eda

June 2, 2025

[55]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go

%matplotlib inline
```

[56]:

```
data_path = r"data\DigitalExposome Dataset.csv"
df = pd.read_csv(data_path)
```

[57]:

```
df.columns
```

[57]:

```
Index(['IBI', 'HR', 'NO2', 'Noise', 'NH3', 'PM10', 'CO', 'PM25', 'Label',
       'PM1', 'EDA', 'BVP'],
      dtype='object')
```

[58]:

```
df.head()
```

[58]:

```
   IBI        HR  NO2     Noise       NH3      PM10        CO      PM25  \
0  0.0  0.377574  0.0  0.511358  0.003018  0.003091  0.871758  0.000000
1  0.0  0.196398  0.0  0.490903  0.003018  0.003091  0.876848  0.003091
2  0.0  0.454163  0.0  0.470449  0.006036  0.006181  0.881939  0.006181
3  0.0  0.322451  0.0  0.449995  0.009055  0.009272  0.887030  0.009272
4  0.0  0.237595  0.0  0.429540  0.012073  0.012362  0.892121  0.012362

   Label       PM1  EDA  BVP
0      5  0.000000  0.0  0.0
1      5  0.001854  0.0  0.0
2      5  0.003709  0.0  0.0
3      5  0.005563  0.0  0.0
4      5  0.007417  0.0  0.0
```

[59]:

```
df.shape
```

[59]:

```
(42436, 12)
```

[60]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 42436 entries, 0 to 42435
Data columns (total 12 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   IBI     42436 non-null  float64
 1   HR      42436 non-null  float64
 2   NO2     42436 non-null  float64
 3   Noise   42436 non-null  float64
 4   NH3     42436 non-null  float64
 5   PM10    42436 non-null  float64
 6   CO      42436 non-null  float64
 7   PM25    42436 non-null  float64
 8   Label   42436 non-null  int64
 9   PM1     42436 non-null  float64
 10  EDA     42436 non-null  float64
 11  BVP     42436 non-null  float64
dtypes: float64(11), int64(1)
memory usage: 3.9 MB
```

[61]:

```
df.describe().T
```

[61]:

```
         count      mean       std  min       25%       50%       75%   max
IBI    42436.0  0.178688  0.230127  0.0  0.000000  0.016760  0.309984   1.0
HR     42436.0  0.530687  0.266531  0.0  0.309505  0.491213  0.776388   1.0
NO2    42436.0  0.502239  0.274914  0.0  0.285412  0.489703  0.736983   1.0
Noise  42436.0  0.427541  0.247601  0.0  0.214008  0.403671  0.618592   1.0
NH3    42436.0  0.564276  0.294515  0.0  0.305285  0.644756  0.826943   1.0
PM10   42436.0  0.208474  0.210981  0.0  0.017624  0.158454  0.326889   1.0
CO     42436.0  0.679874  0.308111  0.0  0.458047  0.805352  0.909832   5.0
PM25   42436.0  0.224901  0.223242  0.0  0.012362  0.176150  0.376813   1.0
Label  42436.0  3.326185  1.599863  1.0  2.000000  4.000000  5.000000   5.0
PM1    42436.0  0.230773  0.255253  0.0  0.006310  0.176316  0.407268  24.0
EDA    42436.0  0.260318  0.221725  0.0  0.060686  0.216064  0.421109   1.0
BVP    42436.0  0.482902  0.175569  0.0  0.449963  0.512280  0.579756   1.0
```

[62]:

```
missing = df.isna().sum()
missing[missing > 0].sort_values(ascending=False)
```

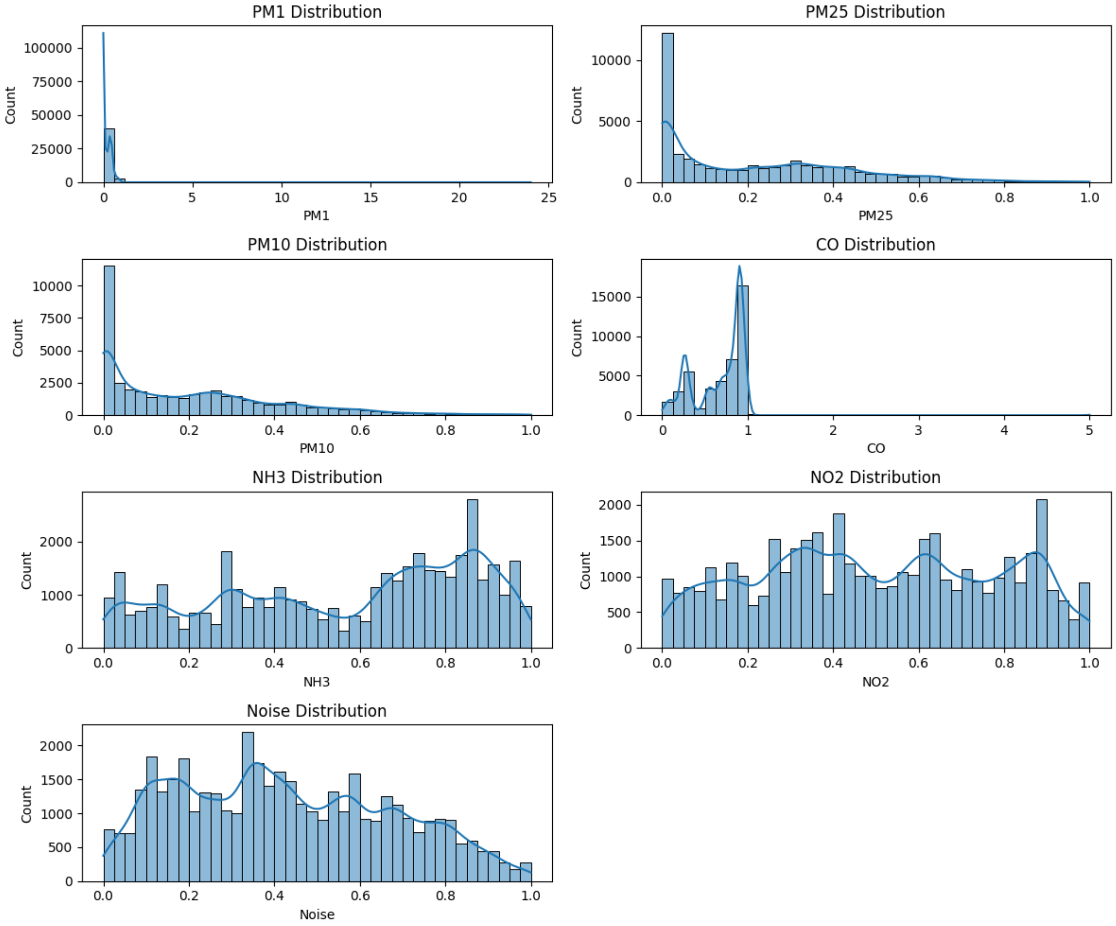
[62]:

```
Series([], dtype: int64)
```

[ ]:

```
env_cols = ["PM1", "PM25", "PM10", "CO", "NH3", "NO2", "Noise"]

plt.figure(figsize=(10, 8))
for i, col in enumerate(env_cols, 1):
    plt.subplot(4, 2, i)
    sns.histplot(df[col], kde=True, bins=40)
    plt.title(f"{col} Distribution")
plt.tight_layout()
plt.show()
```



[64]:
```
(df["PM1"] > 1.0).sum(), (df["PM1"] > 5.0).sum()
```

[64]:
```
(np.int64(1), np.int64(1))
```

[65]:
```
sample = df.sample(5000, random_state=0)
fig = px.density_heatmap(sample,
                         x="PM25",
                         y="PM10",
                         nbinsx=40,
                         nbinsy=40,
                         title="Hexbin: PM25 vs. PM10 (normalized)",
                         width=800,
                         height=600
)
fig.show()
```

[66]:
```
def noise_category(x):
    if x < 0.3:
        return "Low"
    elif x < 0.6:
        return "Medium"
    else:
        return "High"

df["Noise_cat"] = df["Noise"].apply(noise_category)
fig = px.box(
    df,
    x="Noise_cat",
    y="EDA",
    title="EDA by Noise Category",
    width=800,
    height=600
)
fig.show()
```

[67]:
```
corr =␣
  ↪df[["PM1","PM25","PM10","CO","NH3","NO2","Noise","HR","EDA","BVP","IBI"]].
  ↪corr()
fig = px.imshow(
    corr,
    text_auto=".2f",
    title="Correlation Matrix (All Env + Physio Variables)",
    width=800,
    height=600
)
fig.show()
```

[68]:
```
spikes = df[df["PM1"] > 5.0]
fig = go.Figure()
fig.add_trace(go.Scatter(x=spikes.index, y=spikes["PM1"], mode="markers",␣
  ↪name="PM1"))
fig.add_trace(go.Scatter(x=spikes.index, y=spikes["HR"], mode="lines", name="HR␣
  ↪(closeup)"))
fig.update_layout(
    title="PM1 Spikes & HR Overlaps",
    xaxis_title="Time",
    yaxis_title="Values",
    width=800,
    height=600
)
```

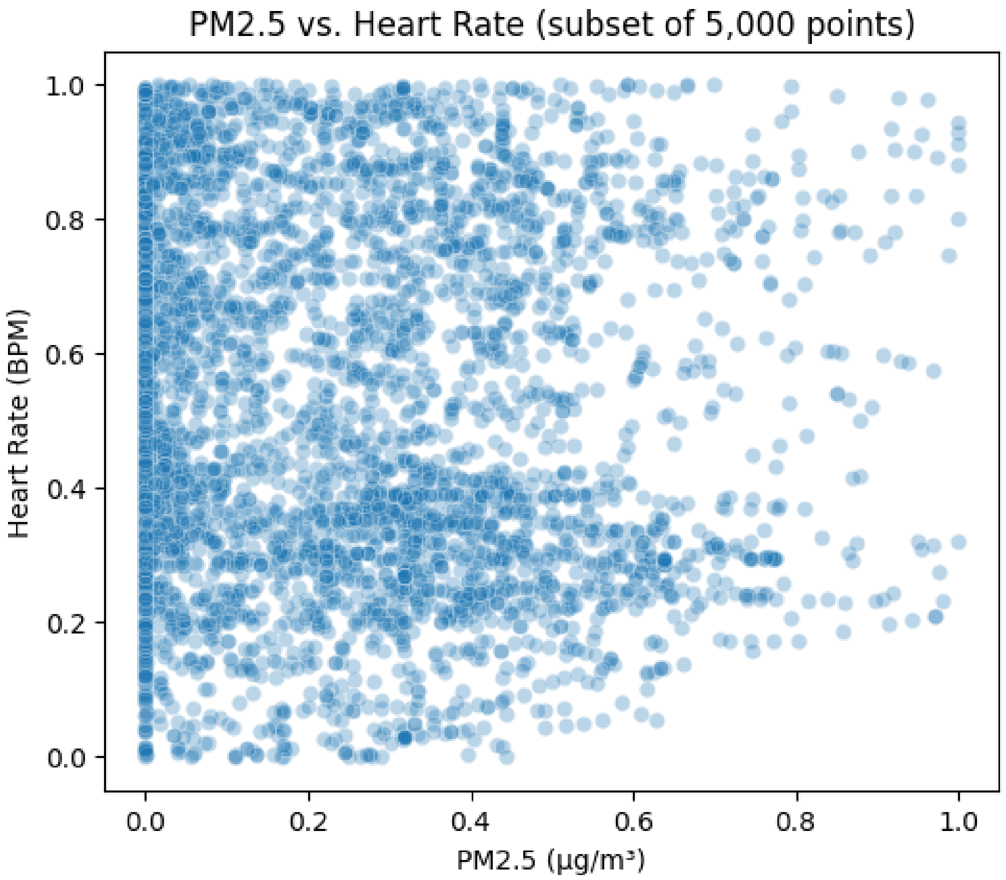
```
fig.show()
```

[69]:

```
df["PM25_bin"] = pd.qcut(df["PM25"], q=4, labels=False)
fig = px.box(
    df,
    x="PM25_bin",
    y="EDA",
    title="EDA by PM2.5 Quartile",
    width=800,
    height=600
)
fig.show()
```

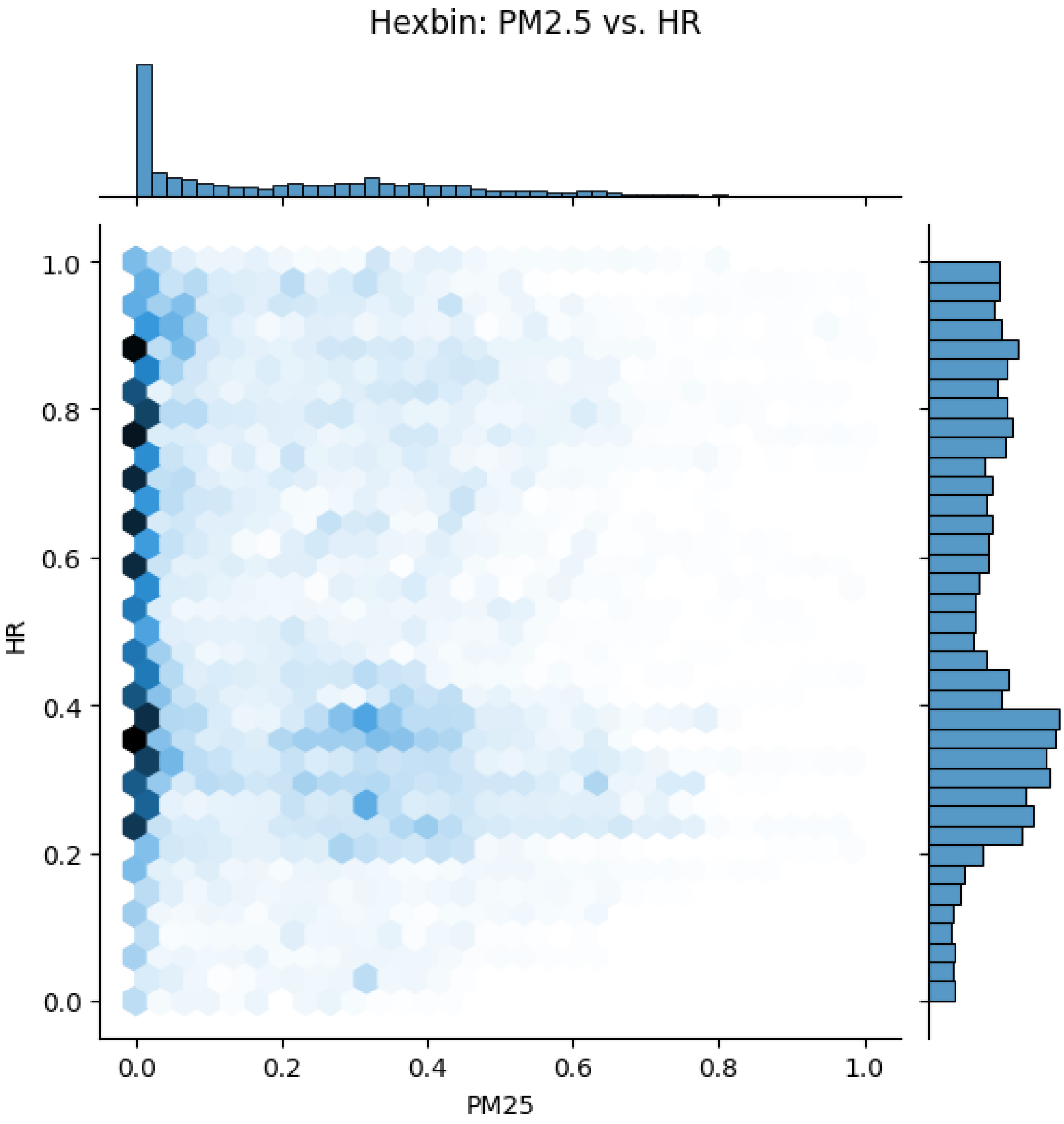
[70]:

```
plt.figure(figsize=(6, 5))
sns.scatterplot(x="PM25", y="HR", data=df.sample(5000), alpha=0.3)
plt.title("PM2.5 vs. Heart Rate (subset of 5,000 points)")
plt.xlabel("PM2.5 (µg/m³)")
plt.ylabel("Heart Rate (BPM)")
plt.show()
```



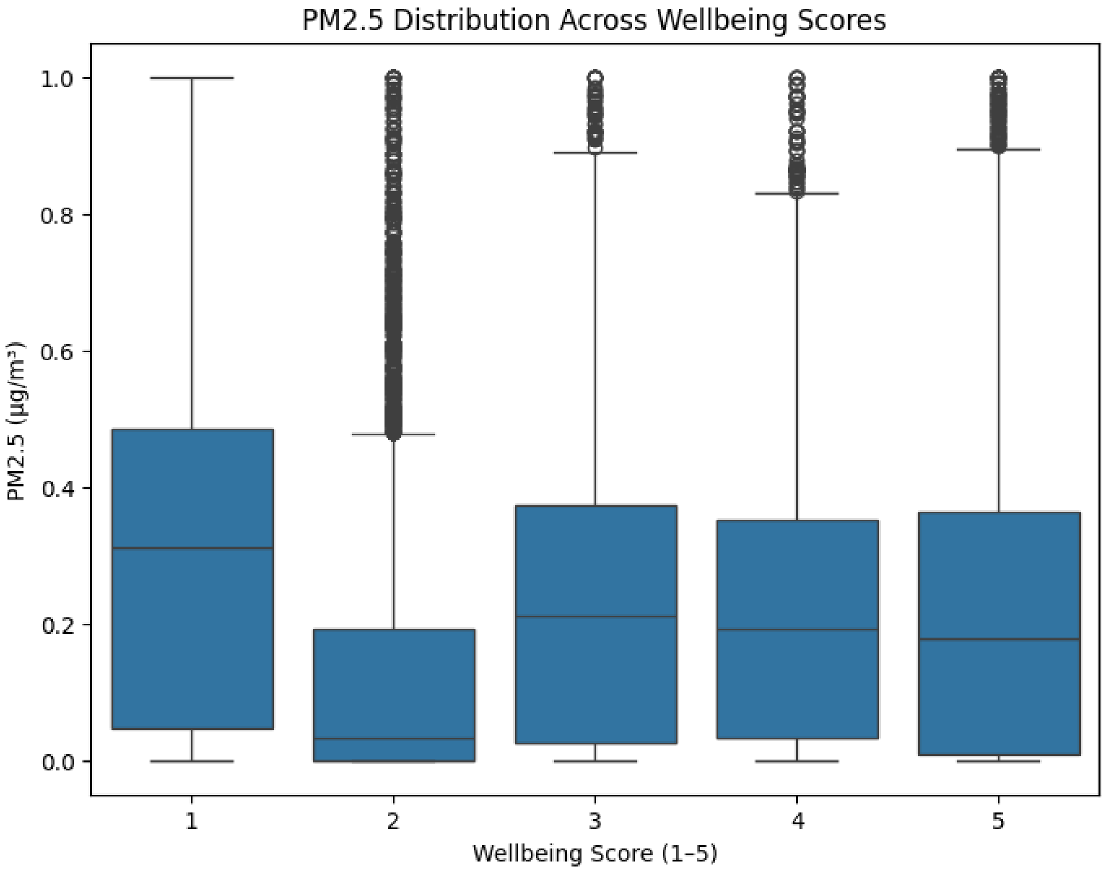
[71]:

```
sns.jointplot(x="PM25", y="HR", data=df, kind="hex", gridsize=30)
plt.suptitle("Hexbin: PM2.5 vs. HR", y=1.02)
plt.show()
```



[72]:

```
plt.figure(figsize=(8, 6))
sns.boxplot(x="Label", y="PM25", data=df)
plt.title("PM2.5 Distribution Across Wellbeing Scores")
plt.xlabel("Wellbeing Score (1-5)")
plt.ylabel("PM2.5 (µg/m³)")
plt.show()
```


PM2.5 Distribution Across Wellbeing Scores
PM2.5 (µg/m³)
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
Wellbeing Score (1–5)

[ ]: