Ashley Deibler

Professor

DSC 550 Spring 2024 Section 303

01 June 2024

Final Project Write-Up

Introduction

The problem I sought to address through this project is the occurrence of wildlife strikes with aircrafts throughout the country, and the underlying conditions and overall effects of these strikes. A wildlife strike can be defined as a collision between an aircraft such as an airplane, jet, or helicopter, with wildlife species mostly consisting of birds, but can sometimes include bats, deer, coyotes, or even alligators. Most often, these strikes are the most disruptive when strikes occur when a bird goes into the engine of an aircraft. This is what happened back in the famous incident in 2009 where captain Chelsey "Sully" Sullenberger safely brought the plane down into the Hudson River after several birds were ingested into the engine of the aircraft, saving the lives of all one-hundred and fifty-five passengers. I wanted to look at the potential causes of wildlife strikes, and assess what conditions may lead to extensive damage to the aircrafts. Ideally, by identifying the conditions that lead to a higher likelihood of damage, we can attempt to come up with a solution to prevent these strikes from occurring, or from enduring any extensive damage.

This problem is important to address and solve because wildlife strikes cause such extensive damage to aircrafts as to consider them "destroyed" from the collision. This may result in hundreds of millions of dollars in damage in repairs and replacements. In addition, these incidents are responsible for many emergency landings of aircrafts involved in wildlife strikes, endangering passengers. According to The Washington Post and their statistics obtained from the

Federal Aviation Administration, over three-hundred people have been killed in downed aircrafts, and over three-hundred million dollars in damage have occurred due to wildlife strikes (2023). By attempting to tackle this problem, we would not only be saving millions of dollars in damage repair, but also making air travel safer, and preventing the deaths of wildlife species.

For the purpose of this project, I obtained my data from a dataset on Kaggle.com, which credits the dataset as a compilation of reports from airlines, airports, and pilots and published by the Federal Aviation Association. The reports were obtained between the years of 1990 and 2015. The dataset included variables and features including dates, airlines, aircraft types, engine make and models, airports, flight phases, species involved, flight impact, aircraft damage, altitude, and more. With the plentiful variables available to me, I was able to create visualizations and models to assess different strike conditions, effects, and features in attempt to get a closer look at why these strikes may occur, and how to prevent them, or at least minimize damage.

Summary

In the first milestone of this project, I created visualizations to better assess the conditions and effects of wildlife strikes with aircrafts. The first question I looked at was the impact the strike had on the flight status. Over fifty percent of incidents resulted in a precautionary landing, such as the one Captain Sully performed in the Hudson River in 2009. Another twenty-three percent resulted in an aborted take-off, implying that the strike happened while the aircraft was still on the ground. This goes to show just how large of an impact that wildlife strikes can have on an aircraft, and how this occurrence interferes with flights.

Another visualization I created helped to display data on the altitude at which strikes occur. The graph showed that it is four times more likely to experience a wildlife strike at altitudes of less than one-thousand feet in the air, than it is to experience them at higher altitudes. This is likely due to altitude limits of flying wildlife. When aircrafts are at lower altitudes, they are more in the altitude range of wildlife and therefore more likely to experience a collision.

I also looked at the phase of flight during which wildlife strikes occur. The majority of the time, strikes occur during the approach, when the aircraft is descending below five-thousand feet and approaching the destination airport. Other instances in which strikes occur include during the landing roll – the phase of a flight between the moment the aircraft touches down and the moment it stops or exits the landing runway – the take-off run, and the climb. This further shows that strikes most commonly occur within an altitude where wildlife is more likely present, and even on the runway when the aircraft is just about to take off, or has already landed.

The second milestone of the project had me cleaning up my dataset and looking closer at the variables I was presented with. I first started by dropping any variables that weren't relevant to the study, or that had over fifty percent of missing data values. I also filled in missing values in the dataset and changed column names for ease of readability and analysis.

The third milestone had me look at more specific questions regarding the damage inflicted on the aircraft due to wildlife strikes. I used a model to further analyze whether or not phase of flight, altitude, and species have any impact on the likelihood of damage to the aircraft. I used a random forest classifier, as it would be the best option to understand the relationships between the features and target variable, "Damage." With this model, we can also tell the degree of influence each feature has on the target using feature importance contribution.

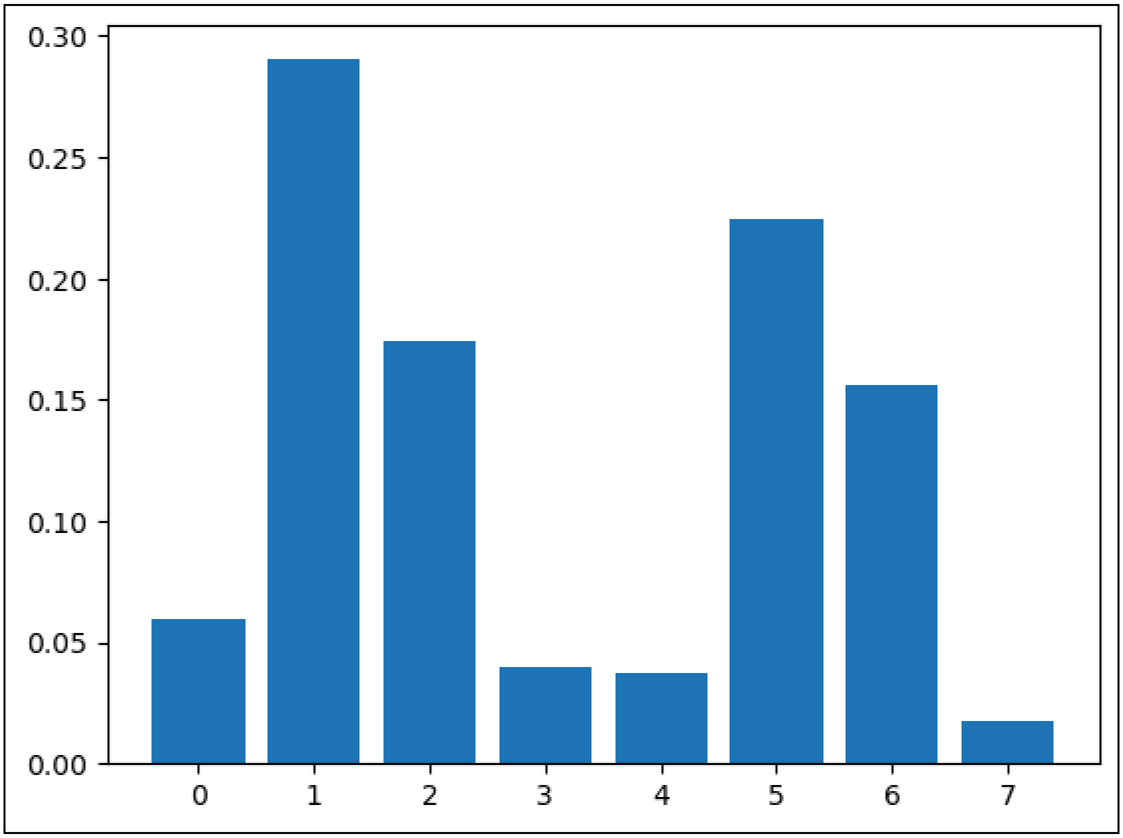

Figure 1. Feature Importance Contribution of Random Forest Classification. Numbers align to features as follows: (0) Wildlife Struck; (1) Flight Date; (2) Origin State; (3) Phase of Flight; (4) Sky Conditions; (5) Species; (6) Feet Above Ground; (7) Aircraft Large.

The feature importance contribution shows that the most influential factors to the likelihood of extensive damage to the aircraft following a wildlife strike are the Species, Origin State, and Feet Above Ground. These features should be considered more important when considering the likelihood of damage to the aircraft. In addition, I calculated the accuracy, precision, and recall of the model, as well as the confusion matrix. The accuracy of the model was 90.6%, meaning the model is very strong in fitting the data. The precision is 91.6% and the recall is 98.5%, both of which provide insight into the model's performance on specific classes. Each of these values was high, informing me that the random tree classifier is a strong model choice for the data.

Conclusion

The analysis tells us that when determining the conditions most influential in damaging an aircraft in a wildlife strike, species, altitude, and geographic region have the largest influence. This does make a lot of sense, as strikes occurring with particular species are more likely to happen where those species are abundant. The three variables tie together nicely to lead to a fair conclusion as to how we may be able to address wildlife strikes. While the model is only the beginning of what could become a much deeper analysis, it is definitely a great starting point. What we are able to do with this information is come up with additional tests and subjects of analysis to further investigate exactly what we can change to decrease the number of wildlife strikes. For example, determining what species are most commonly involved in wildlife strikes, and their geographic ranges may be a good next step. Seeing whether the species involved in the most strikes overlaps with the origin state of the flight involved in an incident may allow us to narrow down what species and areas to focus on. When we are able to pinpoint the species and geographic ranges that are commonly involved in these incidents, we can begin to explore management strategies with wildlife biologists. Some solutions may include relocating individuals of particular species that are in close proximity to airports, or implementing visual or audible repellents to keep them away.

Using the information obtained from this model, we can address a problem that can help improve the safety of air travel, save money in damage repairs, and increase wildlife populations. With further investigation, modeling, and analysis, solutions can be developed that can create positive changes and decrease these statistics.

References

Aircraft Wildlife Strikes, 1990-2015. (n.d.). Retrieved May 27, 2024, from https://www.kaggle.com/datasets/faa/wildlife-strikes

Sampson, H. (2023, May 11). How dangerous are bird strikes to planes? *Washington Post*. https://www.washingtonpost.com/travel/2023/04/25/bird-strike-plane-american-airlines/