Client Report - [Are we missing JSON on our flight?]

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Elevator pitch

------- think about it later

GRAND QUESTION 1

Which airport has the worst delays? How did you choose to define “worst”? As part of your answer include a table that lists the total number of flights, total number of delayed flights, proportion of delayed flights, and average delay time in hours, for each airport.

Considering the table and the chart below, the worst airport among the 7 is SFO in my opinion. It seems like ATL or ORD is the worst, but the columns we need to look at are "average_delayed_hour" and "proportion_of_delayed_flights". ATL and ORD are a very big internatonal airport, so they have more number of flights and delays. However, SFO records 26.1% of delayed flights out of all flights and also .271 hour for having customers wait. The values are both worst out of the seven airports, so I believe SFO is the worst in terms of flights that possibly delay.

TECHNICAL DETAILS

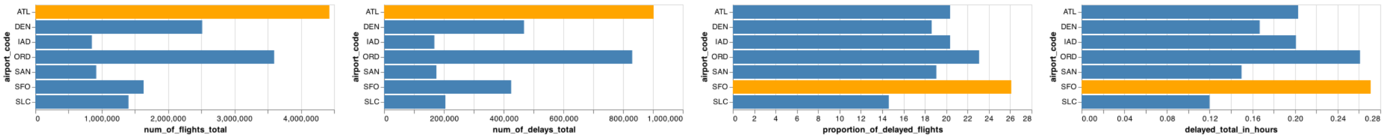
```
# import python modules
import pandas as pd
import altair as alt
import numpy as np
# %%
url = "https://github.com/byuidatascience/data4missing/raw/master/data-raw/flights_missing/flights_missing.json"
flights = pd.read_json(url)

# Drop n/a from the dataframe, "flights"
drpFli = flights.dropna()

# Then, add rows in some columns depending on which airport the data belongs to
group = flights.groupby("airport_code").sum()[["num_of_flights_total", "num_of_delays_total",
"minutes_delayed_total"]].reset_index()

# For proportion_of_delayed_flights
data = {'airport_code':['ATL', 'DEN', 'IAD', 'ORD', 'SAN', 'SFO', 'SLC'],
        'PropOfDelay':[atlPropOfDelay, denPropOfDelay, iadPropOfDelay, ordPropOfDelay, sanPropOfDelay,
sfoPropOfDelay, slcPropOfDelay]}
# Create DataFrame
dfPropOfDelay = pd.DataFrame(data)

# Combine dfPropOfDelay with group
list(round(dfPropOfDelay.PropOfDelay, 2))
group.assign(proportion_of_delayed_flights = dfPropOfDelay["PropOfDelay"], inplace=True)
group
```

The output is the table below.

airport_code	num_of_flights_total	num_of_delays_total	average_delayed_hour	proportion_of_delayed_flights
ATL	4430047	902443	0.203	20.37
DEN	2513974	468519	0.167	18.64
IAD	851571	168467	0.201	20.37
ORD	3597588	830825	0.261	23.09
SAN	917862	175132	0.15	19.08
SFO	1630945	425604	0.271	26.1
SLC	1403384	205160	0.12	14.62

```
# Create a table for each column with y which is all airport_code
# Like below
chart_proportion_of_delayed_flights = alt.Chart(group).mark_bar().encode(
    x="proportion_of_delayed_flights",
    y="airport_code",
    color=alt.condition(
        alt.datum.proportion_of_delayed_flights == group.proportion_of_delayed_flights.max(),
        alt.value('orange'),
        alt.value('steelblue')
        )
)
chart_proportion_of_delayed_flights

# ... other three columns too

# After successfully ploting four charts in total, combine all and save the chart containing all four charts
all_chart = chart_num_of_flights_total | chart_num_of_delays_total | chart_proportion_of_delayed_flights |
chart_delayed_total_in_hours
all_chart.save("./imgs/q1.png")
```

The output is the chart below.



GRAND QUESTION 2

What is the worst month to fly if you want to avoid delays? Include one chart to help support your answer, with the x-axis ordered by month. You also need to explain and justify how you chose to handle the missing Month data.

The worst month to fly in terms of delay is December. December has the worst percentage of delayed flights so it's more likely to delay in December. July and June have the largest number of delayed flights and the longest hours delayed in total, but that is because July and June are the busiest season of travel and flights. However, it's just a small difference between December and June(& July) on average minutes delayed.

TECHNICAL DETAILS

```
# first drop all rows whose month is "n/a"
indexNames = flights[ flights['month'] == "n/a" ].index
flights.drop(indexNames, inplace=True)

# group by month
monthFlight = flights.groupby('month')["month", "num_of_flights_total", "num_of_delays_total",
"minutes_delayed_total"].sum().reset_index()
monthFlight

# Add a column of a proportion of delayed flights
monthFlight = monthFlight.assign(proportion_of_delayed_flights = round(monthFlight.num_of_delays_total /
monthFlight.num_of_flights_total, 2))

# Add a column of an average of delayed minutes
monthFlight = monthFlight.assign(average_minutes_delayed = round(monthFlight.minutes_delayed_total /
monthFlight.num_of_flights_total, 2))
```

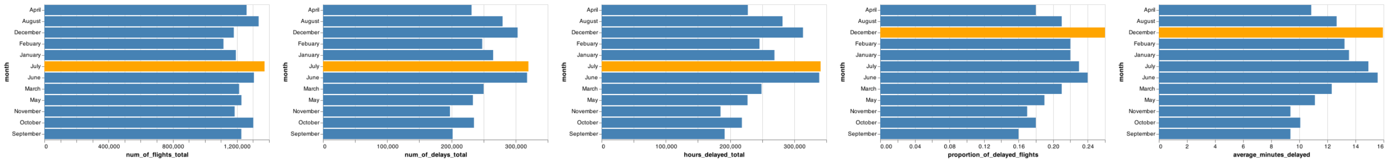
monthFlight should look like the table below.

	month	num_of_flights_total	num_of_delays_total	minutes_delayed_total	proportion_of_delayed_flights	average_delayed_minutes
0	April	1259723	231408	13667654	0.18	10.85
1	August	1335158	279699	16906565	0.21	12.66
2	December	1180278	303133	18821267	0.26	15.95
3	Febuary	1115814	248033	14753955	0.22	13.22
4	January	1193018	265001	16152667	0.22	13.54
5	July	1371741	319960	20465456	0.23	14.92
6	June	1305663	317895	20338750	0.24	15.58
7	March	1213370	250142	14942262	0.21	12.31
8	May	1227795	233494	13637705	0.19	11.11
9	November	1185434	197768	11112089	0.17	9.37
10	October	1301612	235166	13109792	0.18	10.07
11	September	1227208	201905	11495811	0.16	9.37

```
# plot each column with x axis of month
# One example code
```

```
month_num_of_flights_total = alt.Chart(monthFlight).mark_bar().encode(
    x="num_of_flights_total",
    y="month",
    color=alt.condition(
        alt.datum.num_of_flights_total == monthFlight.num_of_flights_total.max(),
        alt.value('orange'),
        alt.value('steelblue')
    )
)
month_num_of_flights_total

# Combine all five
month_num_of_flights_total | month_num_of_delays_total | month_hours_delayed_total |
month_proportion_of_delayed_flights
```

The output is the chart below.



GRAND QUESTION 3

According to the BTS website the Weather category only accounts for severe weather delays. Other “mild” weather delays are included as part of the NAS category and the Late-Arriving Aircraft category. Calculate the total number of flights delayed by weather (either severe or mild) using these two rules:

a. 30% of all delayed flights in the Late-Arriving category are due to weather.

b. From April to August, 40% of delayed flights in the NAS category are due to weather. The rest of the months, the proportion rises to 65%.

THe total number of flights delayed by severe or mild weather from 2005 to 2015 in the 7 airports is about 1,079,909.

TECHNICAL DETAILS

```
# First drop -999 which is an inappropriate value in a column, 'num_of_delays_late_aircraft'
indexNames = flights[ flights['num_of_delays_late_aircraft'] == -999 ].index
flights.drop(indexNames, inplace=True)

# For a,
flights_new = (flights
    .assign(
        weather_late_aircraft = round(
            flights.num_of_delays_late_aircraft * .3, 0))
            [[
                "num_of_delays_late_aircraft",
                "num_of_delays_nas",
                "num_of_delays_weather",
                "weather_late_aircraft"
            ]]
)

# For b,
for i in flights_new.month:
  if i in ['April', 'May', 'June', 'July', 'August']:
    flights_new = flights_new.assign(weather_delays_nas = round(flights.num_of_delays_nas * .4))
  else:
    flights_new = flights_new.assign(weather_delays_nas = round(flights.num_of_delays_nas * .65))

TotalDelayedFlightsDueToWeather = (
  flights_new.num_of_delays_weather.sum()
  + flights_new.weather_late_aircraft.sum()
  + flights_new.weather_delays_nas.sum()
)
TotalDelayedFlightsDueToWeather
# TotalDelayedFlightsDueToWeather should contain 1079909.0
```

GRAND QUESTION 4

Create a barplot showing the proportion of all flights that are delayed by weather at each airport. What do you learn from this graph (Careful to handle the missing Late Aircraft data correctly)?

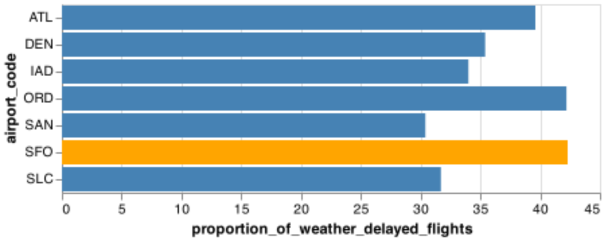
Consideringt the chart, ORD in Chicago and SFO in San Francisco are the two airports with the highest proportion of delayed flights due to weather. ORD is in Chicago with snow in winter so the proportion of delayed flights due to weather is higher than other airports. More importantly, delay due to weather takes up to 30% to 40% of all delayed flights although there are 5 main reasons for delay: carrier, late aircraft, nas, weather, and security.

TECHNICAL DETAILS

```
# Drop error values
indexNames = flights[ flights['num_of_delays_late_aircraft'] == -999 ].index
flights.drop(indexNames, inplace=True)

# Create a new column to store aircraft delayed by weather
flights_new = flights.assign(weather_late_aircraft = round(flights.num_of_delays_late_aircraft * .3, 0))
[["airport_code", "month", "num_of_delays_late_aircraft", "num_of_delays_nas", "num_of_delays_weather",
"num_of_delays_total", "weather_late_aircraft"]]

# Iterate through each month in the dataframe
for i in flights_new.month:
  if i in ['April', 'May', 'June', 'July', 'August']:
    flights_new = flights_new.assign(weather_delays_nas = round(flights.num_of_delays_nas * .4))
  else:
    flights_new = flights_new.assign(weather_delays_nas = round(flights.num_of_delays_nas * .65))

# Organize the dataframe by airport_code
eachAirport = flights_new.groupby('airport_code').sum()

# Calculate the total of weather delays
eachAirport = (eachAirport
    .assign(
        total_weather_delays = (
            eachAirport.num_of_delays_weather
            + eachAirport.weather_late_aircraft
            + eachAirport.weather_delays_nas
        )
    )
)

# Calculate the proportion of weather delays
eachAirport = (eachAirport
    .assign(
        proportion_of_weather_delayed_flights = round(
            eachAirport.total_weather_delays / eachAirport.num_of_delays_total * 100, 1
        )
    )
).reset_index()
```

```
chart = (
    alt.Chart(eachAirport)
        .mark_bar()
        .encode(
            x="proportion_of_weather_delayed_flights:Q",
            y="airport_code:N",
            color=alt.condition(
                alt.datum.proportion_of_weather_delayed_flights ==
eachAirport.proportion_of_weather_delayed_flights.max(),
                alt.value('orange'), # true
                alt.value('steelblue') # false
            )
        )
)
chart
```

The output is the chart below.



GRAND QUESTION 5

Fix all of the varied NA types in the data to be consistent and save the file back out in the same format that was provided (this file shouldn’t have the missing values replaced with a value). Include one record example from your exported JSON file that has a missing value (No imputation in this file).

The two columns, num_of_delays_carrier and num_of_delays_late_aircraft, have now null which had error values.

TECHNICAL DETAILS

```
# Replace all error values with NaN
flights_new = flights.replace(["", -999, "n/a"], np.nan)
flights_new.isnull().sum()
flights_new.to_json("q5.json", orient="records")
```

```
{
    "airport_code":"ATL",
    "airport_name":"Atlanta, GA: Hartsfield-Jackson Atlanta International",
    "month":"January",
    "year":2005.0,
    "num_of_flights_total":35048,
    "num_of_delays_carrier":null,
    "num_of_delays_late_aircraft":null,
    "num_of_delays_nas":4598,
    "num_of_delays_security":10,
    "num_of_delays_weather":448,
    "num_of_delays_total":8355,
    "minutes_delayed_carrier":116423.0,
    "minutes_delayed_late_aircraft":104415,
    "minutes_delayed_nas":207467.0,
    "minutes_delayed_security":297,
    "minutes_delayed_weather":36931,
    "minutes_delayed_total":465533
}
```