

High Altitude Home Runs

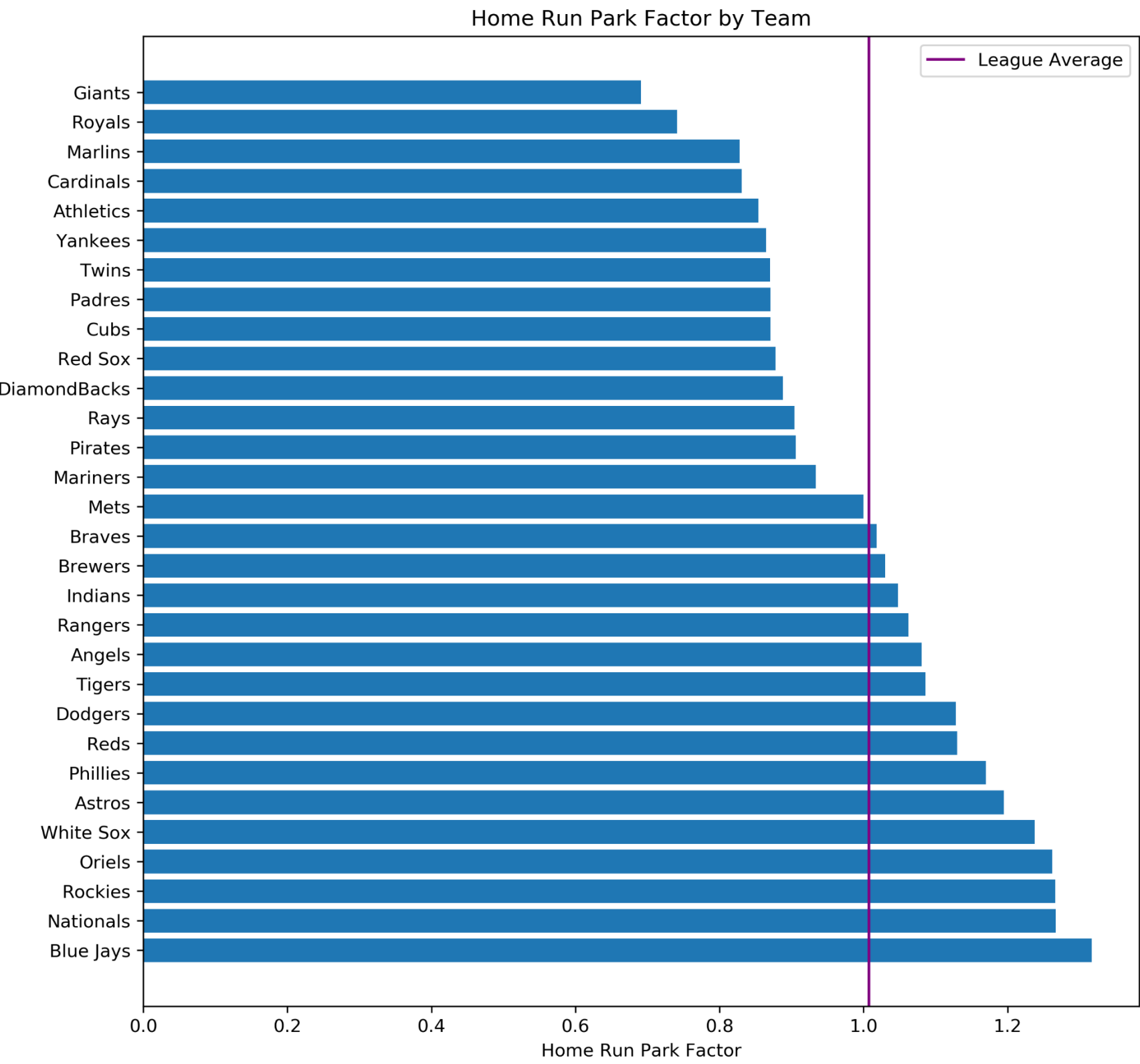
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Introduction

Is it really easier to hit a Home Run in Colorado due to the lower air density or are other factors responsible?

The MLB Park Factor statistic indicates that more home runs are hit in Colorado. But is this caused by thinner air?



Objectives

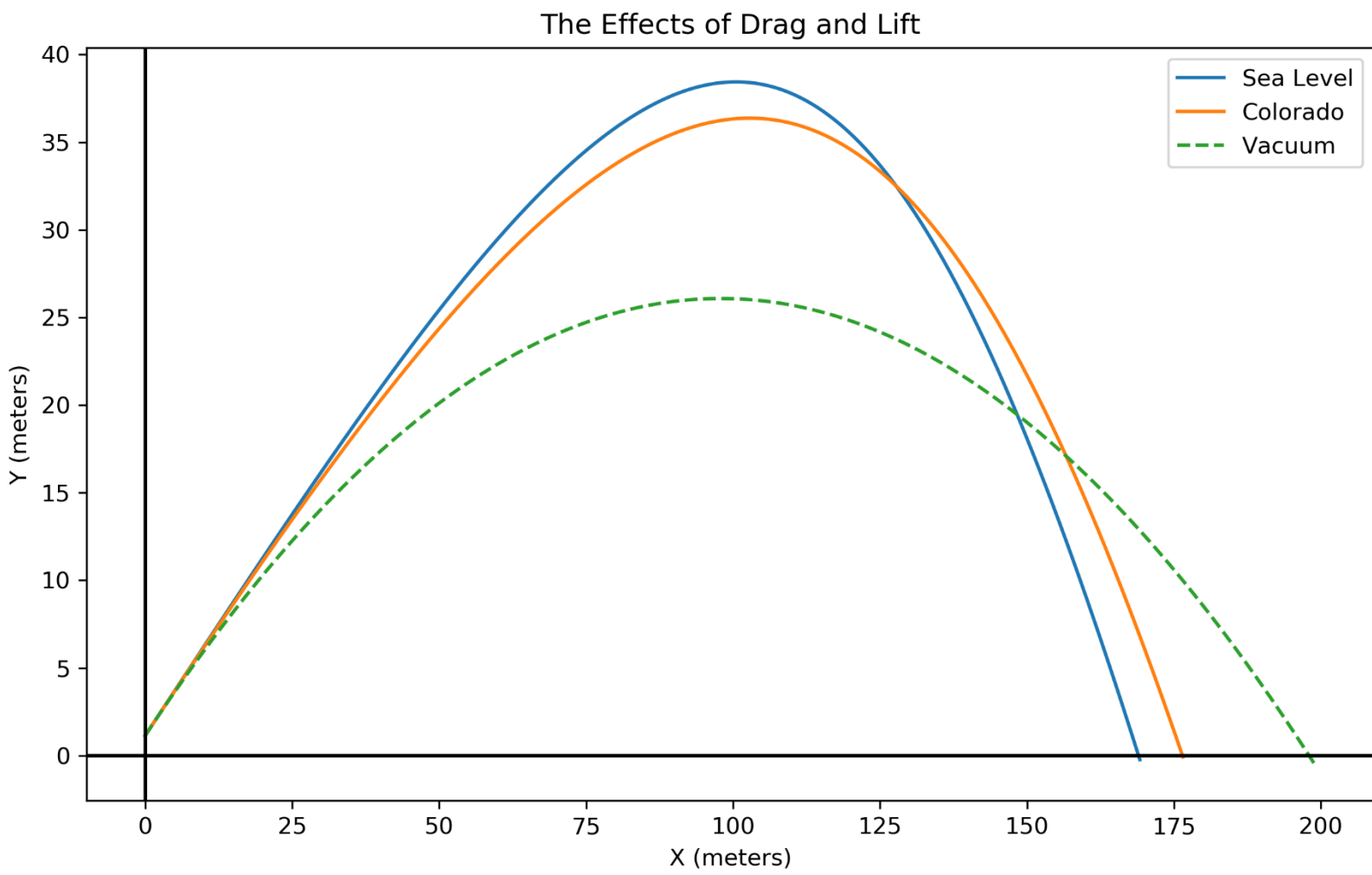
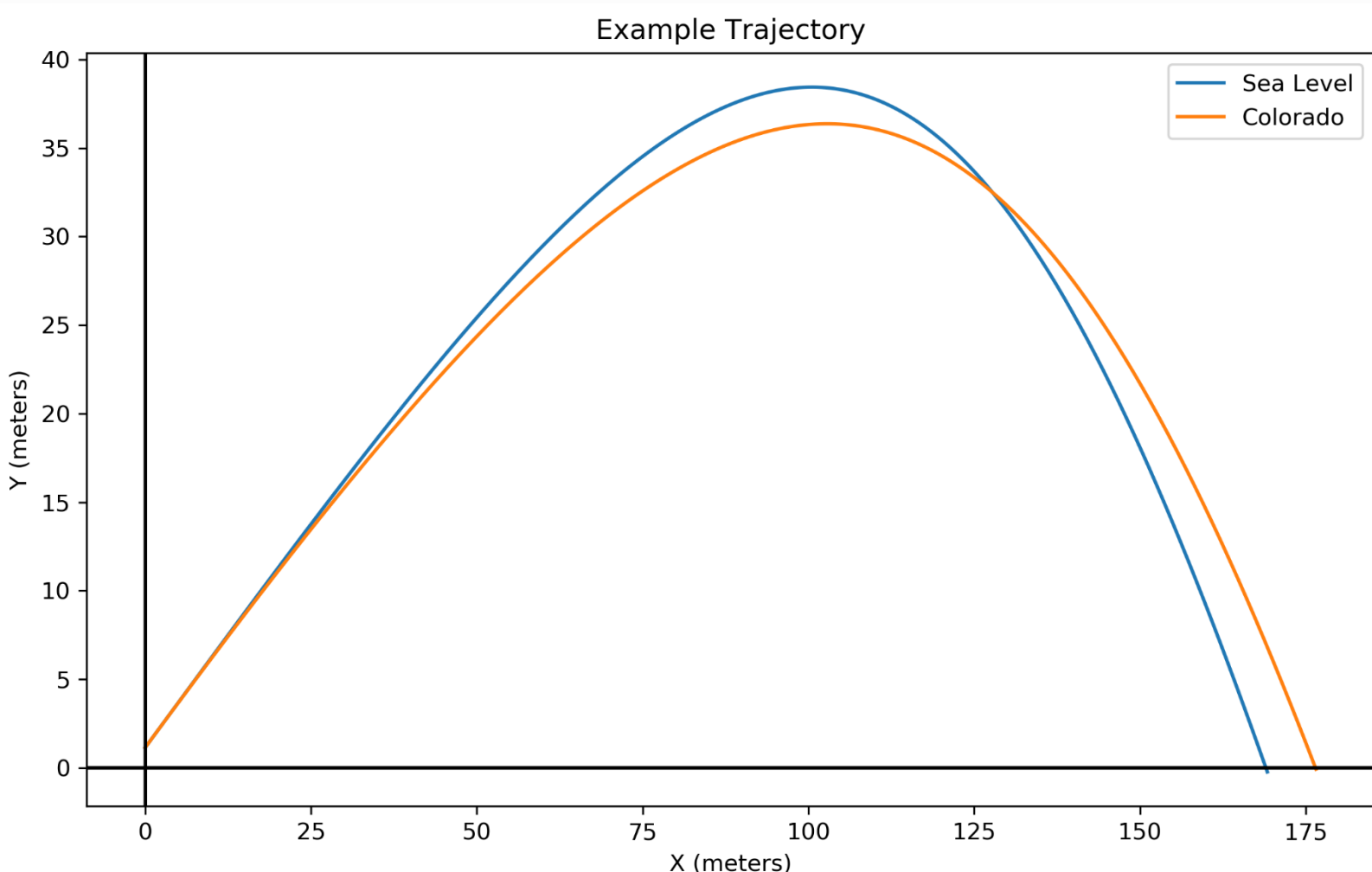
- Model the trajectory of a baseball including drag and lift
- See how lower air densities affect the trajectory
- Compare our estimated increase in home runs to the actual data to see if the lower air density explains the increase

Methods

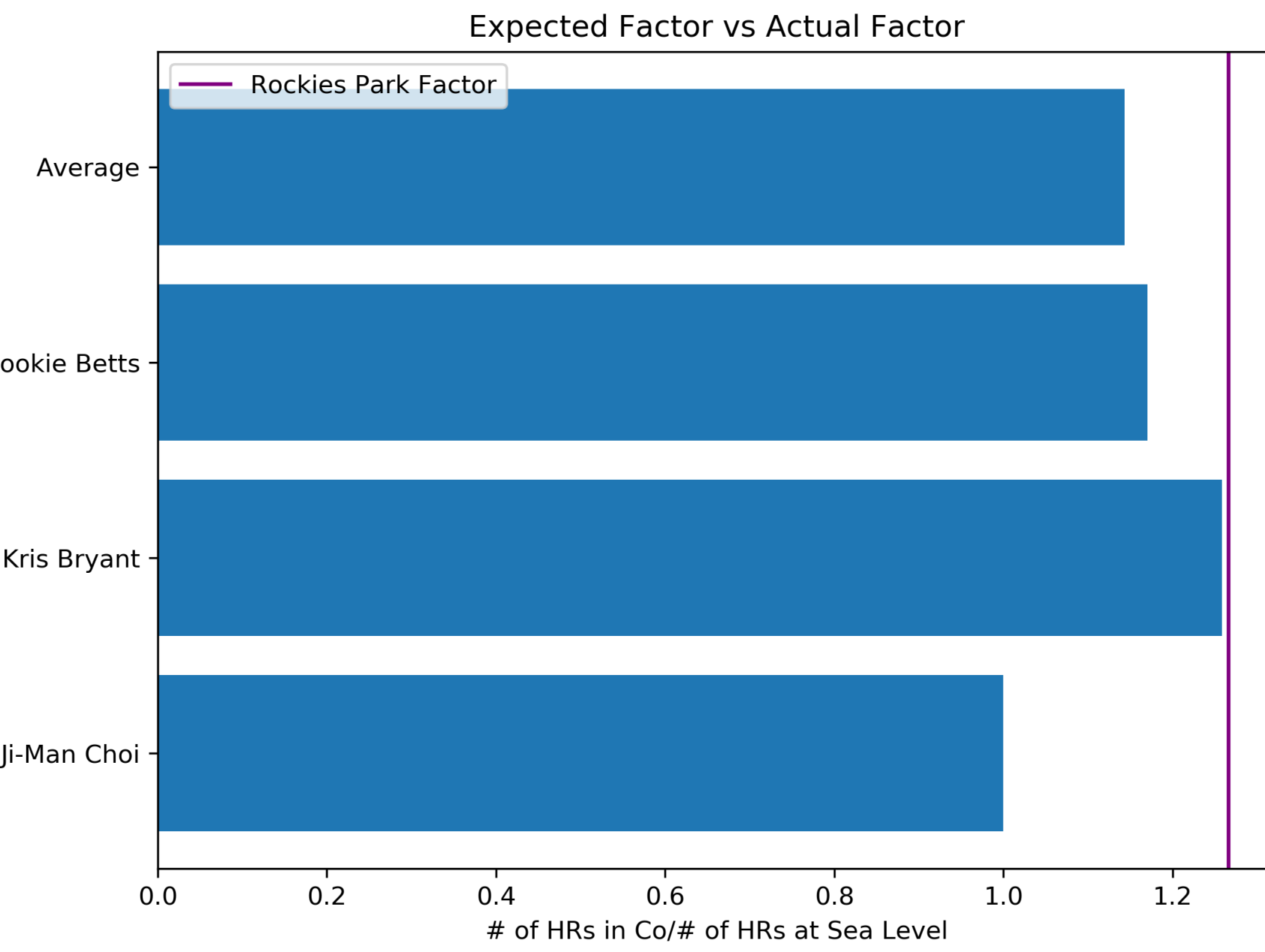
- Create a **second-order ODE** that describes the motion of the baseball in flight
- Use the **Runge-Kutta 4** method to approximate how far the ball travels
- Solve for the **distance travelled** for initial conditions based on all the pop flies hit by three batters during the 2019 season for the two air densities
- These batters are:
 - Ji-Man Choi
 - Mookie Betts
 - Kris Bryant
- Compare these results to the ratio predicted by the Park Factor Described above

Lower air density
does not account
for all of the
increase in home
runs at Coors Field
in Colorado

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the code



Results



While the lower air density definitely increases the amount of homeruns hit, it does not account for all of the increase. This indicates that there is likely another factor.

Discussion

It is important to consider the assumptions I made during the calculations.

1. I assumed all of the spin was directly backwards
2. I assumed that there was no wind impacting the ball

Neither of these assumptions would account for the consistent difference we see.

Instead we must look toward other factors. It could be that the Rockies as a pitching staff allows more home runs, or perhaps the humidity effects the rigidity of the balls.

Sources

Lift and drag coefficients: NASA
Air densities: <https://www.purplerow.com/2018/1/8/16846116/colorado-rockies-coors-field-arizona-diamondbacks-chase-field-comparison>
Backspin values: <https://fivethirtyeight.com/features/home-runs-are-soaring-could-declining-backspin-be-a-factor/>
Ball values: [https://en.wikipedia.org/wiki/Baseball_\(ball\)](https://en.wikipedia.org/wiki/Baseball_(ball))
Park factors: <http://proxy.espn.com/mlb/stats/parkfactor?sort=HRFactor>
Runge-Kutta Method code: Dr. Miller
Batting Values: <https://baseballsavant.mlb.com/>