

# EXPLORING DRONE PERFORMANCE DATA AND INFERRING INSIGHTS



SUBMISSION FOR CONSIDERATION FOR DATA  
SCIENTIST/ANALYST INTERN/CO-OP ROLE AT ZIP LINE.



AASHUTOSH NEMA

# SUMMARY

- ▶ Understanding of product performance : Vital Information to determine necessary improvements and future modifications.
- ▶ Through this project we would be leveraging Data Analysis to study Drone performance and environment data to infer relations and improvement points.

## Report Outline:

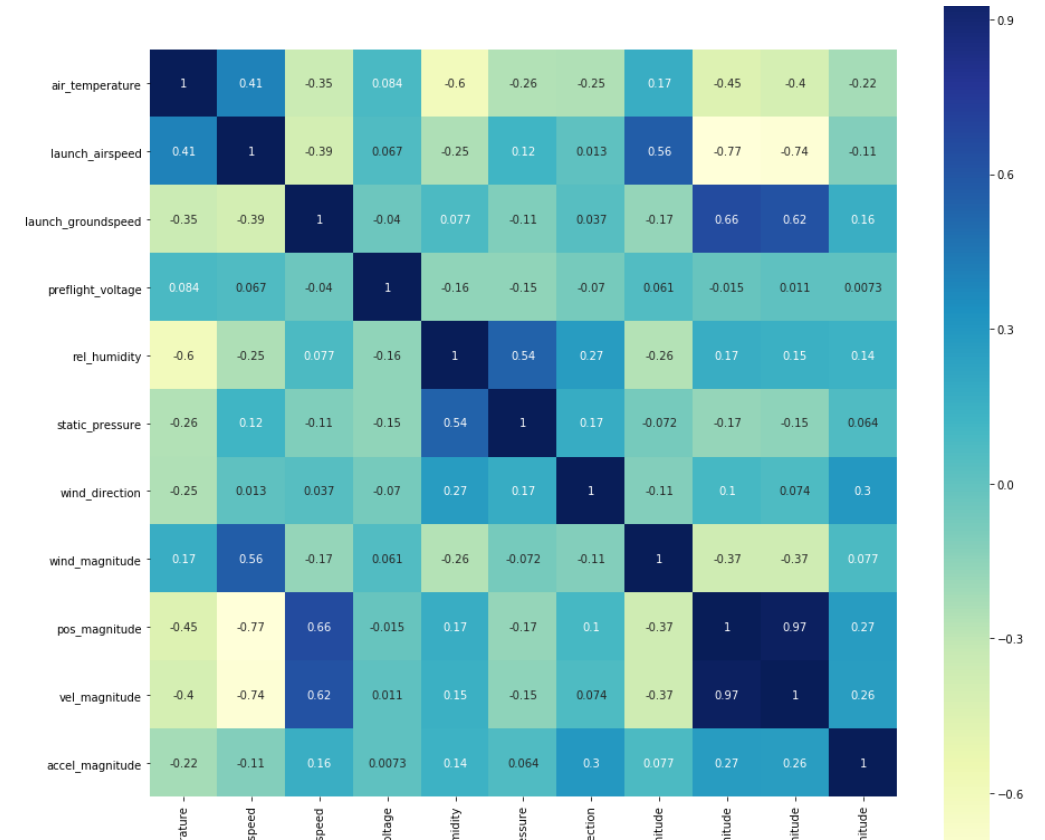
- ▶ Part 1: Data Preprocessing
- ▶ Part 2: Correlation and Outliers Analysis
- ▶ Part 3: Environment Analysis and its effects on Drone Performance
- ▶ Part 4: Components Performance Analysis
- ▶ Part 5: Prediction modeling for magnitude of Distance Covered by Drone

# 1. Pre-Processing steps:

- ▶ Importing necessary libraries to process and visualize data.
- ▶ Assigning the correct data types to the attributes.
- ▶ Converting timestamp to meaningful attributes extracting day, time, date, day of week, week of year, etc.
- ▶ Computing distance, velocity and acceleration magnitude for individual flights computed from each Flight ID.
- ▶ imputing missing value.
- ▶ Analyzing Correlation and Outliers for different predictors.

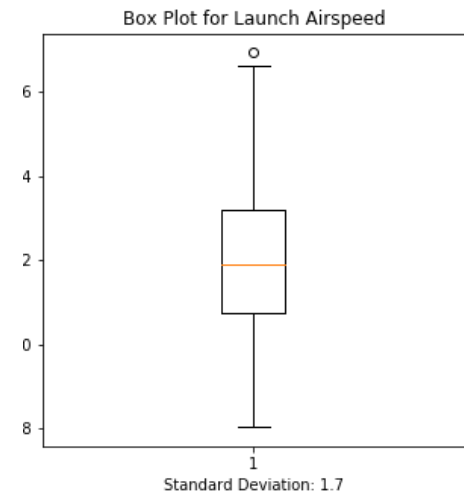
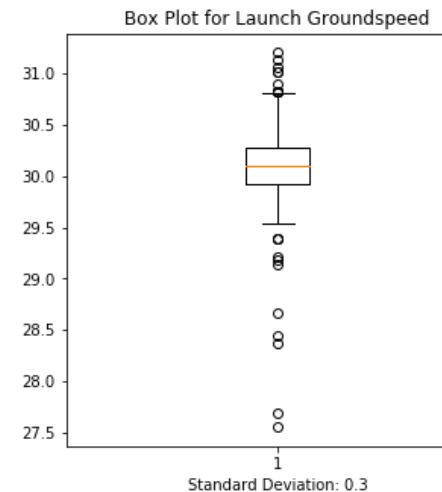
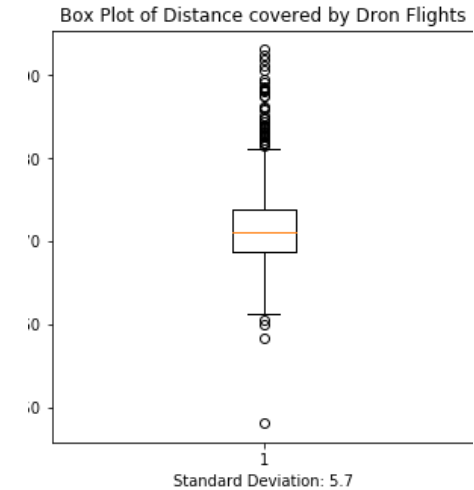
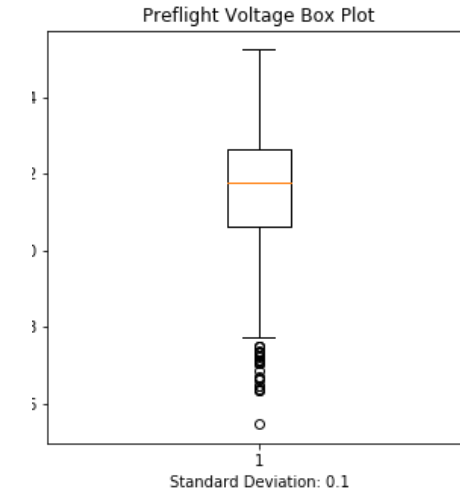
## 2. Correlation Analysis

- ▶ Strong positive correlation between Position and Velocity magnitudes.
- ▶ Negative correlation between: Velocity magnitude & Launch Airspeed, position magnitude & launch air speed.
- ▶ Moderate positive correlation between: Launch Ground speed & Velocity Magnitude, Launch Ground Speed & Position Magnitude, Launch airspeed & wind magnitude, relative humidity & static pressure.
- ▶ Moderate negative correlation between: Relative humidity & Air temperature.



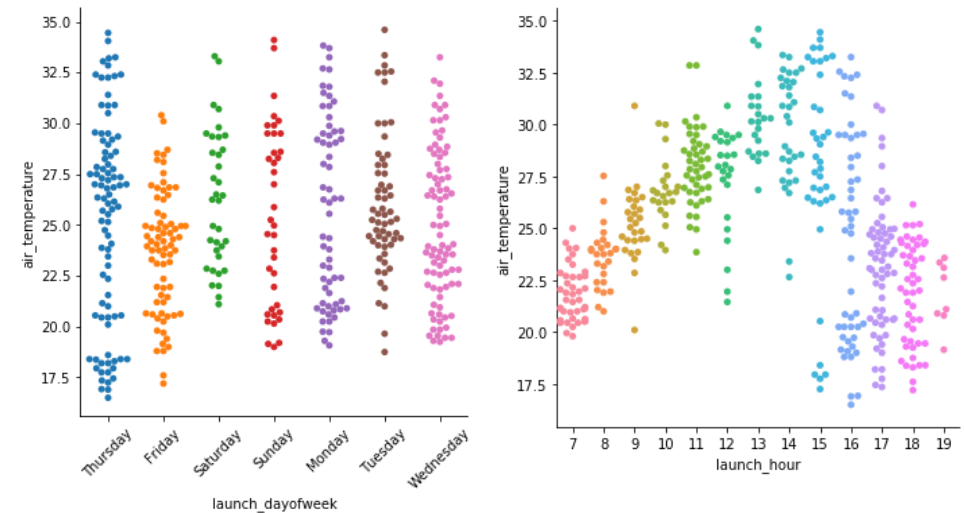
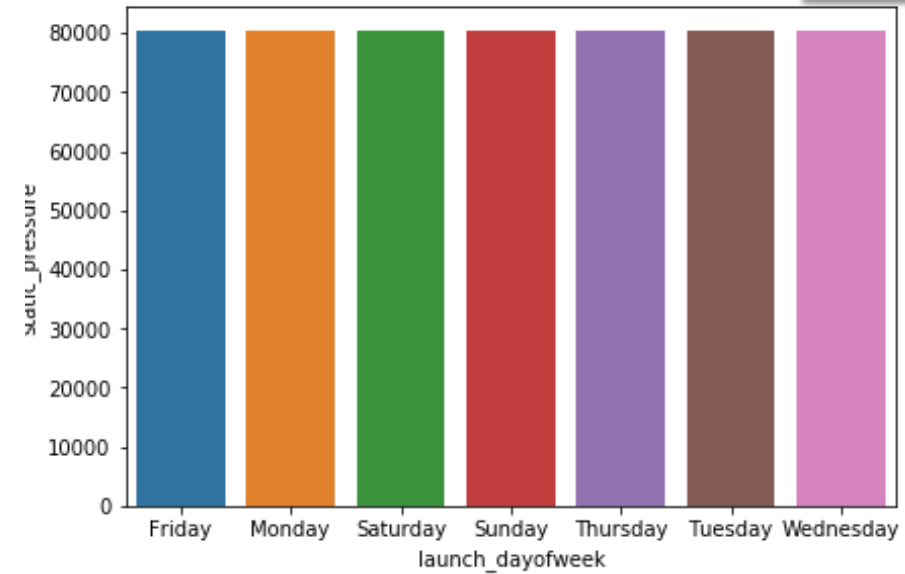
## 2. Analyzing Outliers:

- ▶ Majority of the flights travel a distance between 168 to 175 meters. High number of outliers can be found in the plot in this category which suggests it is common for flights to take longer routes which might be due to weather conditions or operating limitations.
- ▶ Preflight voltages have a median of around 32 Volts. It is found that outliers in this category are only below the minimum voltage for the group. Which suggests that battery providing higher than the required voltage is never a problem for the drone, but there are situations when the drone is receiving less than the necessary Voltage. Hence drones should be made safe to low voltage conditions.
- ▶ For launch airspeed it is found that there is only one outlier rest all launches are within the interval limits.
- ▶ Ground speed characteristic of the drone has most number of outliers, hence this suggests improvement is needed to increase ground performance of the Drone.



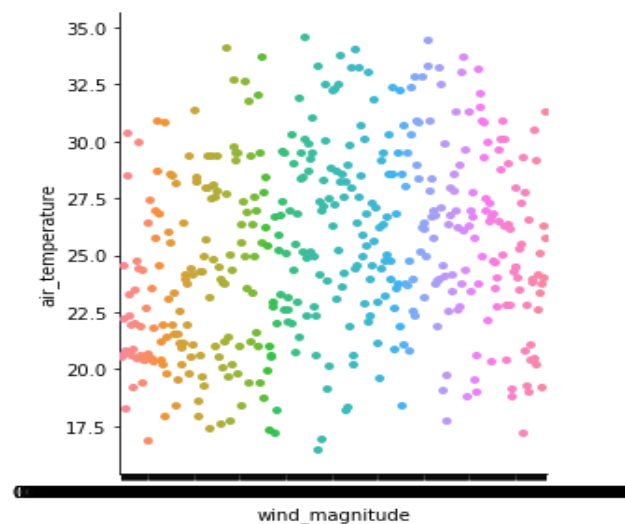
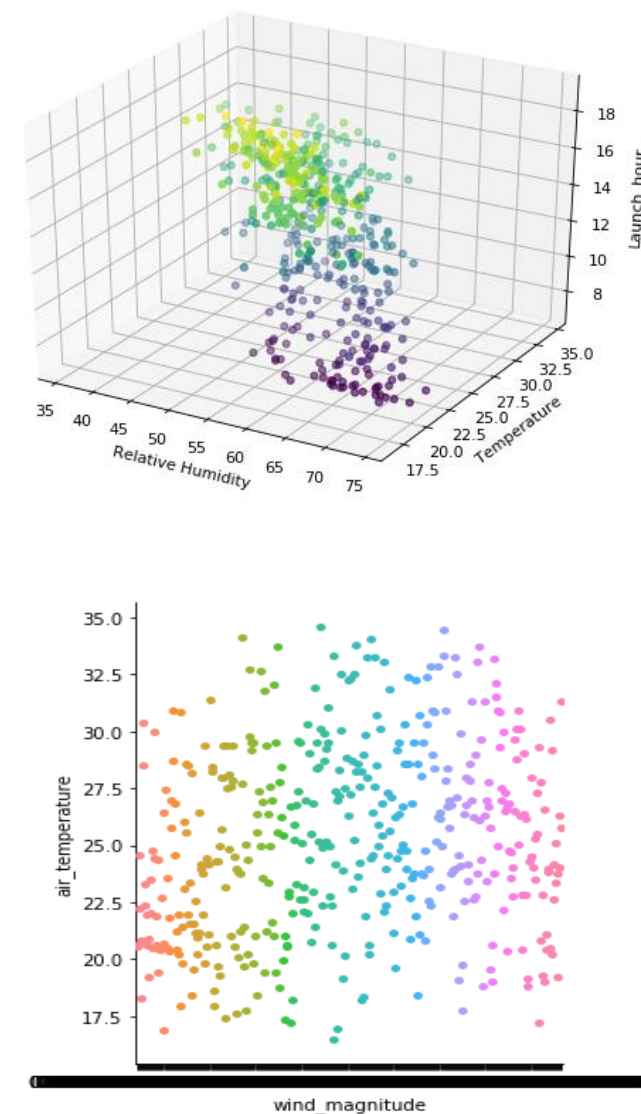
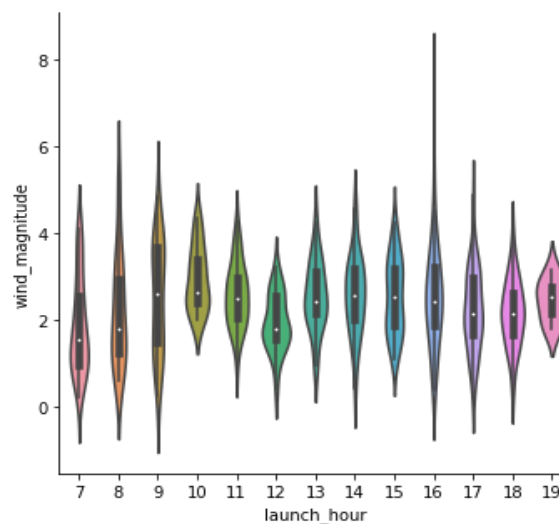
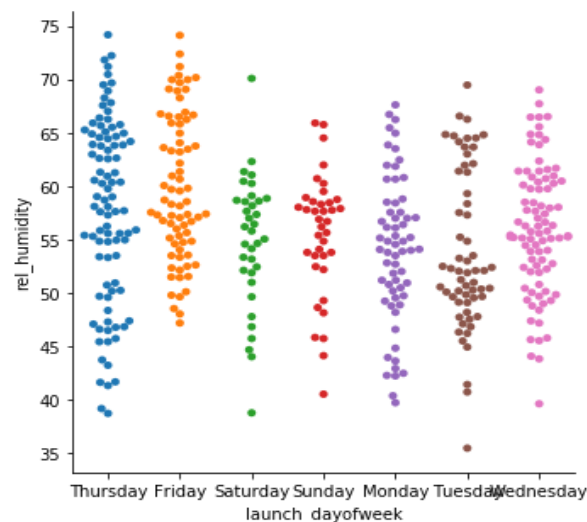
### 3. Temperature and Air pressure

- ▶ Temperature varies the most on Thursday and least on Saturday.
- ▶ On Friday typically average or lower than average temperature is observed.
- ▶ Static pressure remains fairly constant throughout the week



### 3. Relative Humidity and Wind Magnitude

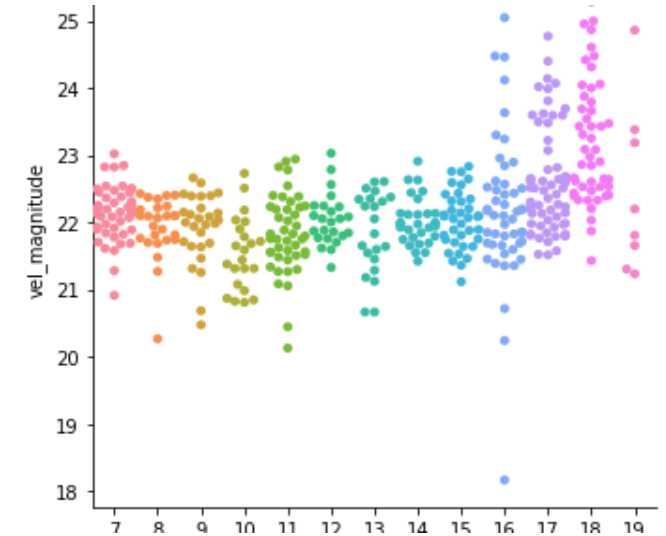
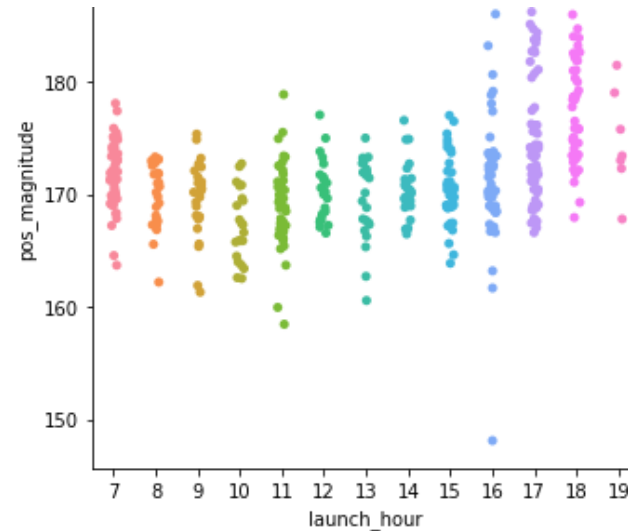
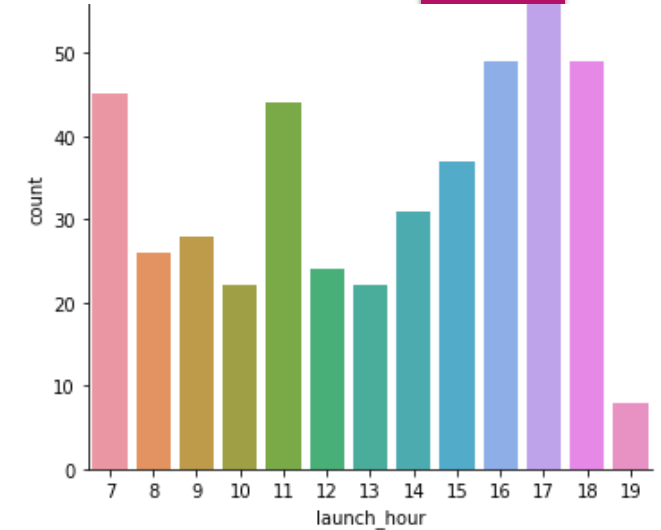
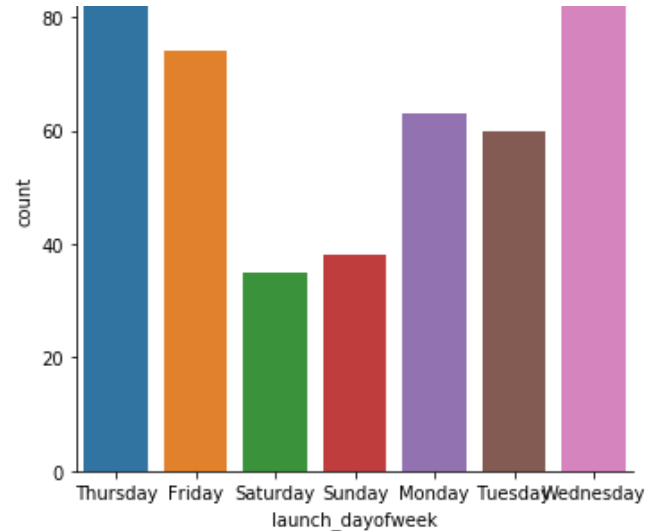
- ▶ Relative humidity varies a bit opposite to air temperature throughout the week, which is also suggested by moderate negative correlation of -0.6 between them.
- ▶ Relative humidity is high during the morning and then decreases with the increase in temperature during the day time.
- ▶ During Morning hours the wind speed is slow which increases with the time of the day, wind speed is most fluctuating during the afternoon hours specially around 4 PM.
- ▶ The plot next to it tries to generate a relation between air temperature and wind magnitude but as the correlation suggests the two are weekly correlated (Correlation = 0.17)





### 3. Launch Time

- ▶ Most launches takes place the morning and evening hours.
- ▶ Judging from the pattern of demand we can infer that most accidents and injuries occur during the early morning and the evening time. M
- ▶ Most requirement of Drone is during Thursday followed by Wednesday and Friday. Saturday and Sunday are the least requirement days. This suggests that most of the accidents and injuries usually occur while commuting to and from workplace. Expectedly the high traffic times increases the chances of accidents.
- ▶ The Drones delivering during the evening cover the most distance. Similarly the velocity and acceleration of drone is highest in the evening. This suggests evening time i.e., low temperature and moderate humidity are favorable operating conditions for the Drone.





## 4. Parts Performance

The part performances do not seem to vary by a great scale which suggests that almost all of the Zips function as designed which is a good this.

Wing observations:

- ▶ Wing Number 15SPJJJ11024054 has the largest distance covered with magnitude 11246.16 meters and wing 15SPJJJ11048054 has covered the least distance of all with magnitude 159.95 meters.
- ▶ Wing number 15SPJJJ11048054 has the highest air speed achieved and wing 15SPJJJ09031032 has the lowest airspeed achieved

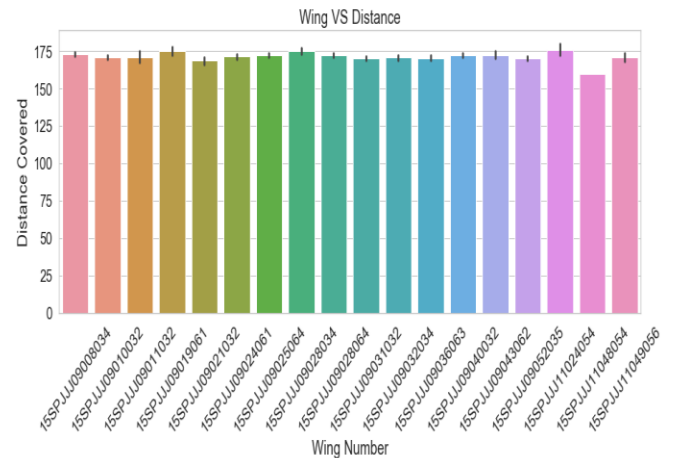
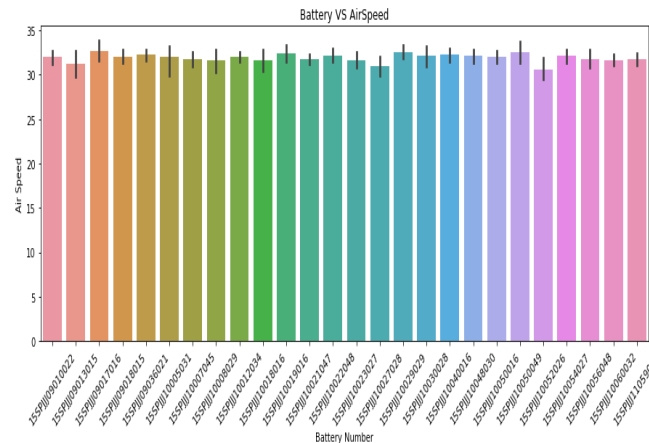
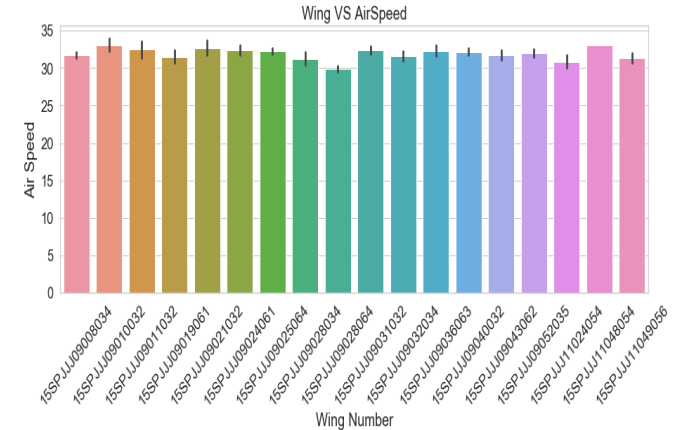
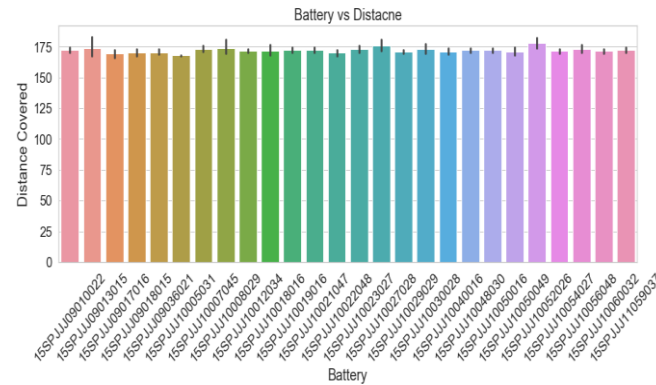
Battery observations:

- ▶ Similarly Battery 15SPJJJ10052026 has the largest distance covered 5317.82 meters while 15SPJJJ10005031 has the shortest distance covered 504.47 meters.
- ▶ The mean voltage provided by all batteries is about the same which suggests that all battery work perfectly well providing a constant voltage.

Body Observations:

- ▶ Body 577350132807368710 has the largest distance covered of 11843.62 and body 577209618523054122 has the smallest distance covered of 510.69 meters
- ▶ Body 577350132807356452 has the lowest air speed and body 577209618523054122 has achieved highest airspeed

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## 5. PREDICTION MODEL (REGRESSION)

- ▶ 10 Fold CV – Artificial Neural Network
- ▶ Prediction of Distance based on condition
- ▶ Neural Networks used:  
[(3),(4),(5),(3,2),(4,3),(5,4),(6,5),(7,6),(9,8),(12,11)]
- ▶ Activation: RELU
- ▶ Solver: lbfgs
- ▶ Best result observed for neurons=6,5
- ▶ Test Data set prediction with average 63.77% observed
- ▶ Features Excluded :  
'flight\_id','commit','launch\_timestamp','vel\_magnitude',  
'accel\_magnitude','launch\_month','launch\_dayofweek',  
'launch\_airspeed','launch\_groundspeed'

Model Metrics.....	Training	Validation
Observations.....	312	135
Features.....	64	64
Number of Layers.....	2	2
Number of Neurons.....	11	11
Number of Outputs.....	1	1
Number of Weights.....	431	431
Number of Iterations...	1189	1189
Activation Function....	relu	relu
Loss.....	6.7421	
R-Squared.....	0.5904	0.6377
Mean Absolute Error....	2.6949	2.5917
Median Absolute Error..	2.2171	2.1647
Avg Squared Error.....	13.4842	11.3793
Square Root ASE.....	3.6721	3.3733

THANK YOU.