part1

October 3, 2025

[9]:
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
```

1 Loading the dataset

[10]:
```
df = pd.read_csv('open-meteo-subset.csv')
```

[11]:
```
print(f'Shape of the dataset: {df.shape}.')
```

```
Shape of the dataset: (8760, 6).
```

[12]:
```
df.dtypes
```

[12]:
```
time                        object
temperature_2m (°C)        float64
precipitation (mm)         float64
wind_speed_10m (m/s)       float64
wind_gusts_10m (m/s)       float64
wind_direction_10m (°)       int64
dtype: object
```

[13]:
```
df.isna().sum()
```

[13]:
```
time                       0
temperature_2m (°C)        0
precipitation (mm)         0
wind_speed_10m (m/s)       0
wind_gusts_10m (m/s)       0
wind_direction_10m (°)     0
dtype: int64
```

[14]:
```
df.head()
```

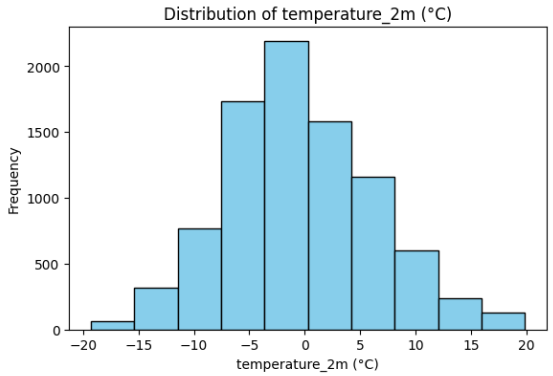
[14]:
```
              time  temperature_2m (°C)  precipitation (mm)  \
0  2020-01-01T00:00                 -2.2                 0.1
1  2020-01-01T01:00                 -2.2                 0.0
```

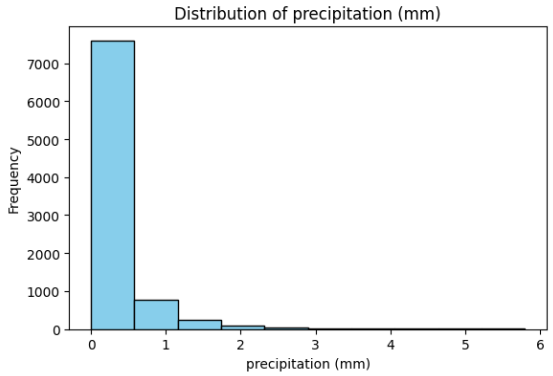
```
2  2020-01-01T02:00                -2.3                0.0
3  2020-01-01T03:00                -2.3                0.0
4  2020-01-01T04:00                -2.7                0.0

   wind_speed_10m (m/s)  wind_gusts_10m (m/s)  wind_direction_10m (°)
0                   9.6                  21.3                     284
1                  10.6                  23.0                     282
2                  11.0                  23.5                     284
3                  10.6                  23.3                     284
4                  10.6                  22.8                     284
```

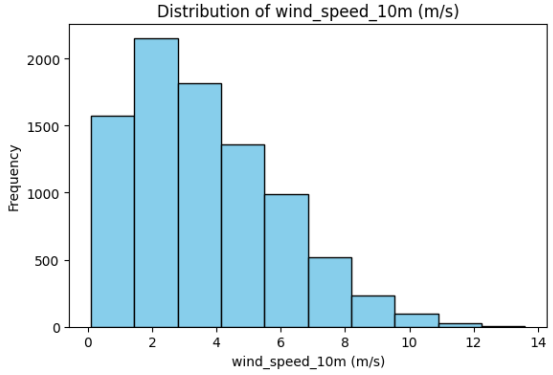
We observe that the dataset consists of 6 columns, 1 column containing time and 5 columns containing weather data.
The temperature, percipitation, wind speed and wind gusts are floats, while wind direction is int. There are no nans in the dataset.

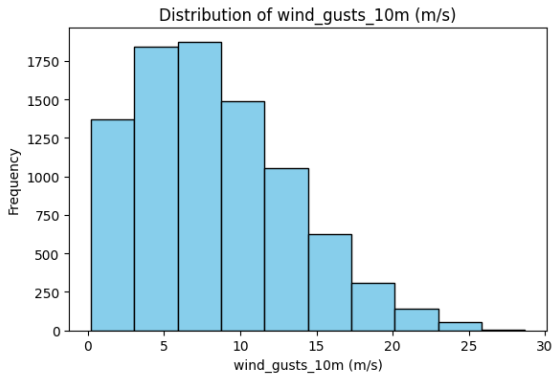
Let's plot the distibutions of the columns of the dataset.

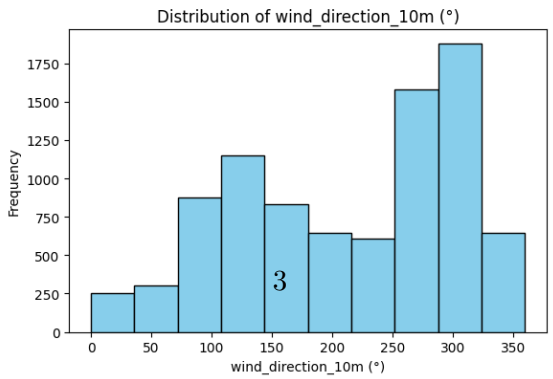
[15]:
```python
df = df.set_index('time')
n_cols = df.shape[1]
fig, axes = plt.subplots(n_cols, 1, figsize=(6, 4 * n_cols))
for i, col in enumerate(df.columns):
    axes[i].hist(df[col], bins=10, color='skyblue', edgecolor='black')
    axes[i].set_title(f'Distribution of {col}')
    axes[i].set_xlabel(col)
    axes[i].set_ylabel('Frequency')

plt.tight_layout()
plt.show()
```


Distribution of temperature_2m (°C)
Frequency
temperature_2m (°C)


Distribution of precipitation (mm)
Frequency
precipitation (mm)


Distribution of wind_speed_10m (m/s)
Frequency
wind_speed_10m (m/s)

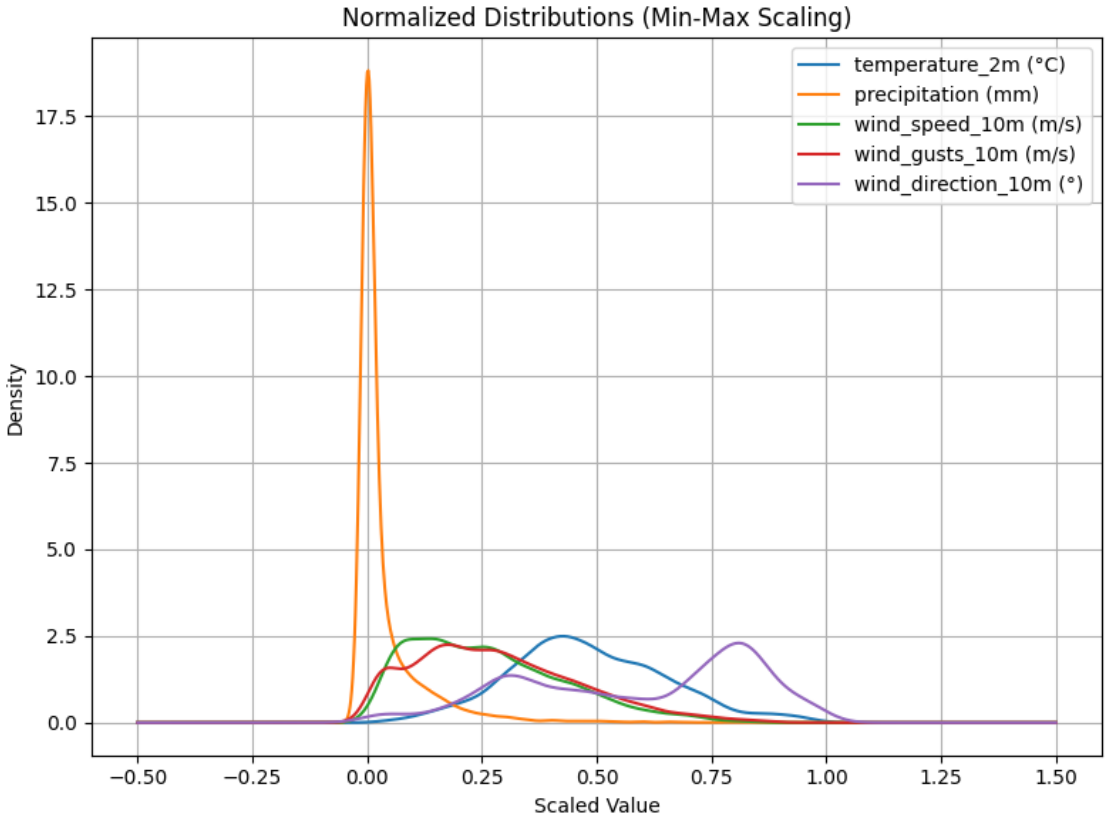

Distribution of wind_gusts_10m (m/s)
Frequency
wind_gusts_10m (m/s)


Distribution of wind_direction_10m (°)
Frequency
wind_direction_10m (°)

We observe that the temperature distibution is normally ditributed, percipitation, wind speed and wind gust all have right tails, and the wind direction has a bimodal distribution.

To plot all columns together we will normalize the data using MinMaxScaler from scikitLearn. We will also drop the time column from the plot as it is uniform and will not add any information to the plot.

[16]:
```
scaler = MinMaxScaler()

df_scaled = pd.DataFrame(scaler.fit_transform(df), columns=df.columns)

# Plot all scaled columns as KDEs
plt.figure(figsize=(8, 6))

for col in df_scaled.columns:
    df_scaled[col].plot(kind='kde', label=col)

plt.title('Normalized Distributions (Min-Max Scaling)')
plt.xlabel('Scaled Value')
plt.ylabel('Density')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```


Normalized Distributions (Min-Max Scaling)
temperature_2m (°C)
precipitation (mm)
wind_speed_10m (m/s)
wind_gusts_10m (m/s)
wind_direction_10m (°)
Density
Scaled Value
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50