Excercises Ch2

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1 Hands-On Data Preprocessing in Python

Learn how to effectively prepare data for successful data analytics

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1.0.1 Chapter 1: Review of the core modules NumPy, Pandas, and Matplotlib

[2]:
```
import pandas as pd
```

Excercise 1 Use adult.csv and Boolean Masking to answer the following questions.

[3]:
```
adult_df = pd.read_csv('adult.csv')
adult_df.head()
```

[3]:
```
   age         workclass  fnlwgt  education  education-num  \
0   39         State-gov   77516  Bachelors             13
1   50  Self-emp-not-inc   83311  Bachelors             13
2   38           Private  215646    HS-grad              9
3   53           Private  234721       11th              7
4   28           Private  338409  Bachelors             13

       marital-status         occupation   relationship   race     sex  \
0       Never-married       Adm-clerical  Not-in-family  White    Male
1  Married-civ-spouse    Exec-managerial        Husband  White    Male
2            Divorced  Handlers-cleaners  Not-in-family  White    Male
3  Married-civ-spouse  Handlers-cleaners        Husband  Black    Male
4  Married-civ-spouse     Prof-specialty           Wife  Black  Female

   capitalGain  capitalLoss  hoursPerWeek  nativeCountry income
0         2174            0            40  United-States  <=50K
1            0            0            13  United-States  <=50K
2            0            0            40  United-States  <=50K
3            0            0            40  United-States  <=50K
4            0            0            40           Cuba  <=50K
```

```
a)  Calculate the mean and median of education-num for every race in the data.
b)  Draw one histogram of education-num that includes the data for each race in the data.
c)  Draw a comparative boxplot that compares the education-num for each race.
```

```
d)  Create a subplot that puts the visual from b on top of the one on c.
```

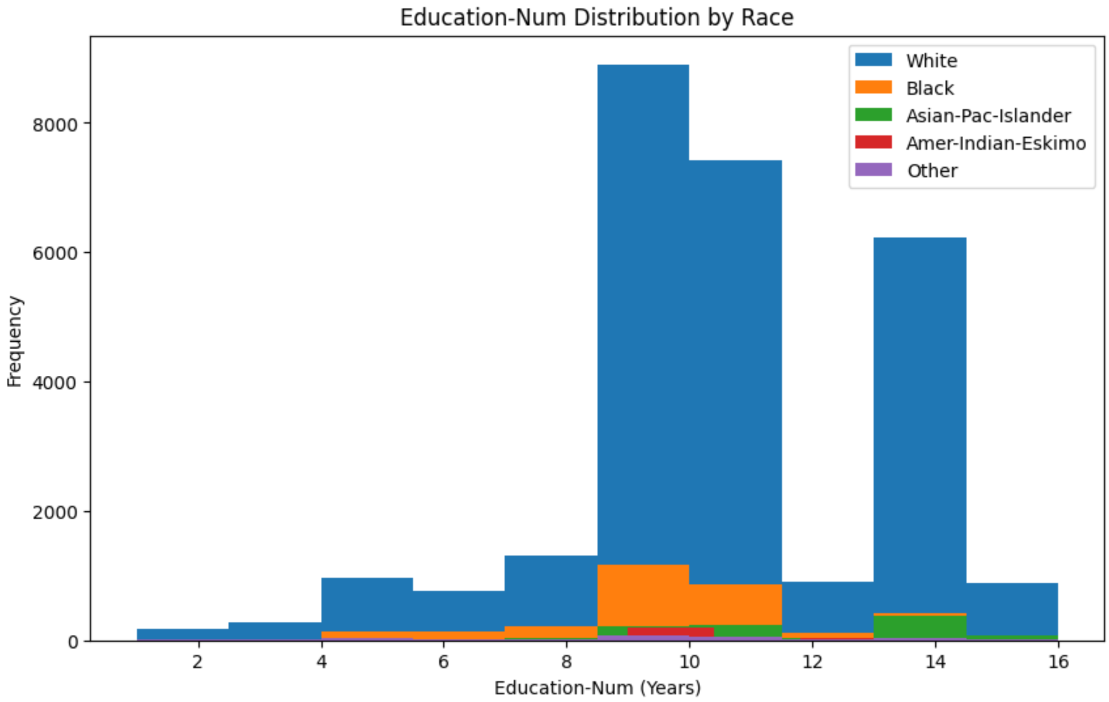
[11]:

```python
# a) Calculate the mean and median of education-num for every race in the data.
races = adult_df['race'].unique()

for race in races:
    mask = adult_df['race'] == race
    mean = adult_df.loc[mask, 'education-num'].mean()
    median = adult_df.loc[mask, 'education-num'].median()
    print(f"Race: {race}\n  Mean: {mean: 1f}, Median: {median: .0f}\n")
```

```
Race: White
  Mean:  10.135246, Median:  10

Race: Black
  Mean:  9.486236, Median:  9

Race: Asian-Pac-Islander
  Mean:  10.960539, Median:  10

Race: Amer-Indian-Eskimo
  Mean:  9.311897, Median:  9

Race: Other
  Mean:  8.841328, Median:  9
```

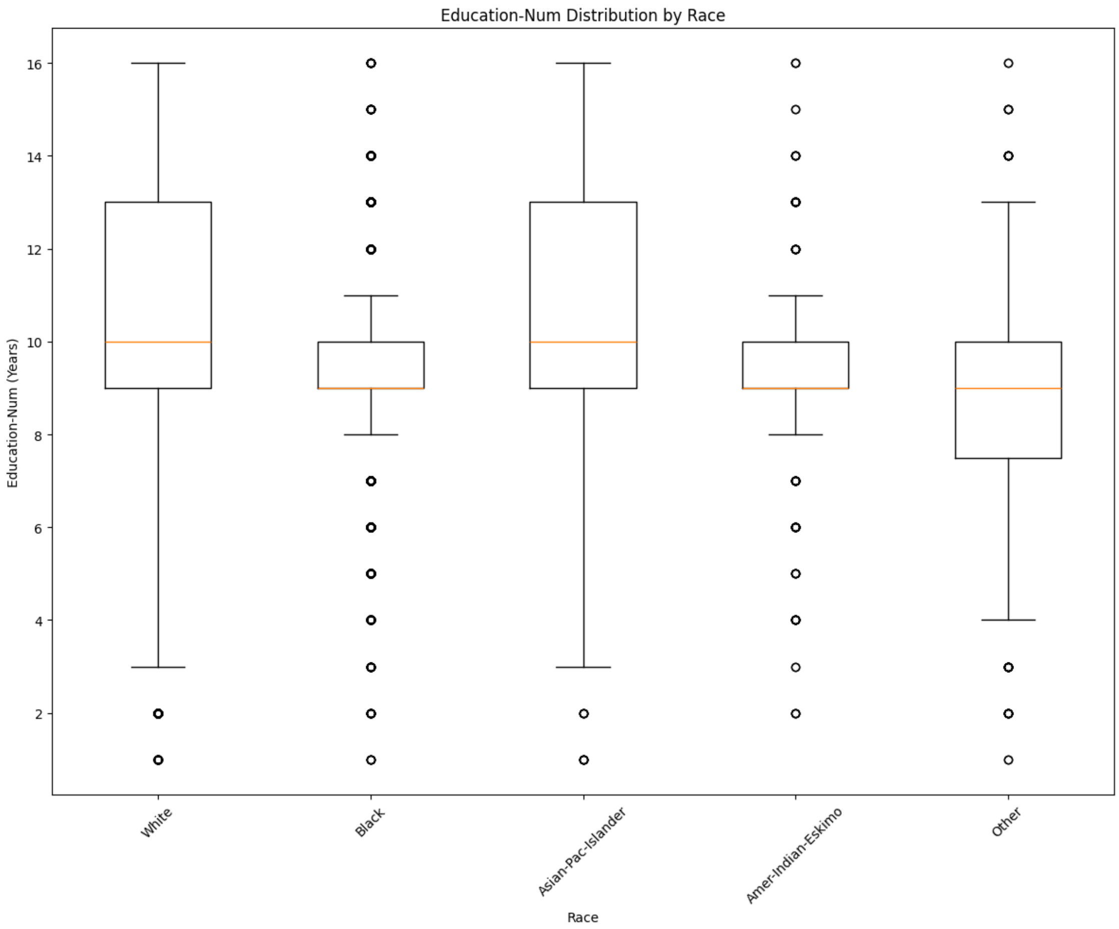
[26]:

```python
# b) Draw one histogram of education-num that includes the data for each race␣
 ↪in the data.

import matplotlib.pyplot as plt

plt.figure(figsize=(10, 6))
for race in adult_df['race'].unique():
    plt.hist(
        adult_df[adult_df['race'] == race]['education-num'],
        label=race
    )

plt.title('Education-Num Distribution by Race')
plt.xlabel('Education-Num (Years)')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```



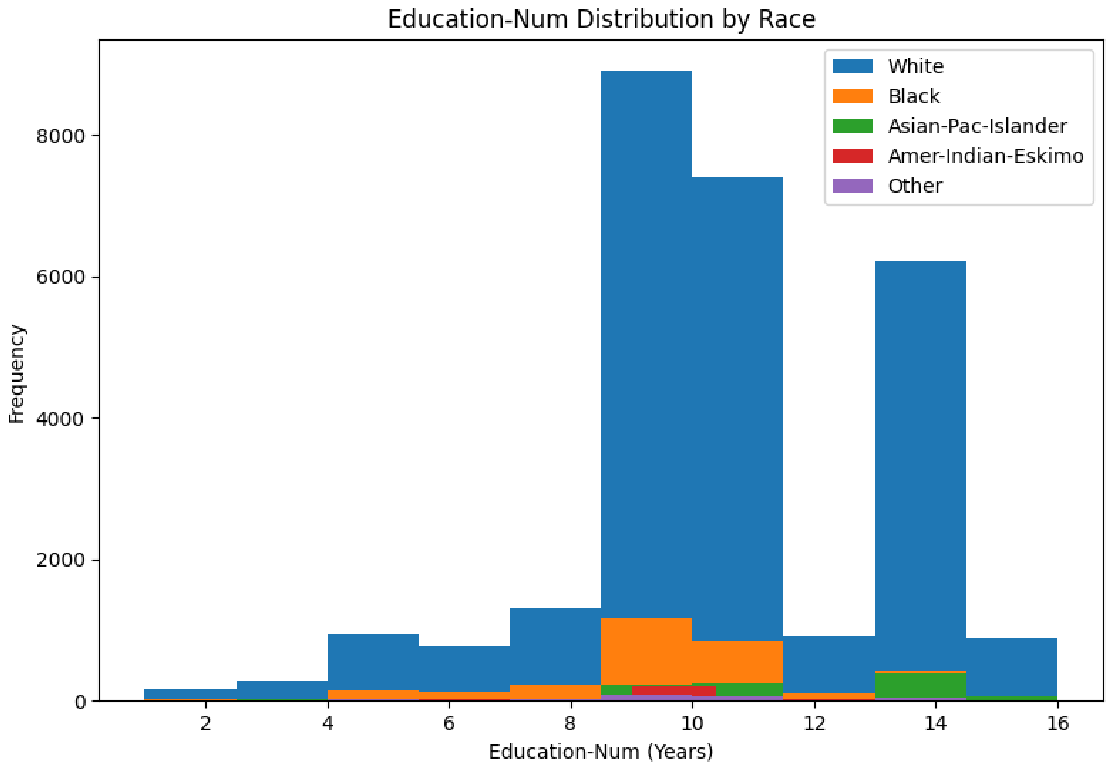
[39]:

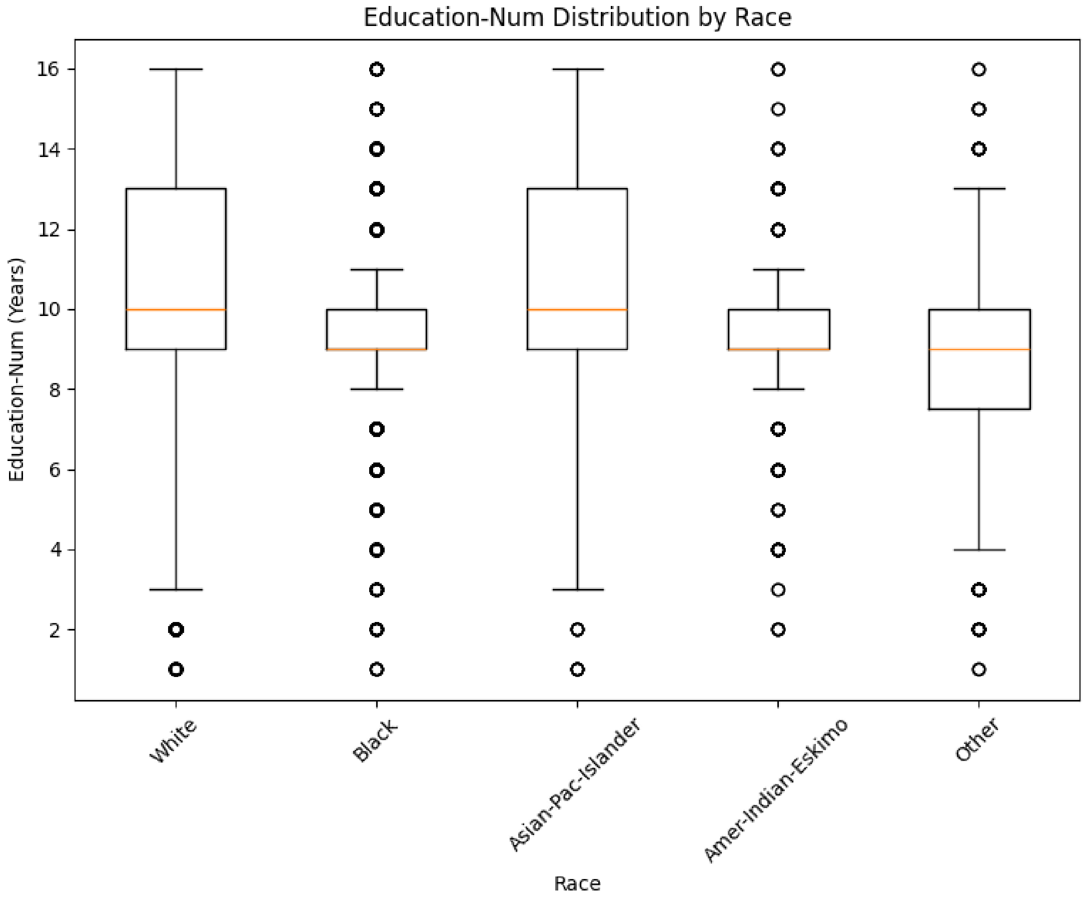
```python
# c) Draw a comparative boxplot that compares the education-num for each race.

import matplotlib.pyplot as plt

# Prepare data: List of arrays (one per race)
data = [
    adult_df[adult_df['race'] == race]['education-num'].values
    for race in adult_df['race'].unique()
]
labels = adult_df['race'].unique()

# Create boxplot
plt.figure(figsize=(12, 10))
plt.boxplot(data, tick_labels=labels)

# Customize
plt.title('Education-Num Distribution by Race')
plt.xlabel('Race')
plt.ylabel('Education-Num (Years)')
plt.xticks(rotation=45)

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



[48]:

```
# d) Create a subplot that puts the visual from b on top of the one on c.

plt.figure(figsize=(8, 12))

plt.subplot(2, 1, 1)
for race in adult_df['race'].unique():
    plt.hist(
        adult_df[adult_df['race'] == race]['education-num'],
        label=race
    )
plt.title('Education-Num Distribution by Race')
plt.xlabel('Education-Num (Years)')
plt.ylabel('Frequency')
plt.legend()

plt.subplot(2, 1, 2)
data = [
    adult_df[adult_df['race'] == race]['education-num'].values
    for race in adult_df['race'].unique()
]
labels = adult_df['race'].unique()
plt.boxplot(data, tick_labels=labels)
plt.title('Education-Num Distribution by Race')
plt.xlabel('Race')
plt.ylabel('Education-Num (Years)')
plt.xticks(rotation=45)

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


Education-Num Distribution by Race
White
Black
Asian-Pac-Islander
Amer-Indian-Eskimo
Other
Frequency
0
2000
4000
6000
8000
2
4
6
8
10
12
14
16
Education-Num (Years)


Education-Num Distribution by Race
Education-Num (Years)
2
4
6
8
10
12
14
16
White
Black
Asian-Pac-Islander
Amer-Indian-Eskimo
Other
Race

Excercise 2

```
a)  Repeat the analysis on Exercise 1. a), but this time use groupby function.
b)  compare the runtime of using BM vs. groupby. (hint: you can import the module time and use
```

[54]:

```
# a) Repeat the analysis on Exercise 1. a), but this time use groupby function.

print(adult_df.groupby('race')['education-num'].agg(['mean', 'median']))
```

```
                         mean  median
race
Amer-Indian-Eskimo   9.311897     9.0
Asian-Pac-Islander  10.960539    10.0
Black                9.486236     9.0
Other                8.841328     9.0
White               10.135246    10.0
```

[56]:

```
# b) compare the runtime of using BM vs. groupby. (hint: you can import the␣
 ↪module time and use the fuction .time())

import time

# Boolean Masking Approach
def boolean_masking_stats():
    races = adult_df['race'].unique()
    for race in races:
        mask = adult_df['race'] == race
        mean = adult_df.loc[mask, 'education-num'].mean()
        median = adult_df.loc[mask, 'education-num'].median()

# GroupBy Approach
def groupby_stats():
    grouped_stats = adult_df.groupby('race')['education-num'].agg(['mean',␣
 ↪'median'])

# Measure runtime
n_iterations = 100

# Time Boolean Masking
bm_time = time.time()
for _ in range(n_iterations):
    boolean_masking_stats()
bm_time = (time.time() - bm_time) / n_iterations

# Time GroupBy
```

```
gb_time = time.time()
for _ in range(n_iterations):
    groupby_stats()
gb_time = (time.time() - gb_time) / n_iterations

print(f"Boolean Masking: {bm_time:.6f} sec per iteration")
print(f"GroupBy: {gb_time:.6f} sec per iteration")
print(f"GroupBy is {bm_time/gb_time:.1f}x faster")
```

```
Boolean Masking: 0.010407 sec per iteration
GroupBy: 0.002198 sec per iteration
GroupBy is 4.7x faster
```

Excercise 3

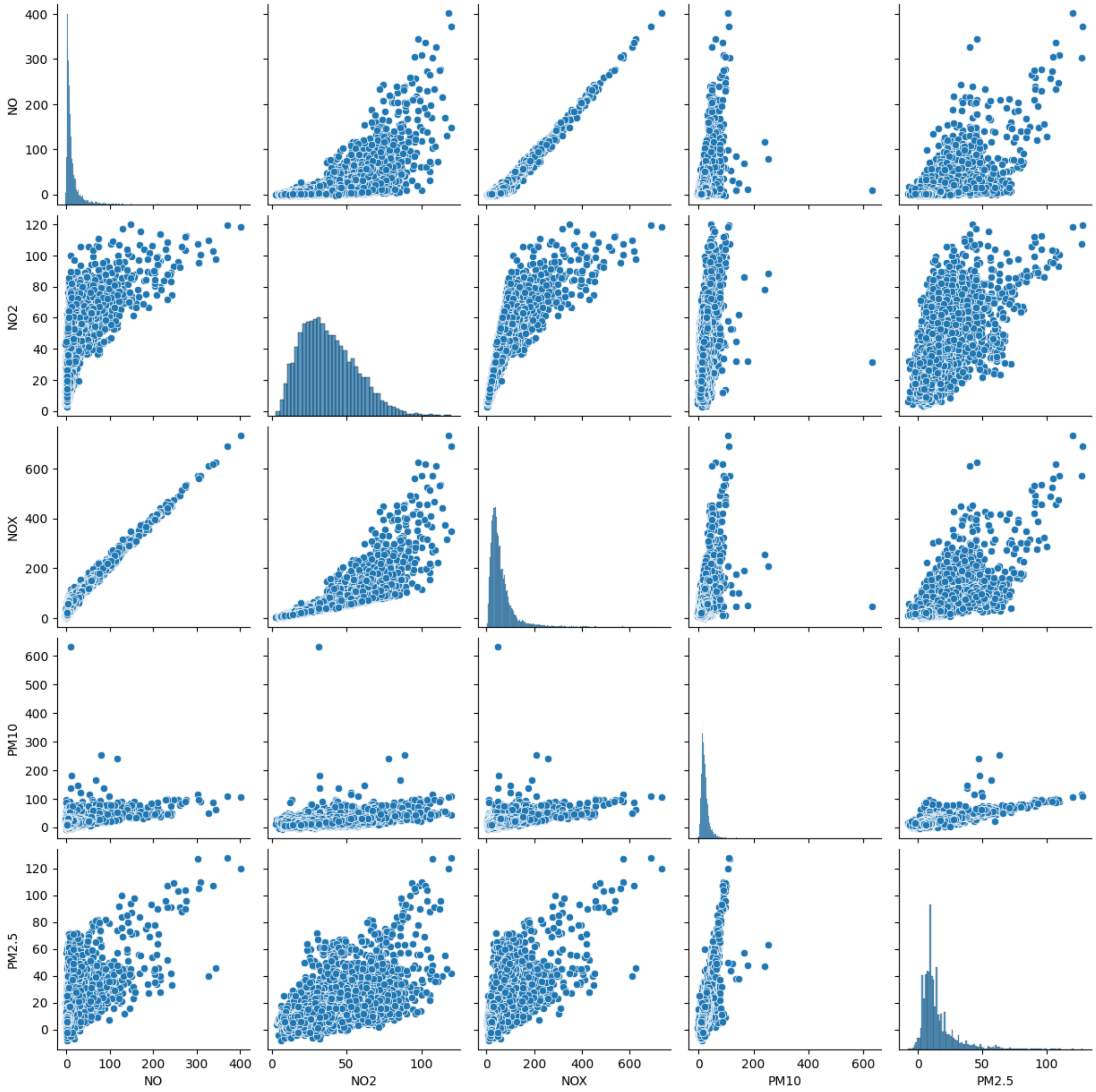
If you have not already, solve exercise 4 in the previous chapter. After you created pvt_df fo

[57]:

```
import seaborn as sns

air_df = pd.read_csv('LaqnData.csv')
air_df.drop(columns=['Site','Units','Provisional or Ratified'], inplace=True)

pvt_df = air_df.pivot(
    index="ReadingDateTime",
    columns="Species",
    values="Value"
)

sns.pairplot(pvt_df)
```

[57]:

```
<seaborn.axisgrid.PairGrid at 0x7f0f25a75990>
```



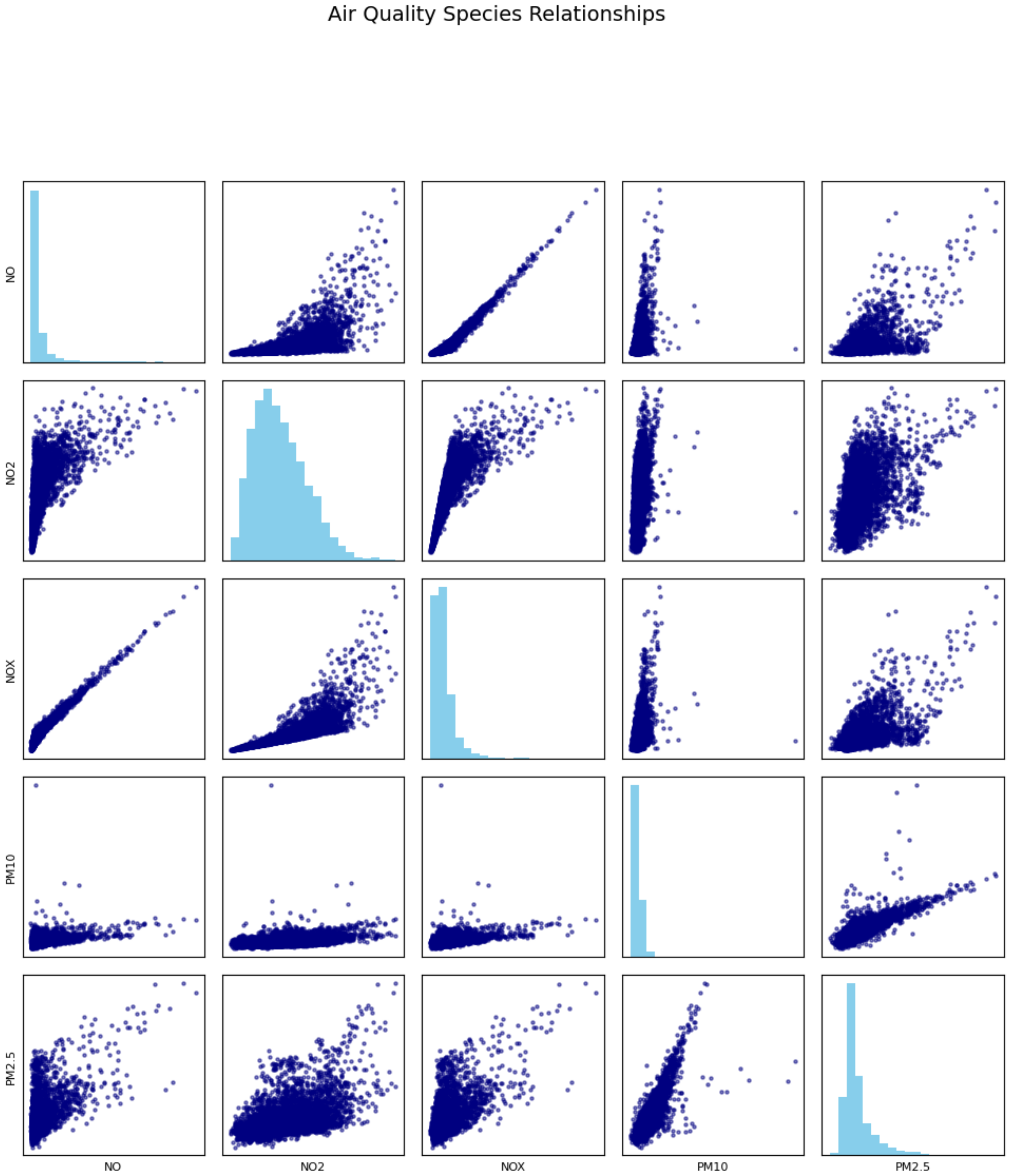
The code ouputs what is known as scatter matrix. This code takes advantage of seaborn modue whi

[59]:

```
# Get species names and count
species = pvt_df.columns
n_species = len(species)

# Create figure with proper sizing
fig = plt.figure(figsize=(12, 12))
plt.suptitle('Air Quality Species Relationships', y=1.02, fontsize=14)

# Create gridspec for more control
gs = plt.GridSpec(n_species, n_species, wspace=0.1, hspace=0.1)
```

```
# Plot each combination
for i in range(n_species):
    for j in range(n_species):
        ax = plt.subplot(gs[i, j])

        if i == j:
            # Diagonal - show histogram
            ax.hist(pvt_df.iloc[:, i], bins=20, color='skyblue')
            ax.set_xticks([])
            ax.set_yticks([])
        else:
            # Off-diagonal - show scatter plot
            ax.scatter(pvt_df.iloc[:, j], pvt_df.iloc[:, i],
                    s=5, alpha=0.5, color='navy')
            ax.set_xticks([])
            ax.set_yticks([])

        # Add axis labels only on edges
        if i == n_species-1:
            ax.set_xlabel(species[j], fontsize=8)
        if j == 0:
            ax.set_ylabel(species[i], fontsize=8)

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

```
/tmp/ipykernel_253923/3982319793.py:35: UserWarning: This figure includes Axes
that are not compatible with tight_layout, so results might be incorrect.
  plt.tight_layout()
```



Air Quality Species Relationships