

High Altitude Home Runs

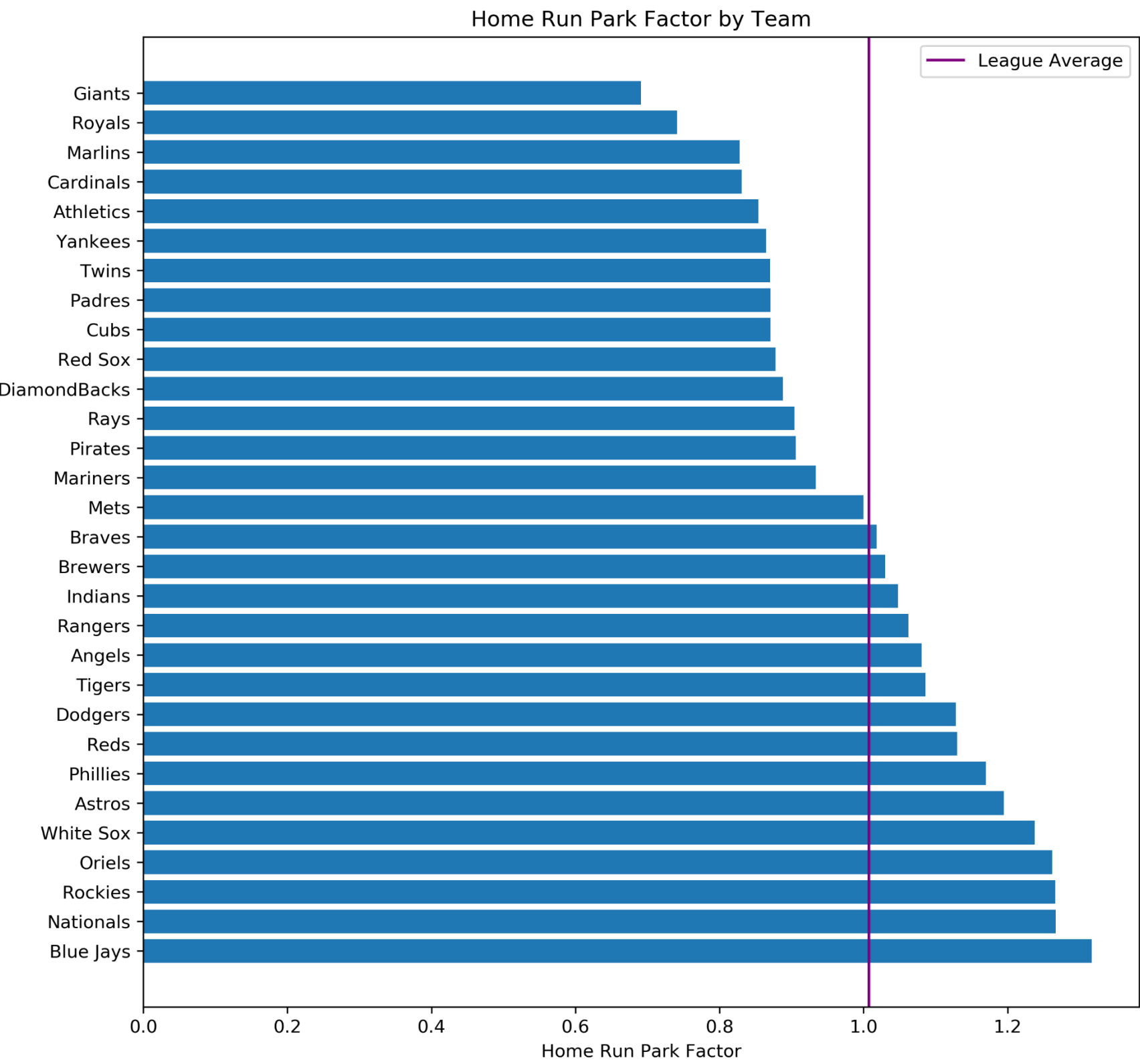
Analyzing the effect of air density on projectile motion

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Introduction

Is it really easier to hit a Home Run (HR) 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 a lower air density value 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

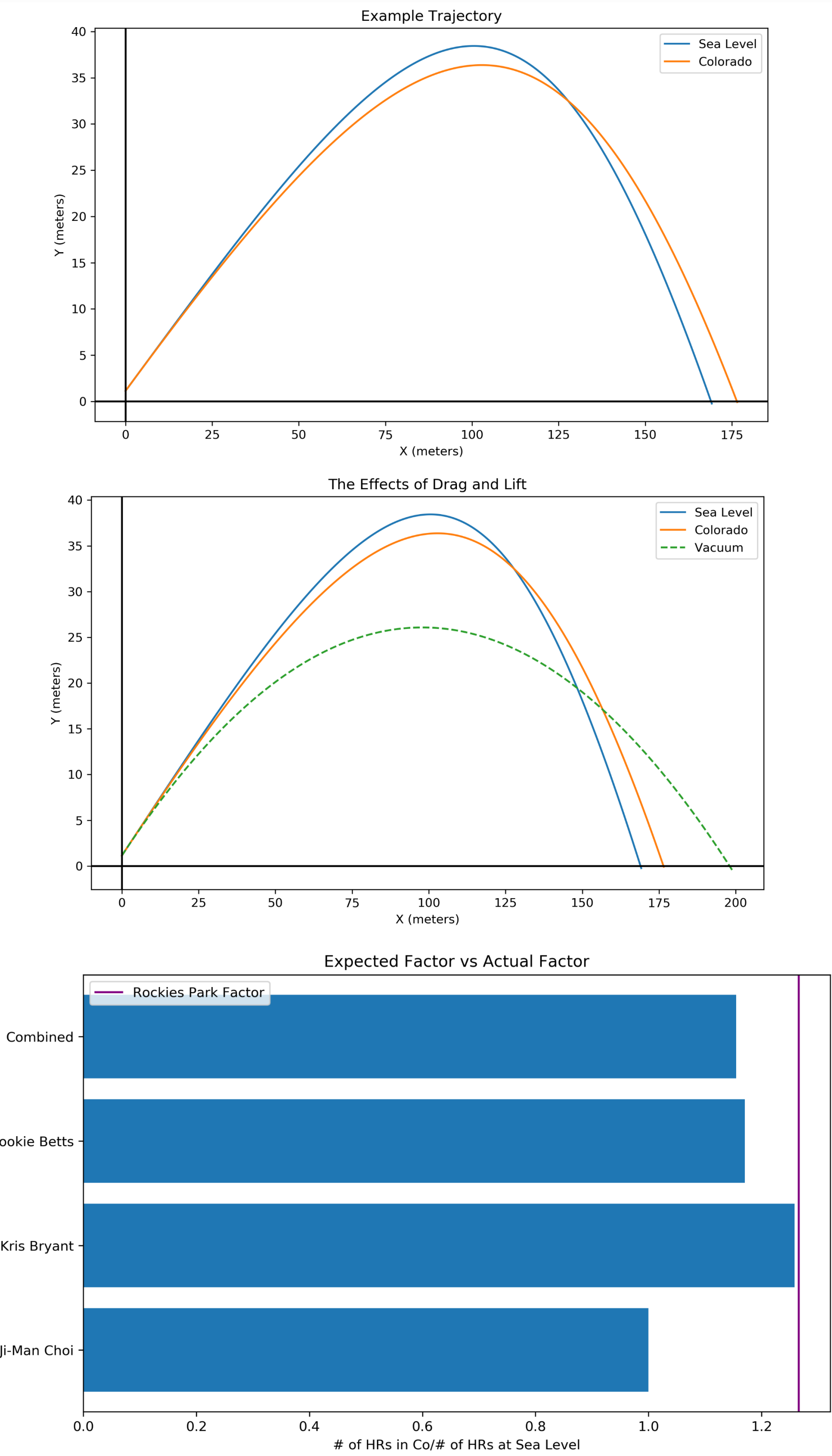
- Create a **second-order ODE** that describes the motion of the baseball in flight
- Use the **Runge-Kutta** method to approximate the distance the ball travels
- Solve for the **distance travelled** in both **Colorado** and at **sea level** based on initial conditions derived from all the pop flies hit by three batters during the 2019 season
- These batters are:
 - Ji-Man Choi
 - Mookie Betts
 - Kris Bryant
- If the distance traveled is **greater** than the distance to the center field wall that hit is marked as a HR
- Compare the **ratio** of HRs in Colorado over HRs at sea level to the park factor.

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

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Results



While the lower air density **does increase** the amount of HRs, it **does not** account for all of the increase.

This indicates that there is likely **additional factors** that effect the distance.

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 some other factor related to altitude such as humidity could influence the ball

Sources

Lift and drag coefficients: NASA
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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 base code: Dr. Miller
Batting Values: <https://baseballsavant.mlb.com/>