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PROJECT 1

Introduction

Programming for Analytics - Project 1 This project encompasses various modules for data processing, analysis, and visualization. We will be using Numpy, Pandas and Matplotlib to manipulate and analyze data. We will be creating a program that takes in the details of what a small sized aircraft's limit is for landing in different weather conditions and compares it to the actual weather condition at the Sioux Falls Regional Airport (KFSD) to determine if it is safe for the aircraft to land. We will be taking the weather data from the Open-Meteo API. The end goal for this project is to create a program that can take in the parameters of the aircraft and then decide if it is safe to land or not based on the weather conditions.

Task

Why this in specific? For this project, I wanted to explore something that I care about and have a personal interest in: aviation. I often wonder what types of aircraft can physically land in varying weather conditions. My goal for this project is to use real-time weather data from the Sioux Falls Regional Airport (FSD) to determine whether small aircraft, such as a Cessna 172 can safely land under different environmental conditions.

This analysis uses hourly weather data (wind gusts, visibility, snowfall, cloud cover, and rain) gathered from the Open-Meteo API. The results show how changing weather factors can affect flight feasibility for small planes based on their performance limits.

Data Dictionary

Purpose

Weather conditions for Sioux Falls Regional Airport (FSD) to check whether small aircrafts can land safely within given time periods.

Source

Open-Meteo Forecast API (Hourly Data). Parameters used to fetch the data: latitude=43.5814, longitude=-96.7417, timezone=auto, windspeed_unit=kn, temperature=F

Coverage

Past 5 days + next 16 days (per API call)

Primary Key

Time (Local)

Fields from the API after renaming

Field	Description	Unit	Type	Example
Time	Timestamp of the weather reading	ISO 8601	datetime	2025-10-19 14:00
Wind Gusts	Peak gust at 10 m above ground	knots(kt)	float	18.7
Snowfall	Amount of snow in that hour	cm	float	0.0
Cloud Cover	Fraction of sky covered by clouds	%	float	45
Visibility	Horizontal visibility distance	meters	float	25000
Wind Direction	Direction of where the wind is coming from	degrees(0-360)	int	273
Rain	Hourly rainfall	mm	float	0.2
Wind Speed	Mean wind speed at 10 m above ground	knots(kt)	float	16.3
Temperature	Air temperature 80 m above ground	F	float	45.32
Cessna 172 (Aircraft Name in general)	Flight classification based on thresholds	category	string	Safe to fly / Warning / No Fly

Data Analysis

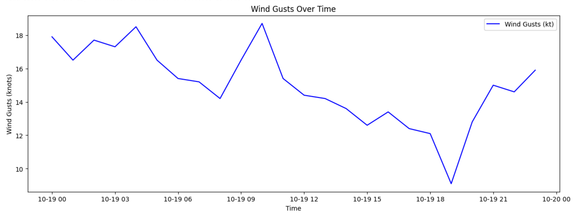
In [34]:
```
import requests
import pandas as pd
import matplotlib.pyplot as plt
url = "https://api.open-meteo.com/v1/forecast?latitude=43.5814&longitude=-96.7417&hourly=temperature_2m,rain,wind_gusts_10m,visibility,cloud_cover,snowfall,wind_speed_10m,wind_direction_10m&
resp = requests.get(url)
resp
data = resp.json()
hourlydata = data["hourly"]
df = pd.DataFrame(hourlydata)
df = df.rename(columns={
    "time": "Time",
    "temperature_2m": "Temperature",
    "rain": "Rain",
    "wind_gusts_10m": "Wind Gusts",
    "visibility": "Visibility",
    "cloud_cover": "Cloud Cover",
    "snowfall": "Snowfall",
    "wind_speed_10m": "Wind Speed",
    "wind_direction_10m": "Wind Direction"
})
df["Time"] = pd.to_datetime(df["Time"])
df
```

Out[34]:

	Time	Temperature	Rain	Wind Gusts	Visibility	Cloud Cover	Snowfall	Wind Speed	Wind Direction
0	2025-10-19 00:00:00	42.8	0.0	17.9	25800.0	0	0.0	10.5	293
1	2025-10-19 01:00:00	41.7	0.0	16.5	23800.0	0	0.0	9.2	288
2	2025-10-19 02:00:00	40.9	0.0	17.7	23600.0	0	0.0	10.3	290
3	2025-10-19 03:00:00	40.3	0.0	17.3	25000.0	0	0.0	9.8	287
4	2025-10-19 04:00:00	39.5	0.0	18.5	24300.0	0	0.0	10.7	286
5	2025-10-19 05:00:00	39.2	0.0	16.5	23400.0	0	0.0	9.7	290
6	2025-10-19 06:00:00	38.3	0.0	15.4	22000.0	0	0.0	7.9	287
7	2025-10-19 07:00:00	37.4	0.0	15.2	21300.0	0	0.0	7.4	290
8	2025-10-19 08:00:00	36.5	0.0	14.2	20600.0	0	0.0	5.9	281
9	2025-10-19 09:00:00	39.9	0.0	16.5	22200.0	0	0.0	8.2	275
10	2025-10-19 10:00:00	45.5	0.0	18.7	28200.0	0	0.0	9.9	286
11	2025-10-19 11:00:00	50.4	0.0	15.4	34900.0	0	0.0	8.1	285
12	2025-10-19 12:00:00	54.9	0.0	14.4	41600.0	0	0.0	9.6	278
13	2025-10-19 13:00:00	57.7	0.0	14.2	50400.0	0	0.0	9.9	270
14	2025-10-19 14:00:00	59.1	0.0	13.6	57100.0	0	0.0	10.5	265
15	2025-10-19 15:00:00	60.0	0.0	12.6	61100.0	0	0.0	9.9	248
16	2025-10-19 16:00:00	60.7	0.0	13.4	62400.0	0	0.0	8.3	237
17	2025-10-19 17:00:00	60.9	0.0	12.4	66100.0	0	0.0	7.4	215
18	2025-10-19 18:00:00	57.9	0.0	12.1	63900.0	0	0.0	5.5	188
19	2025-10-19 19:00:00	53.0	0.0	9.1	55200.0	0	0.0	5.1	133
20	2025-10-19 20:00:00	50.6	0.0	12.8	50400.0	0	0.0	6.0	135
21	2025-10-19 21:00:00	49.5	0.0	15.0	45700.0	0	0.0	6.8	143
22	2025-10-19 22:00:00	48.6	0.0	14.6	43200.0	0	0.0	6.5	141
23	2025-10-19 23:00:00	48.2	0.0	15.9	43300.0	0	0.0	7.4	147

In [35]:
```
print(f"Wind Gusts Over the day (in knots) for {df['Time'].iloc[0]} to {df['Time'].iloc[-1]}:")
plt.figure(figsize=(15, 5))
plt.plot(df["Time"], df["Wind Gusts"], color="blue", label="Wind Gusts (kt)")
plt.xlabel("Time")
plt.ylabel("Wind Gusts (knots)")
plt.title("Wind Gusts Over Time")
plt.legend()
plt.show()
```

```
Wind Gusts Over the day (in knots) for 2025-10-19 00:00:00 to 2025-10-19 23:00:00:
```



In [36]:
```
def flight_conditions(df,name="Aircraft",windwarning=17,noflywind=20,snowlimit=0,cloudlimit=5,visibilitylimit=0,rainlimit=0):
    result = df.copy()
    result[name] = "Safe to fly"
    # Checking conditions
    result.loc[result["Wind Gusts"] > noflywind, name] = "NO FLY"
    result.loc[(result["Wind Gusts"] > windwarning) &(result["Wind Gusts"] <= noflywind), name] = "WARNING: Difficult "
    result.loc[result["Snowfall"]> snowlimit, name] = "NO FLY"
    result.loc[result["Cloud Cover"] > cloudlimit, name] = "NO FLY"
    result.loc[result["Visibility"] < visibilitylimit, name]= "NO FLY"
    result.loc[result["Rain"] > rainlimit, name] ="NO FLY"
    # Returning the columns that matter
    return result[["Wind Gusts", "Snowfall", "Cloud Cover", "Visibility", "Rain", name]]
```

In [37]:
```
cessna_df = flight_conditions(df, name="Cessna 172", windwarning=17, noflywind=20, snowlimit=0, cloudlimit=5, visibilitylimit=5000, rainlimit=0)
cessna_df
```

Out[37]:

	Wind Gusts	Snowfall	Cloud Cover	Visibility	Rain	Cessna 172
0	17.9	0.0	0	25800.0	0.0	WARNING: Difficult
1	16.5	0.0	0	23800.0	0.0	Safe to fly
2	17.7	0.0	0	23600.0	0.0	WARNING: Difficult
3	17.3	0.0	0	25000.0	0.0	WARNING: Difficult
4	18.5	0.0	0	24300.0	0.0	WARNING: Difficult
5	16.5	0.0	0	23400.0	0.0	Safe to fly
6	15.4	0.0	0	22000.0	0.0	Safe to fly
7	15.2	0.0	0	21300.0	0.0	Safe to fly
8	14.2	0.0	0	20600.0	0.0	Safe to fly
9	16.5	0.0	0	22200.0	0.0	Safe to fly
10	18.7	0.0	0	28200.0	0.0	WARNING: Difficult
11	15.4	0.0	0	34900.0	0.0	Safe to fly
12	14.4	0.0	0	41600.0	0.0	Safe to fly
13	14.2	0.0	0	50400.0	0.0	Safe to fly
14	13.6	0.0	0	57100.0	0.0	Safe to fly
15	12.6	0.0	0	61100.0	0.0	Safe to fly
16	13.4	0.0	0	62400.0	0.0	Safe to fly
17	12.4	0.0	0	66100.0	0.0	Safe to fly
18	12.1	0.0	0	63900.0	0.0	Safe to fly
19	9.1	0.0	0	55200.0	0.0	Safe to fly
20	12.8	0.0	0	50400.0	0.0	Safe to fly
21	15.0	0.0	0	45700.0	0.0	Safe to fly
22	14.6	0.0	0	43200.0	0.0	Safe to fly
23	15.9	0.0	0	43300.0	0.0	Safe to fly

In [38]:
```
schweizer_sgs_223_df = flight_conditions(df, name="Schweizer SGS 2-33", windwarning=15, noflywind=18, snowlimit=0, cloudlimit=3, visibilitylimit=5, rainlimit=0)
schweizer_sgs_223_df
```

Out[38]:

	Wind Gusts	Snowfall	Cloud Cover	Visibility	Rain	Schweizer SGS 2-33
0	17.9	0.0	0	25800.0	0.0	WARNING: Difficult
1	16.5	0.0	0	23800.0	0.0	WARNING: Difficult
2	17.7	0.0	0	23600.0	0.0	WARNING: Difficult
3	17.3	0.0	0	25000.0	0.0	WARNING: Difficult
4	18.5	0.0	0	24300.0	0.0	NO FLY
5	16.5	0.0	0	23400.0	0.0	WARNING: Difficult
6	15.4	0.0	0	22000.0	0.0	WARNING: Difficult
7	15.2	0.0	0	21300.0	0.0	WARNING: Difficult
8	14.2	0.0	0	20600.0	0.0	Safe to fly
9	16.5	0.0	0	22200.0	0.0	WARNING: Difficult
10	18.7	0.0	0	28200.0	0.0	NO FLY
11	15.4	0.0	0	34900.0	0.0	WARNING: Difficult
12	14.4	0.0	0	41600.0	0.0	Safe to fly
13	14.2	0.0	0	50400.0	0.0	Safe to fly
14	13.6	0.0	0	57100.0	0.0	Safe to fly
15	12.6	0.0	0	61100.0	0.0	Safe to fly
16	13.4	0.0	0	62400.0	0.0	Safe to fly
17	12.4	0.0	0	66100.0	0.0	Safe to fly
18	12.1	0.0	0	63900.0	0.0	Safe to fly
19	9.1	0.0	0	55200.0	0.0	Safe to fly
20	12.8	0.0	0	50400.0	0.0	Safe to fly
21	15.0	0.0	0	45700.0	0.0	Safe to fly
22	14.6	0.0	0	43200.0	0.0	Safe to fly
23	15.9	0.0	0	43300.0	0.0	WARNING: Difficult

Conclusion

This project's objective was to use hourly meteorological data to investigate the viability of small aircraft landing at Sioux Falls Regional Airport (FSD). Based on wind, visibility, and precipitation, the previously mentioned analysis allows us to determine the times of day when certain aircraft types are safe to land. Due to their sensitivity to severe wind gusts, aircraft like the Schweizer SGS 2-33 glider demonstrated fewer landing opportunities, but the Cessna 172 was able to operate safely for the majority of the day with only a few "NO FLY" intervals.

This comparison shows how weather variability and aircraft performance limitations have a direct impact on flight safety and decision-making. To increase accuracy, future studies might incorporate more aircraft types or extra meteorological factors, including crosswind or peak height data.