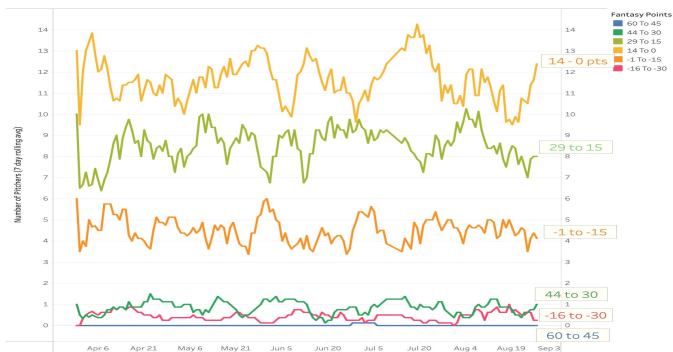
Accuracy: 0.4865283749181901

- ~50% for a binary classification would be bad
 - Analogy: coin flip
- But ~50% accuracy for 5-6 classes is relatively good
 - Analogy: rolling a die, getting it right half the time



Underlying Issue

- Sports are essentially (weighted) random number generators
- Chaotic behavior is tough to model



However!

Prediction is a key part of sports analysis:

- Fantasy apps
- Sportsbooks

Better predictions → more value, traffic, revenue

Pos	Pitchers	Opp	Status	Fan Pts
P	Mitch Keller PIT - P	NYN	6:35 pm	12
P	Merrill Kelly ARI - P	CHC	8:10 pm	13
P	Jon Gray TEX - P	@CLE	6:10 pm	11
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TODAY	RUN LINE	TOTAL	MONEYLINE
 6:40PM  NY Mets Jose Butto	+1.5 -155	O 8.5 -120	+136
 MIA Marlins Edward Cabrera	-1.5 +130	U 8.5 +100	-162
 6:40PM  MIN Twins Joe Ryan	-1.5 +105	O 9.5 -108	-148
 CIN Reds Connor Phillips	+1.5 -125	U 9.5 -112	+124

Ideas for Improving Accuracy

- Tweak how data is customized
- Tweak neural network further (possibly hyperparameter auto-tuner)
- Explore about *which* pitchers to train on
 - Only consider pitchers that would be in the pool in the first place
 - Exclude the best pitchers
 - Increase model attention to available pitchers

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stat_selector = {  
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    'Gtm': 0,  
    'Tm': 0,  
    'Rslt': 0,  
    'Inngs': 0,  
    'R': 0,  
    'ERA': 0,  
    'FIP': 1,  
    'BF': 0,  
    'Pit': 0,  
    'Str': 0,  
    'StL': 0,  
    'StS': 0,
```

```
opp_stat_selector = {'Rk': 0,  
    'Gtm': 0,  
    'Opp': 0,  
    'Rslt': 0,  
    'AB': 0,  
    'R': 1,  
    'H': 1,  
    '2B': 0,  
    '3B': 0,  
    'HR': 1,  
    'RBI': 0,  
    'BB': 1,  
    'IBB': 0,  
    'SO': 1,  
    'HBP': 0,
```

```
# How wide do you want the predicted performance buckets to be?
```

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bucket_width = 12
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# How many games do you want to include in a pitcher's "recent performance" (think, rolling avg)
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