

# **BIG DATA ANALYTIC APPLICATIONS SYMPOSIUM - FALL 2019**

Analytics Project:

**Relationship between Flight delays and Weather Data  
for different US airports**

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Abstract:

- Many factors influence the air travel delays
- The aviation areas generate huge amounts of data
- Weather, flight information and sensor data can be used to develop predictive model using big data analytics
- Influence of weather on the flight delays can lead to helpful insights for the airport and airline operations to enhance flight safety, improve customer satisfaction and reduce flight delays

# **Relationship between Flight delays and Weather Data for different US airports**

## **Motivation:**

- Citizens can use the application to find the status of their upcoming flight.
- Airline companies can use this analytic to manage their flight passengers.

## **Importance:**

- Citizens can arrange for change in their plans after the flight in case the flight is getting delayed
- Airline companies can make proper arrangements for the passengers if the flight is getting delayed and make any schedule change for connecting flights

# Relationship between Flight delays and Weather Data for different US airports

## Goodness

We compared our analytic with existing researches/ findings in the domain and we then checked if our findings align with them and tried to analyze the causes of observed results

We used following paper for this purpose:

- Chained Predictions of Flight Delay Using Machine Learning

[https://www.researchgate.net/publication/330185077\\_Chained\\_Predictions\\_of\\_Flight\\_Delay\\_Using\\_Machine\\_Learning](https://www.researchgate.net/publication/330185077_Chained_Predictions_of_Flight_Delay_Using_Machine_Learning)

- Integrating Flight-related Information into a (Big) Data Lake

[https://www.researchgate.net/publication/320968718\\_Integrating\\_flightrelated\\_information\\_into\\_a\\_Big\\_data\\_lake](https://www.researchgate.net/publication/320968718_Integrating_flightrelated_information_into_a_Big_data_lake)

# Relationship between Flight delays and Weather Data for different US airports

## Actuation/Remediation

1. Check status of upcoming flight
  - Developed an application which takes user flight details as input and returns whether the flight will be delayed according to our model.
  - User is required to provide flight date, time and airport within 5 days from that days date.
  - Weather data forecast from NOAA API is collected.
  - The features are used by the model to predict the delay chance.
  
2. An app which shows the flight delays for an airport for the past few years
  - User can take into account the past information about delays to get an idea about delays while booking the flight

# Relationship between Flight delays and Weather Data for different US airports

## Data Sources:

Name: National Centers for Environmental Information, National Oceanic and Atmospheric Administration Link

Description: This dataset includes data collected by various weather stations in US. It contains data fields like air temperature, precipitation, snow, wind, sun shine, etc.

Size of data: 0.5 GB

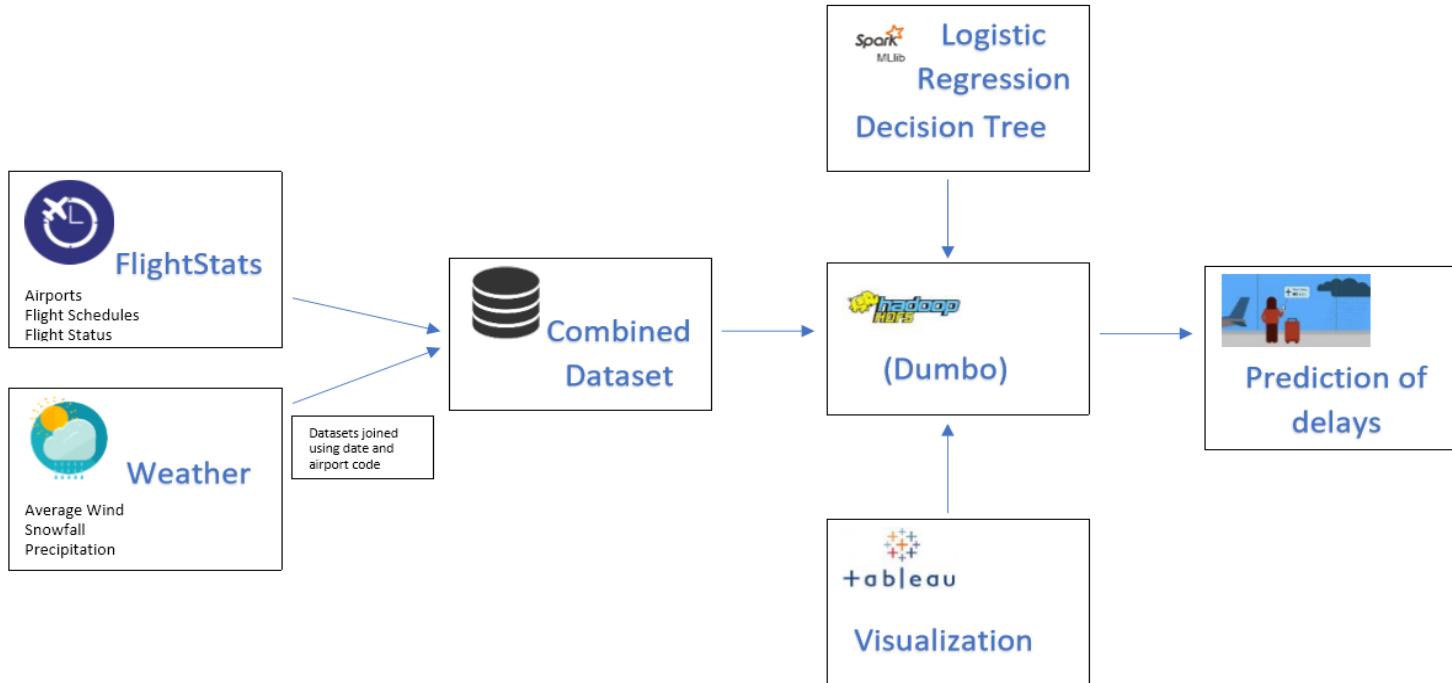
Name: Bureau of Transportation Statistics – flight data

Description: The airline trip records include fields capturing date, time, origin and destination airports, flight distance, flight departure time, flight departure scheduled time, flight departure delay, flight arrival time, flight arrival delay, flight arrival scheduled time, etc.

Size of data: 5 GB

# Relationship between Flight delays and Weather Data for different US airports

Design Diagram:

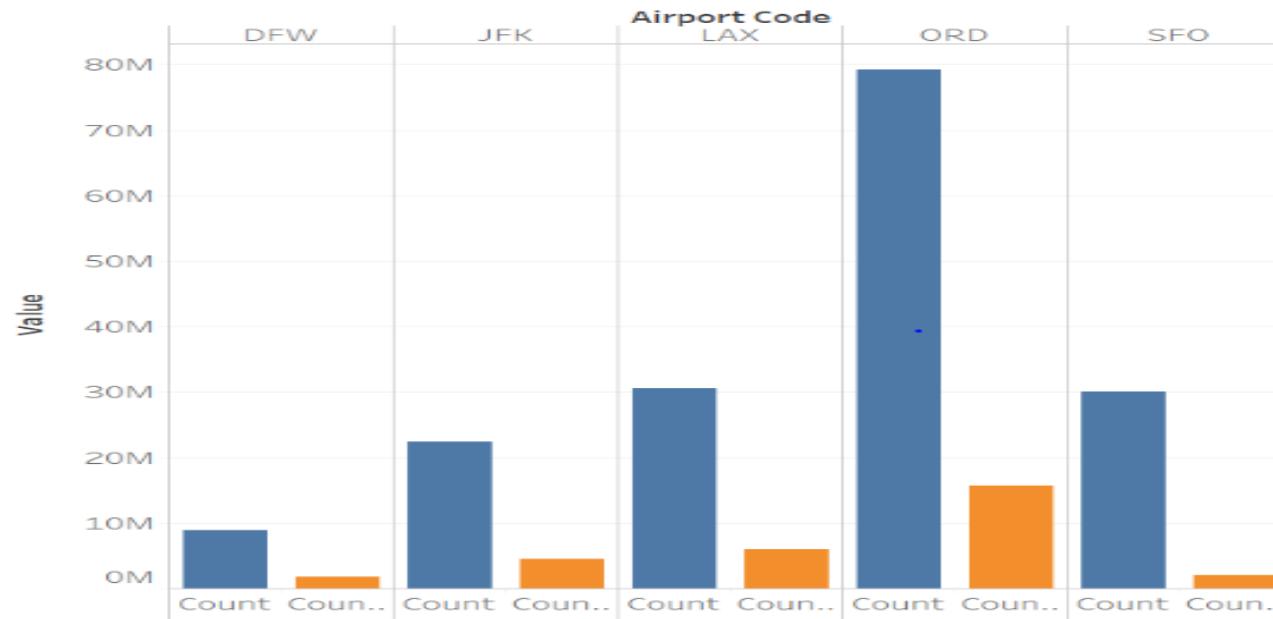


Platform on which the analytic ran:  
NYU HPC Cluster

# Relationship between Flight delays and Weather Data for different US airports

Code Challenge1:

1. Non-uniform data distribution



Graph of total flight records, delay records count per airport

- Delayed flight records four times the number of non-delayed flight records.
- Synthetic Minority Over-Sampling techniques is used to generate synthetic samples to make the data distribution uniform

# Relationship between Flight delays and Weather Data for different US airports

Code Challenge 2:

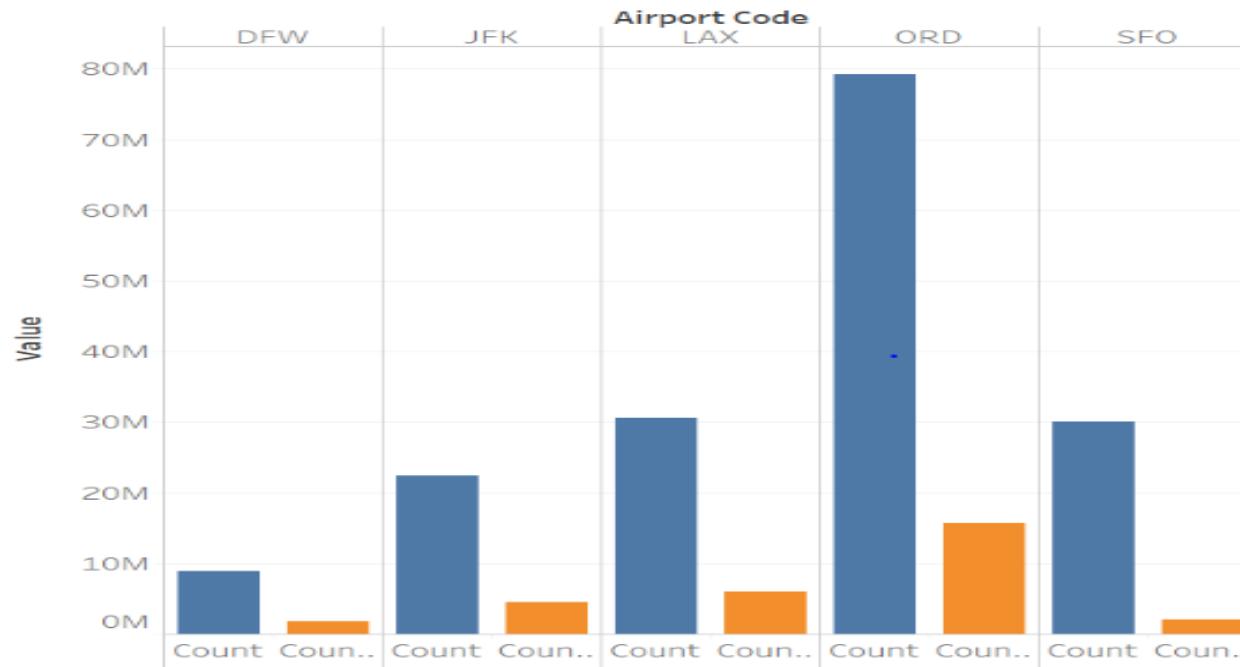
## 2. Choosing important features

- Number of factors regarding flight information and weather delays were available
- As too many factors can confuse the classifier, it is important to choose to features affecting the analytic the most.
- Random forest algorithm was used to select the features according to the importance

# Relationship between Flight delays and Weather Data for different US airports

Insight:

- ❖ SFO has least percentage of delays but other airports show almost equal percentage of delays



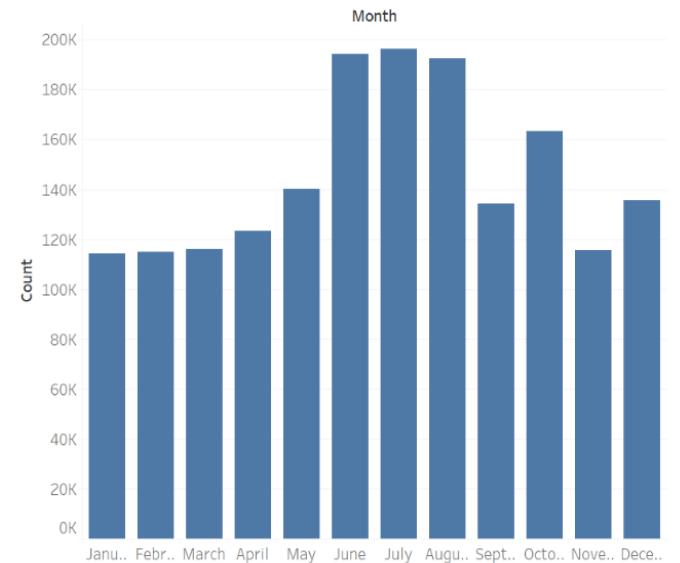
Graph of total flight records, delay records count per airport

# Relationship between Flight delays and Weather Data for different US airports

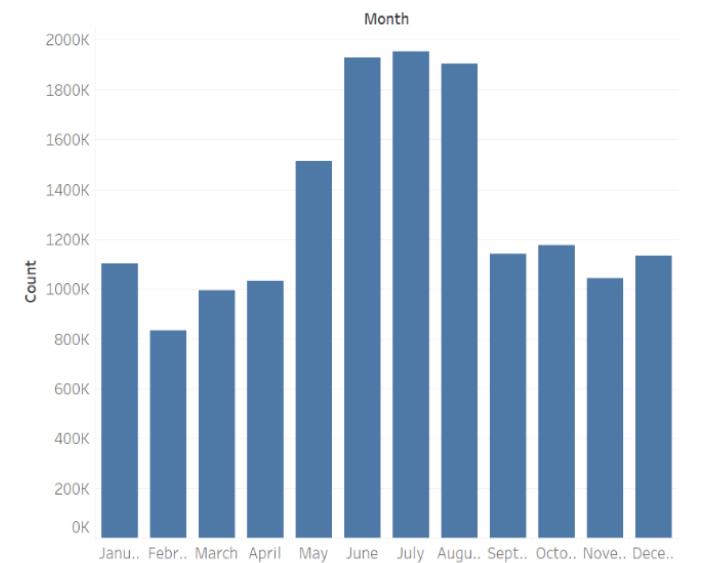
Insight:

- ❖ The flight departure delays were high at ORD and DFW showed high number of delays from June to August.

DFW monthwise delays



ORD monthwise delays

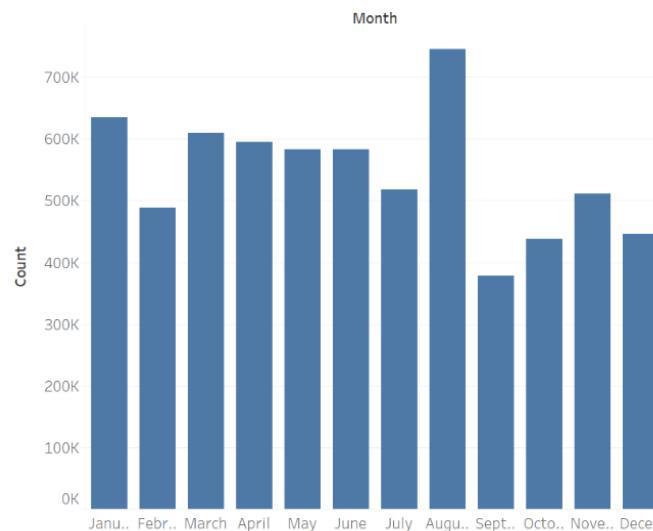


# Relationship between Flight delays and Weather Data for different US airports

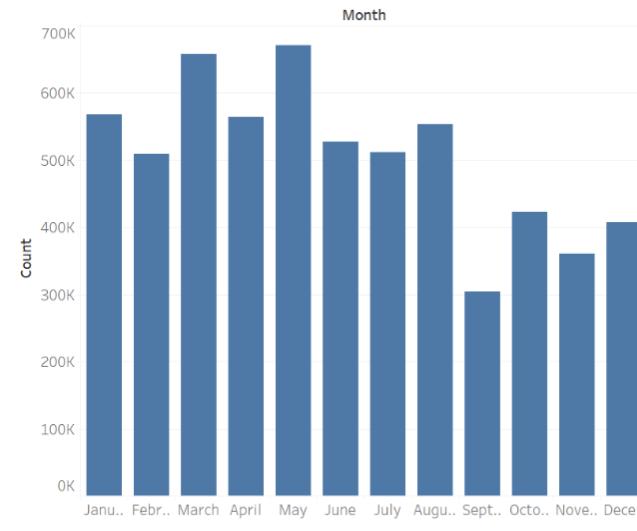
Insight:

- ❖ The delays distribution was spread evenly at LAX and SFO, less delays were observed from September to December.

SFO monthwise delays



LAX monthwise delays



# Relationship between Flight delays and Weather Data for different US airports

Insight:

- ❖ Validation accuracy was 78 % when model was trained using data collected from sources
- ❖ To remove bias during training SMOTE was used to generate data with 50% delayed flights and 50% non-delayed and cancelled flights
- ❖ Validation accuracy of 87 % was obtained
- ❖ Addition of features like arrival delay and flight distance led to increased accuracy to 92% with Random Forest Algorithm
- ❖ Amongst the 4 algorithms, Logistic Regression, SVM, Decision Trees, Random Forest, highest accuracy was obtained with random forests

# Relationship between Flight delays and Weather Data for different US airports

Obstacles:

1. Cleaning NOAA Weather data
  - Difficult to parse due to more number of columns in some rows
  - There were many missing values
  - Some dates were having inconsistent formats
2. Cleaning Bureau of Transportation Statistics - Flight Data
  - There were extra columns in few records
  - Few values of dates were inconsistent
  - Some origin and destination airport codes were wrong
  - There were negative values for flight distance
  - Many iterations for cleaning as data was huge
3. Non-uniform data distribution
  - As the non delayed flight records outnumber the delayed records by over 4 times, it was necessary to remove the bias while training the model.

# Relationship between Flight delays and Weather Data for different US airports

## Next Steps

- Adding more flight related information to improve the analysis
- Use Random Forest algorithm to select important features
- Develop a Chained delay prediction model for connected flights
- Use other Machine Learning models and compare the performance
- Addition of data for more airports and airlines can lead to more insights

# Relationship between Flight delays and Weather Data for different US airports

## Summary

Flight delays are positively correlated with weather conditions though there are number of other factors which have an impact on flight delays like arrival delay, propagation delay, etc. There is chained delay due to late arrival and late departure for connecting flights. All factors together can be used to predict the flight delays for a particular date and airport.

## Acknowledgements

- Thanks to NYU HPC for helping with Tableau and Dumbo.
- Thank you Professor Suzanne McIntosh for guiding us, helping us with every blocker we encountered and constantly encouraging us.
- Thanks to course grader Lakshmi for helping us with obstacles during this project.

# Relationship between Flight delays and Weather Data for different US airports

## References

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## Demo

Check the status of your upcoming flight

**Status:**

Airport:

Zip Code:

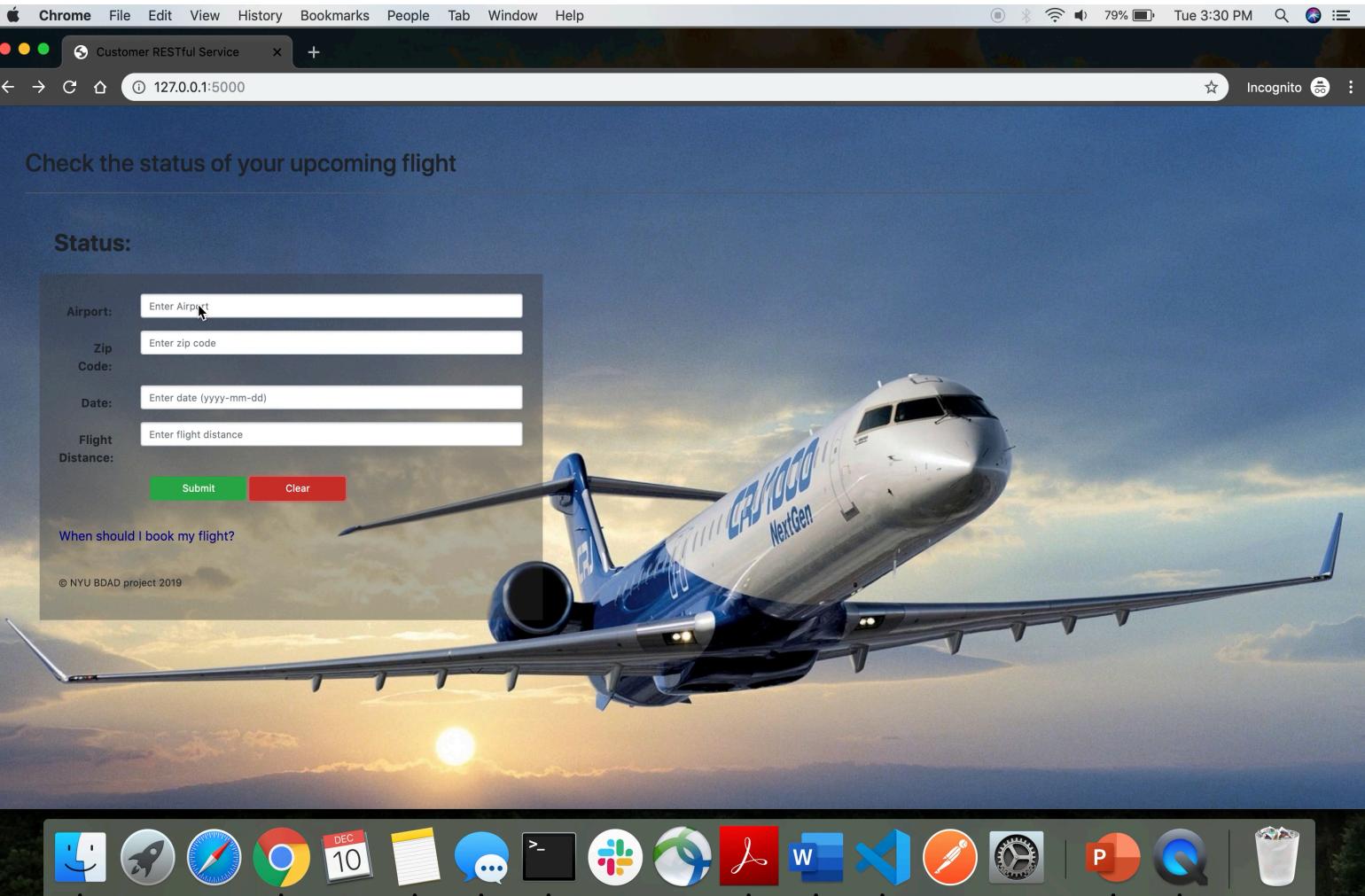
Date:

Flight Distance:

**Submit** **Clear**

When should I book my flight?

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The screenshot shows a web browser window on a Mac OS X desktop. The title bar reads "Customer RESTful Service" and the address bar shows "127.0.0.1:5000". The main content area displays a flight status checker form over a background image of an airplane in flight at sunset. The form includes fields for airport, zip code, date, and flight distance, along with "Submit" and "Clear" buttons. A copyright notice for "© NYU BDAD project 2019" is at the bottom. The desktop dock at the bottom contains icons for various applications like Mail, Finder, and Visual Studio Code.

Thank You