Optimizing Training Times For Mission-ready Navy Pilots

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Introduction

This is a data analysis report that addresses the best training times for mission-ready Navy fighter pilots. The report has eight major sections including Introduction, Background & Purposes, Data Source, Methods & Instrumentation, Results, Recommendations, Limitations, and a Summary. This report was prepared by Samuel Garcia, Krystal Gonzalez, Eric Le, and Fernando Olivares.

Background & Purposes

Being a Navy Pilot is one of the most critical and challenging jobs in the military. It is a job that requires rigorous education, extensive training, hard work, and trust; because of this, the Navy sets high-standards for the pilots and holds them accountable for education and continuous improvement in their skills. Pilots go through challenging tests, and one of these tests requires knowing how to land on an aircraft carrier. The present state of affairs of training and usinmaintaining mission-ready Navy pilots is inefficient. There is one area of improvement for pilots to demonstrate their capabilities in aircraft carrier landings; that is, unexpected lousy weather can negatively impact pilot results.

Our client, the Force Readiness Analytics Group (FRAG), represented by Lieutenant Commander Drew Barker and Michael Hard, has tasked our team to find the best time and weather conditions of the year to conduct aircraft carrier landing training. Our goal is to give these mission-ready pilots the best possible chance to improve training times and do well on flight tests.

Data Source

The data we collected came from the National Oceanic and Atmospheric Administration (NOAA). Our client gave the team the parameters to find the optimal times of year to conduct training which was the following:

- Wave height approximately 4 feet.

- Visibility more significant than 3 miles
- No clouds below 3000ft Above Sea Level

The client stated that training would be held along the California coast in an area from 12NM to 120NM from the California coast from 100NM south of the US Mexican Border to San Francisco. Searching through NOAA's website, we found that the most relevant data came from two sources; the National Data Buoy Center and the National Climatic Data Center.
The first data set gathered for the analysis was provided by the National Data Buoy Center for buoy's along the coastline, specifically for station 46026 (LLNR 357) near San Francisco. The data set includes data for wave height. The National Climatic Data Center provided the second data set, and it contains data for weather and sky conditions.

Methods & Instrumentations

To determine the optimal training times for aircraft carrier landings, we conducted a predictive analysis. The business intelligence tool Tableau 2020.2 was utilized to handle quantitative analysis. Based on the constraints our client provided, our first task was to clean the datasets. The next step in our assignment was to create a Tableau dashboard. The datasets were filtered as follows:

- **Average Wave Height by Month and Date**: To measure the optimal wave height, we decided to measure the wave height in meter (y-axis) against each month and day (x-axis). We then took a look at the average wave height for each month to determine which month had the lowest waves. Lighter color provides more optimal time where wave height has a lower average.

- **Average Wave Height by hours**: After determining which month had the lowest height we can see a more in-depth look at the average height based on hours for each day of the year. It will provide us with an optimal hour in which the training should be conducted.

- **Average Visibility by Month** - The data is filtered so that all visibility is greater than the 3 statute miles. To measure the optimal month for the station visibility, we measured the station's visibility in miles against each month. This provided us with the average visibility for each month and the data can be drilled down to days by clicking on the selected month. The months with the highest visibility are more preferred for flying conditions, so pilots can actually see where they land. Lighter colored boxes provide more visibility and by drilling down you can see the larger cluster of days within that month that are ideal for flying.

- **Cloud Height by Month** - To measure the optimal flying conditions based on cloud height, we measured the cloud height in feet by the month/day/hour. All of our data actually hit the criteria we were given so we did further research at weather.gov that showed us a pilot guide for flying navigation and it showed us that anything below 6000ft is not ideal for pilots to fly, and everything over 6000 ft will be more of an ideal flying condition because there are less clouds causing any obstruction. The best way to look at this chart is to see where the data points gather between 6,000ft and 10,000ft

- **Count of Conditions Met by Month** - To give an overall summary to our data listed above, we included a count of conditions met by month. This data is used to count how many times each month the given condition was met.

Results & Recommendations

Based on the findings the team gathered during the data analysis, there are three seasons to look for when flying an airplane:

- In the winter, airplanes have better performance*;* however, there are some conditions :
    - If ice or snow is present, which is especially dangerous to planes, which are often not as prepared to deal with them, it is dangerous to some degree to *all* airplanes.

    - Pilots have to be careful of low temperatures when starting the airplane before take-off.
- In the summer, airplanes have worse performance.
    - Many small airplanes have poor airflow inside the cockpit, which means planes get rather hot (it is easier to run a heater inside a small cockpit than to cool it)
    - Pilots have to be more careful to avoid overheating the engine.
    - Some places may form thunderstorms continuously.
- In the rainy season, which is often in the spring, pilots will have degraded performance. Even if it is not rainy, the air will likely be more humid, which decreases aircraft performance.

Upon gathering the data and analyzing it for the years 2017 through 2019, we discovered the following:

1. By looking at station visibility over the course of two years, we determined that visibility is not a significant problem for every month of the year (Figure 1). The average visibility is more significant than three statute miles for all months; however, September has the most number of days where visibility is more significant than nine statute miles. December has a couple of days where visibility is barely over three statute miles.

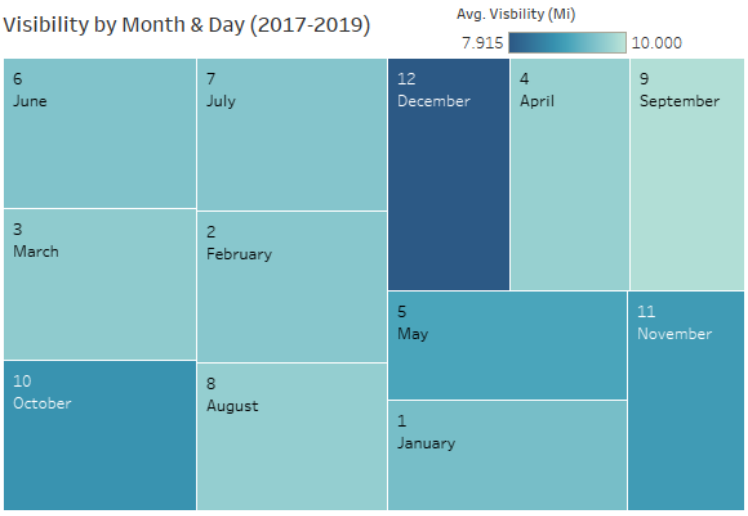

Figure 1:The lighter the color, the better the visibility.

2. When analyzing average wave height by month, we discovered that there are only four months in the year that meet the ~4ft threshold (on average). Figure 2 demonstrates that the four months include July, August, September, and October, with the lowest average wave height being in August. The month with the highest average wave height was December at a staggering 7.67ft or 2.239 meters. At this point we determined that we should rule out December as an optimal month for training. But, please note that these months are on an average basis, so there could be days that meet the requirements for optimal training times, in which a user can drill down to look at wave height average by date.

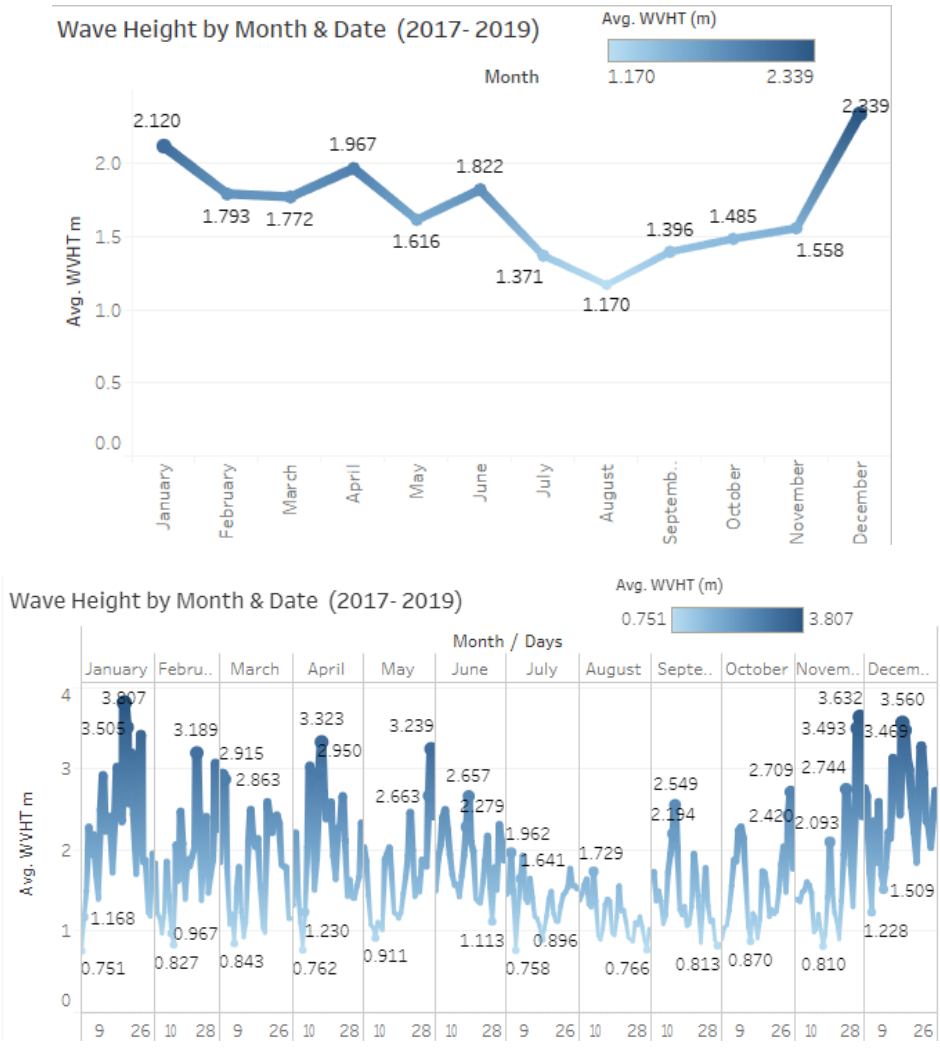

Figure 2: Wave Height, Measured in Meters by Months and days

3. For wave height, by the hour, we observed that July, August, and September had the lowest wave height. August especially had the lowest average wave height, with waves being at around 3.99ft at 0300 - 0400 hours (Figure 3). Nevertheless, we also had to factor in that pilots will have better performance when training when there is daylight. Since we stated that airplanes have worse performance when it is hot, we want to avoid the pilots' training when the sun is at its zenith. With that being stated, average wave height is at its lowest between 1200 - 2300 hours. For the reason that waves are lower after 1200 hours, airplanes perform better when it is cooler, and visibility is an essential factor, we recommend that pilots train between 1400 and 1700 hours.

Hour	
0	1.6518
1	1.6694
2	1.7017
3	1.7049
4	1.7000
5	1.7121
6	1.7141
7	1.7145
8	1.6959
9	1.6729
10	1.6683
11	1.6607
12	1.6668
13	1.6746
14	1.6524
15	1.6504
16	1.6433
17	1.6229
20	1.6178
18	1.6134
19	1.6227
21	1.6117
22	1.6353
23	1.6341

Figure 3: Average Wave Height Per Hour

4. After observing the sky conditions for every month and taking into account that training should not be conducted when clouds are below 3000ft above sea level, we determined that we should narrow our choice down to the months that already meet the visibility and wave height criteria (Figure 4). October on average has a higher cloud height than August and September but it also has a higher wave height than those two months. However, all three months meet the criteria of high visibility, cloud height above 3000ft above sea level, and wave height at an approximate of four feet.

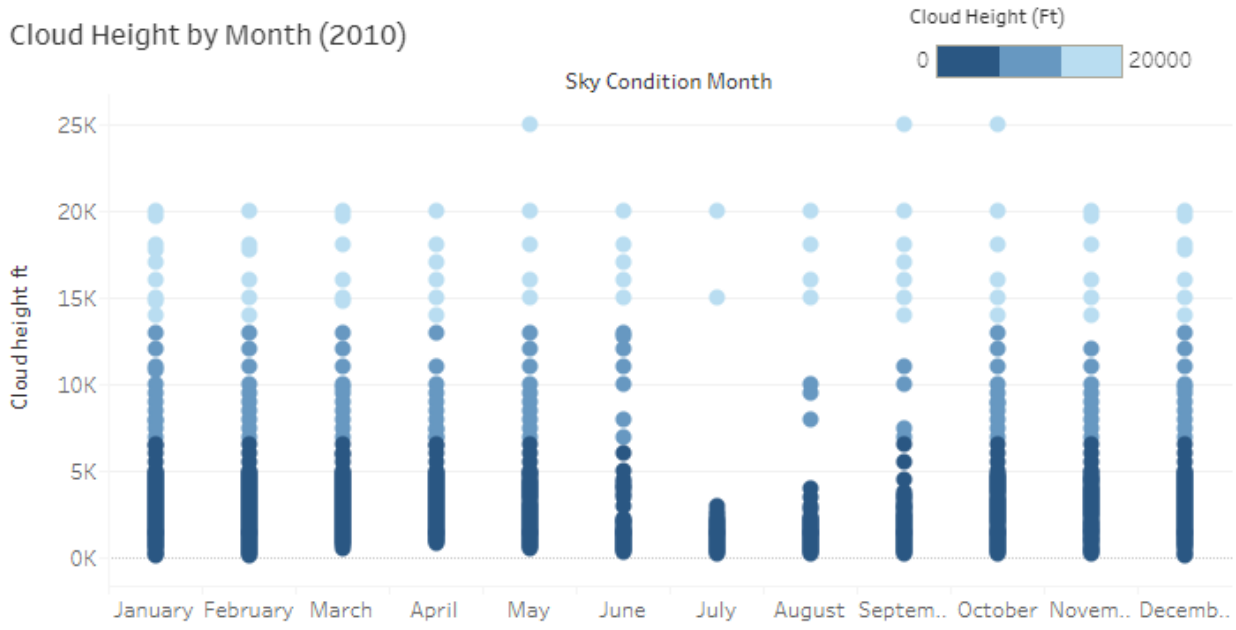

Figure 4: Average Cloud Height

5. The dashboard is interactive, so that when a user clicks on a specific data point, in any given worksheet, the rest will filter from the information to give the user a holistic idea of what the wave height, visibility, and cloud height is for that respective data point (Figure 6). This provided us with an area chart with all three conditions to show the hours all three conditions are met. For example, we found the best date for training is in September, by using the dashboard to predict which day and hour the wave height is usually at its lowest. We can also see which range of dates have the best visibility in miles on average, and how frequently the cloud height in September is over 6000ft. Using this dashboard will give the user a general idea of the conditions and best ways to prepare. In addition, to the dashboard we have a summary of how many times the

condition was met each month to help users make quicker and more effective decisions (Figure 5).

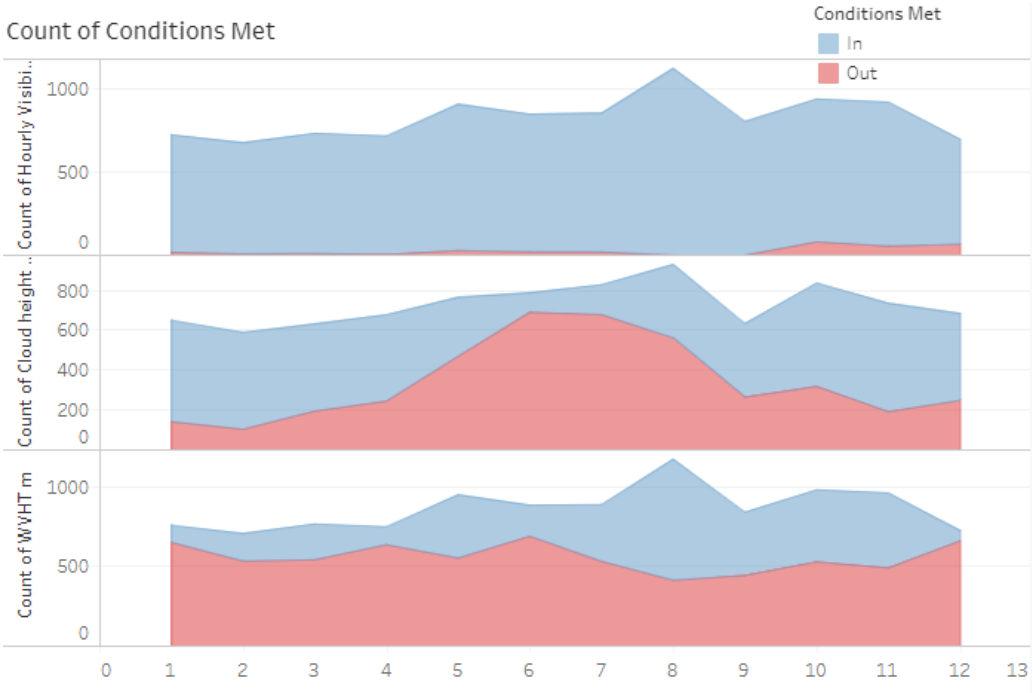

Figure 5: Area Chart With All Three Conditions

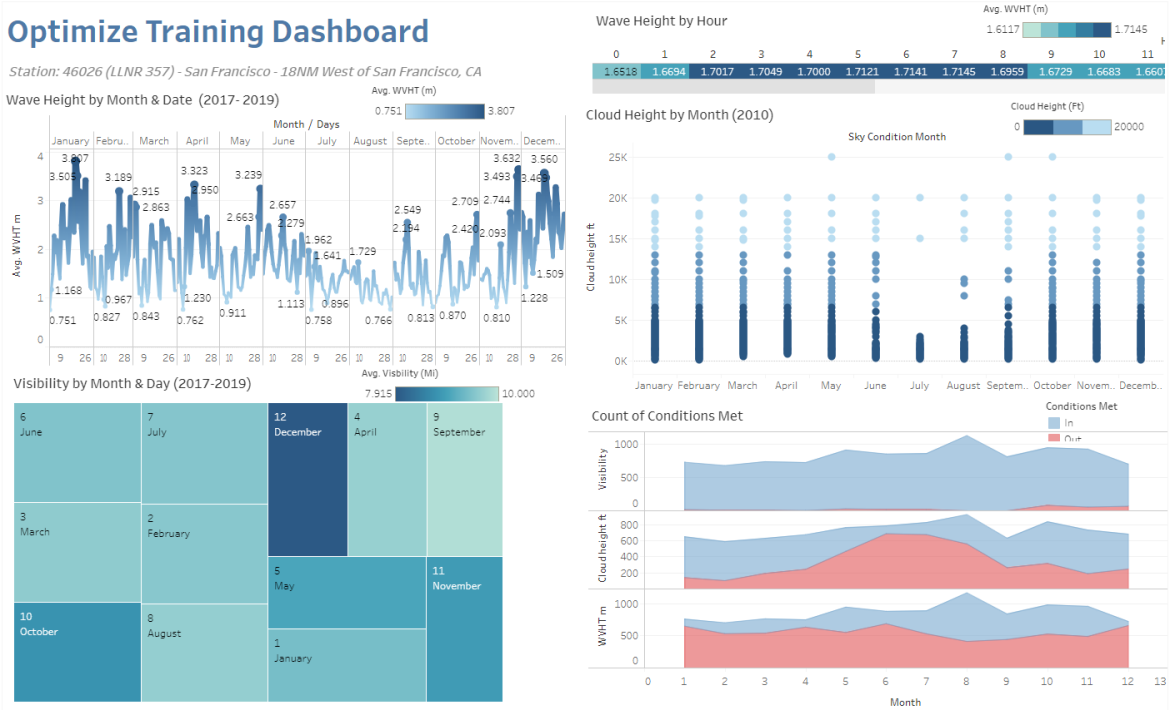

Figure 6: Overall Dashboard

Limitations

- Data was collected from two different sources, meaning it varied in quality and format.
- Based on the typical California weather, we hypothesized that the best months for pilots' training would be during the summer, although weather varies by year.
- Our focus was mainly on the area around the San Francisco Bay area.
- Our analysis does not include how much air traffic there is in the area, or other major factors that may affect a pilot's training time.
- We only found cloud height data for the year of 2010

Summary

Our team constructed a dashboard to the constraints our client specified. Our dashboard is user friendly and can work by merely adding clean datasets that can be filtered by wave height, cloud height, and visibility. This dashboard can and will be improved over time by adding past and current datasets. After analyzing the data, we concluded that the optimal time the Navy should conduct training on its pilots should be in September. We recommended September over the other months because visibility is at the highest in the year; wave height is at an approximate of 4ft, and cloud height is above 6000ft. The most appropriate time to conduct training is between 1400 and 1700 hours.

References: Tableau 2020.2 Professional Edition

Tableau Dashboard:

https://public.tableau.com/app/profile/ohhericle/viz/OptimizeTrainingDashboard/OptimizeTrainingDashboard