



# The Effect of External Factors on Baseball


Kayoung Kim





# Research Question

Does air density, its three factors considered separately (air pressure, humidity, and temperature), or full moons affect the number of runs scored in baseball?



# Hypothesis

- All of the external factors (air density, air pressure, humidity, temperature, and full moons) are predicted to each show a correlation with the number of runs scored.
- Air density and air pressure: - correlation with the runs scored
- Humidity and temperature: + correlation
- Presence of full moons: predicted to make the number of runs lower

# Methodology

- Data for the Cincinnati Reds from seasons 2015-2019, Excel was used
- Atmospheric data- NOAA Local Climatological Data (LCD) Map tool
- Moon phase data- NOAA Tides & Currents Astronomical Data
- IV- type of external factor (air density, air pressure, temperature, relative humidity, presence/absence of full moon)
- DV- number of runs scored by the Cincinnati Reds (home score)

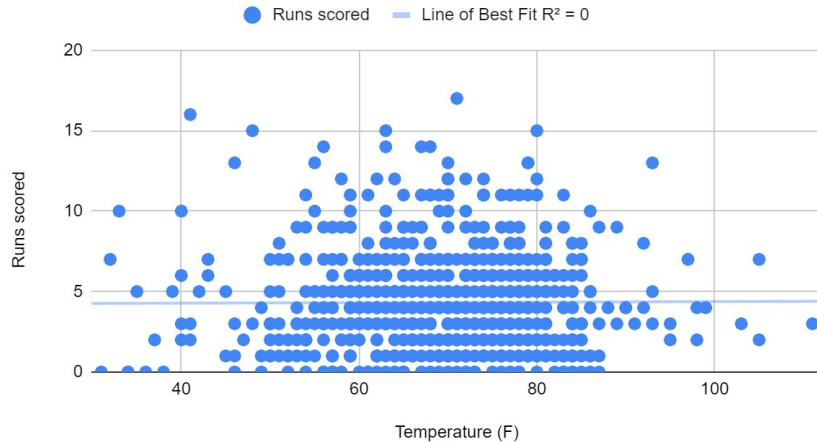
## Sample Data

date	place	Temperature (F)	Humidity (%)	Air Pressure (Hg)	moon
20-May	CIN	59	93	29.47	
21-May	CIN	58	90	29.49	1
22-May	CIN	67	45	29.41	

*Table 1.* Sample raw data table for external factors.

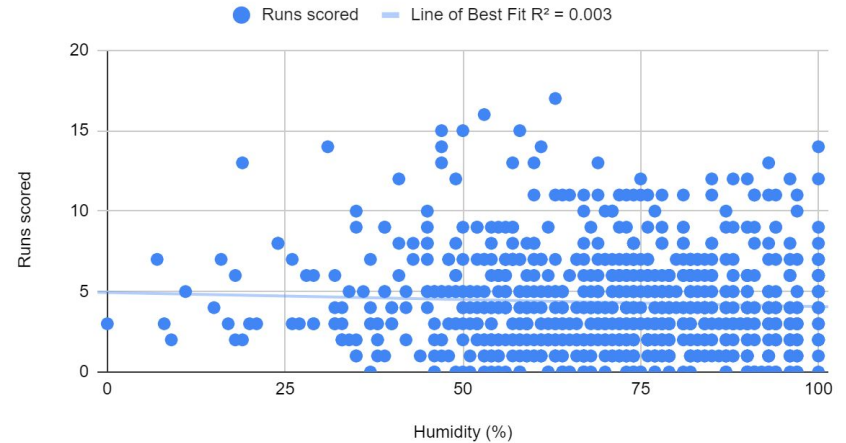
# Data Analysis - Correlation Analysis (Atmospheric)

Runs scored vs. Temperature (F)



Correlation coefficient:  
0.005824322

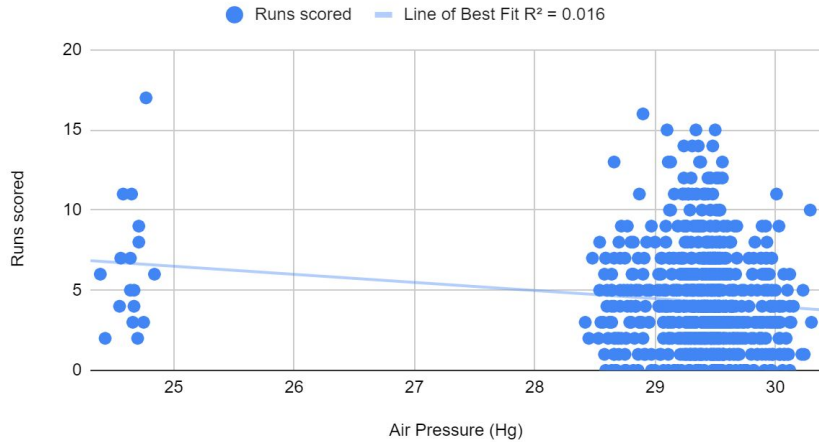
Runs scored vs. Humidity (%)



Correlation coefficient:  
-0.053159915

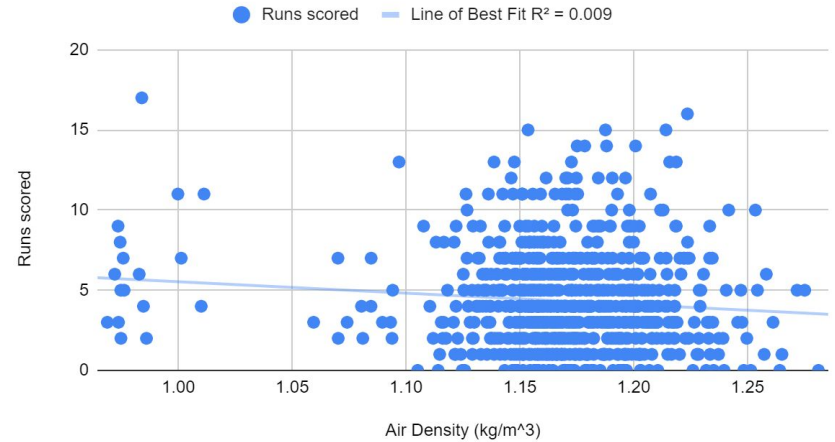
# Data Analysis- Correlation Analysis Continued

Runs scored vs. Air Pressure (Hg)



Correlation coefficient:  
-0.126041456

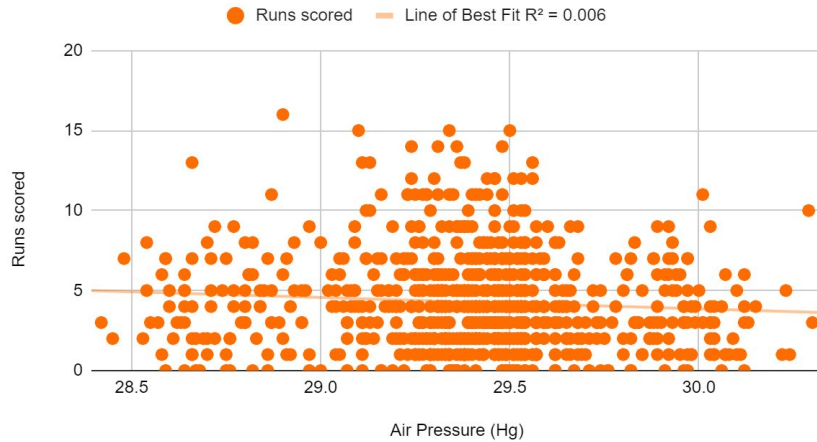
Runs scored vs. Air Density (kg/m³)



Correlation coefficient:  
-0.095936452

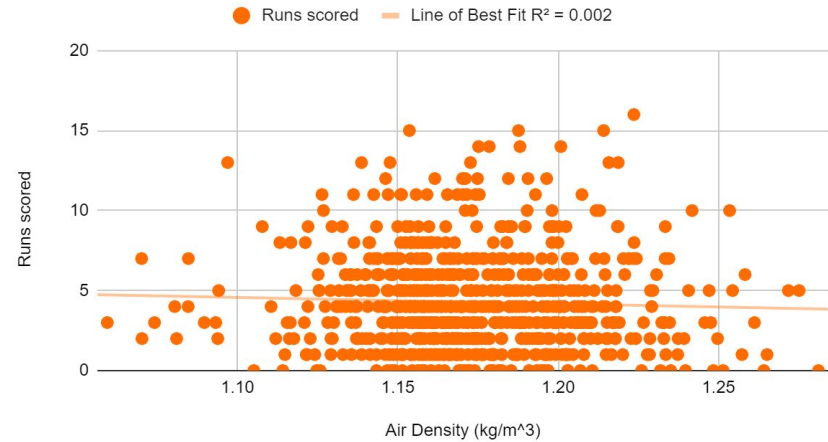
# Data Analysis- Correlation Analysis Without COL

Runs scored vs. Air Pressure (Hg)



Correlation coefficient:  
-0.079529926

Runs scored vs. Air Density ( $\text{kg/m}^3$ )



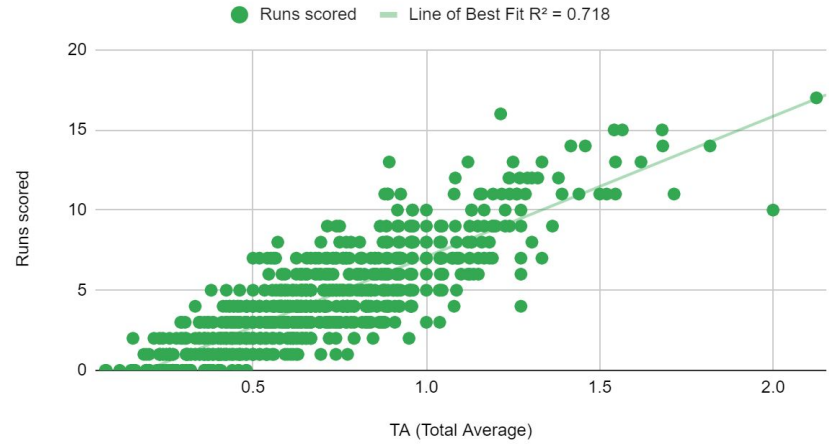
Correlation coefficient:  
-0.040913404



# Data Analysis- Correlation Analysis (Team Batting Statistics)

- Data from Baseball Reference
- Total Average: 0.847555032
- Temperature: 0.005824322
- Relative Humidity:  
-0.053159915
- Air pressure: -0.126041456
- Air density: -0.095936452

Runs scored vs. TA (Total Average)



Correlation coefficient:  
0.847555032

# Measures of Central Tendency and Variability (Full Moons)

- Mean
  - No full moon: 4.339498018, Full moon: 4
- Median
  - No full moon: 4, Full moon: 4
- Variance
  - No full moon: 9.565805568, Full moon: 9.076923077

## F test and t test

	<i>No full moon</i>	<i>Full moon</i>
Mean	4.339498018	4
Variance	9.565805568	9.076923077
Observations	757	27
df	756	26
F	1.053859935	
P(F<=f) one-tail	0.461739913	
F Critical one-tail	1.700170089	

*Table 2.* One-tailed F test

	<i>No full moon</i>	<i>Full moon</i>
Mean	4.339498018	4
Variance	9.565805568	9.076923077
Observations	757	27
Pooled Variance	9.549551163	
Hypothesized Mean Difference	0	
df	782	
t Stat	0.560941478	
P(T<=t) one-tail	0.287499061	
t Critical one-tail	1.646804505	

*Table 3.* One-tailed uncorrelated t test assuming equal variances with a significance level of 0.05

# Conclusion

- No statistically significant impact observed
- Full moons- no impact visible in baseball
- Atmospheric factors- trends can be seen
  - Air pressure and air density- comparatively stronger trend in desired direction
  - Temperature- trend in desired direction (low magnitude)
  - Relative Humidity- trend in opposite direction (low magnitude)

# Possible Errors and Improvements / Extensions

- Possible errors
  - Weather data may not exactly be from where the game took place
  - Games may not have been played during the estimated time (7 P.M.)
- Improvements / Extensions
  - More data (more teams, longer time periods)
  - Compare the external factors with another statistic in baseball other than the score (SLG, number of home runs, etc.)
  - Observe additional external factors, such as social media

# Data Sources

NOAA Local Climatological Data Map Tool:

<https://www.ncdc.noaa.gov/cdo-web/datatools/lcd>

NOAA Tides & Currents:

<https://tidesandcurrents.noaa.gov/astronomical.html>

Baseball Reference:

<https://www.baseball-reference.com/teams/tgl.cgi?team=CIN&t=b&year=2015>

## References

Bahill, T., Baldwin, D., & Ramberg, J. (2009, February 5). Effects of altitude and atmospheric conditions on the flight of a baseball. Academia.edu - Share research.

[https://www.academia.edu/8605937/Effects\\_of\\_Altitude\\_and\\_Atmospheric\\_Conditions\\_on\\_the\\_Flight\\_of\\_a\\_Baseball](https://www.academia.edu/8605937/Effects_of_Altitude_and_Atmospheric_Conditions_on_the_Flight_of_a_Baseball)

Muñoz-Delgado, J., Santillán-Doherty, A. M., Mondragón-Ceballos, R., & Erkert, H. G. (2000, October 3). Moon cycle effects on humans: myth or reality? Medigraphic - Literatura Biomédica.

<https://www.medigraphic.com/pdfs/salmen/sam-2000/sam006e.pdf>



Thank you!

Any questions?

