```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
```

```
df = pd.read_csv("/content/drive/MyDrive/Metro_Interstate_Traffic_Volume.csv", parse_dates=["date_time"])
```

```
print("Rows, Cols:", df.shape)
display(df.head())
print(df.info())
display(df.describe(include='all'))
```

```
Rows, Cols: (48204, 9)
```

	holiday	temp	rain_1h	snow_1h	clouds_all	weather_main	weather_description	date_time	traffic_volume
0	NaN	288.28	0.0	0.0	40	Clouds	scattered clouds	2012-10-02 09:00:00	5545
1	NaN	289.36	0.0	0.0	75	Clouds	broken clouds	2012-10-02 10:00:00	4516
2	NaN	289.58	0.0	0.0	90	Clouds	overcast clouds	2012-10-02 11:00:00	4767
3	NaN	290.13	0.0	0.0	90	Clouds	overcast clouds	2012-10-02 12:00:00	5026
4	NaN	291.14	0.0	0.0	75	Clouds	broken clouds	2012-10-02 13:00:00	4918

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 48204 entries, 0 to 48203
Data columns (total 9 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   holiday              61 non-null     object
 1   temp                 48204 non-null  float64
 2   rain_1h              48204 non-null  float64
 3   snow_1h              48204 non-null  float64
 4   clouds_all           48204 non-null  int64
 5   weather_main         48204 non-null  object
 6   weather_description  48204 non-null  object
 7   date_time            48204 non-null  datetime64[ns]
 8   traffic_volume       48204 non-null  int64
dtypes: datetime64[ns](1), float64(3), int64(2), object(3)
memory usage: 3.3+ MB
None
```

	holiday	temp	rain_1h	snow_1h	clouds_all	weather_main	weather_description	date_time	traffic_volume
count	61	48204.000000	48204.000000	48204.000000	48204.000000	48204	48204	48204	48204.000000
unique	11	NaN	NaN	NaN	NaN	11	38	NaN	NaN
top	Labor Day	NaN	NaN	NaN	NaN	Clouds	sky is clear	NaN	NaN
freq	7	NaN	NaN	NaN	NaN	15164	11665	NaN	NaN
mean	NaN	281.205870	0.334264	0.000222	49.362231	NaN	NaN	2016-01-05 10:46:16.773711616	3259.818355
min	NaN	0.000000	0.000000	0.000000	0.000000	NaN	NaN	2012-10-02 09:00:00	0.000000
25%	NaN	272.160000	0.000000	0.000000	1.000000	NaN	NaN	2014-02-06 11:45:00	1193.000000
50%	NaN	282.450000	0.000000	0.000000	64.000000	NaN	NaN	2016-06-11 03:30:00	3380.000000
75%	NaN	291.806000	0.000000	0.000000	90.000000	NaN	NaN	2017-08-11 06:00:00	4933.000000
max	NaN	310.070000	9831.300000	0.510000	100.000000	NaN	NaN	2018-09-30 23:00:00	7280.000000
std	NaN	13.338232	44.789133	0.008168	39.015750	NaN	NaN	NaN	1986.860670

Non-Graphical EDA

```
tv = df["traffic_volume"].dropna()

mean_tv = tv.mean()
median_tv = tv.median()
mode_tv = tv.mode().iloc[0] if not tv.mode().empty else np.nan
std_tv = tv.std()
min_tv = tv.min()
max_tv = tv.max()
range_tv = max_tv - min_tv
skew_tv = tv.skew()
kurt_tv = tv.kurtosis()

print(f"Mean: {mean_tv:.2f}")
print(f"Median: {median_tv:.2f}")
print(f"Mode: {mode_tv}")
print(f"Std: {std_tv:.2f}")
print(f"Range: {range_tv}")
print(f"Skewness: {skew_tv:.3f}")
print(f"Kurtosis (excess): {kurt_tv:.3f}")
```

```
Mean: 3259.82
Median: 3380.00
Mode: 353
Std: 1986.86
Range: 7280
Skewness: -0.089
Kurtosis (excess): -1.309
```

إذا كان الوسيط اكبر من المتوسط هذا يشير إلى توزيع منحرف لليسار.

الفرق بين الوسيط والمتوسط يدل على وجود قيم متطرفة تؤثر على المتوسط.

```
group_weather = df.groupby("weather_main")["traffic_volume"].agg(["mean","std","count"]).sort_values("mean", ascending=False)
display(group_weather)
```

weather_main	mean	std	count
Clouds	3618.449749	1906.202879	15164
Haze	3502.101471	1873.511057	1360
Rain	3317.905501	1982.228705	5672
Drizzle	3290.727073	1997.901830	1821
Smoke	3237.650000	1978.015893	20
Clear	3055.908819	1987.101411	13391
Snow	3016.844228	1900.185883	2876
Thunderstorm	3001.620890	1988.296012	1034
Mist	2932.956639	2073.025670	5950
Fog	2703.720395	2125.525863	912
Squall	2061.750000	1950.070490	4

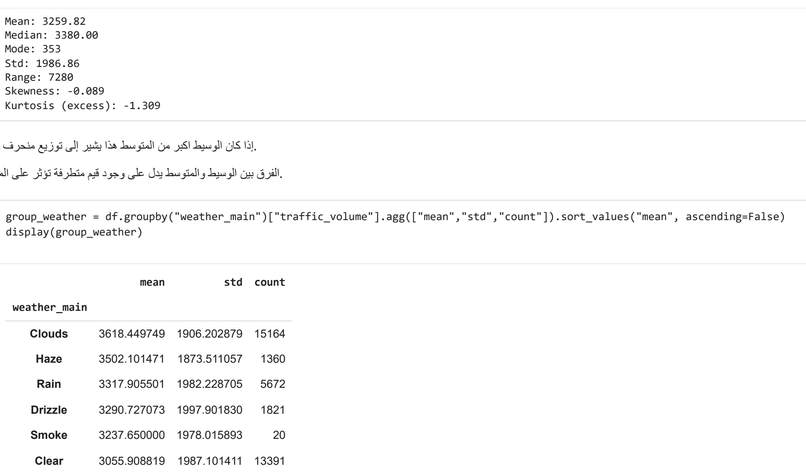
Task C: Multivariate Analysis via Grouping

The weather condition associated with the highest average traffic is Clouds.

The road condition with the highest variance is Thunderstorm.

Graphical EDA

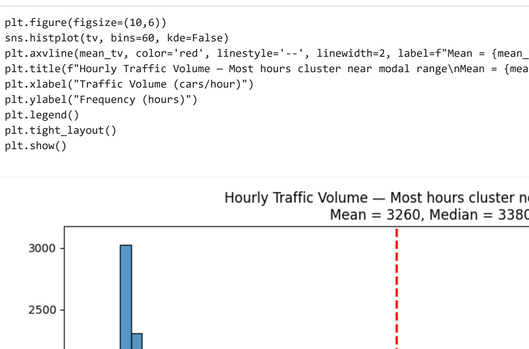
```
plt.figure(figsize=(10,6))
sns.histplot(tv, bins=60, kde=False)
plt.axvline(mean_tv, color='red', linestyle='--', linewidth=2, label=f"Mean = {mean_tv:.0f}")
plt.title(f"Hourly Traffic Volume – Most hours cluster near modal range\nMean = {mean_tv:.0f}, Median = {median_tv:.0f}")
plt.xlabel("Traffic Volume (cars/hour)")
plt.ylabel("Frequency (hours)")
plt.legend()
plt.tight_layout()
plt.show()
```



B. Box plot and calculating IQR

```
plt.figure(figsize=(8,4))
sns.boxplot(x=tv)
plt.title("Box plot of traffic_volume")
plt.xlabel("Traffic Volume (cars/hour)")
plt.show()

# حساب IQR
Q1 = tv.quantile(0.25)
Q3 = tv.quantile(0.75)
IQR = Q3 - Q1
print(f"Q1={Q1}, Q3={Q3}, IQR={IQR}")
```




```
Q1=1193.0, Q3=4933.0, IQR=3740.0
```

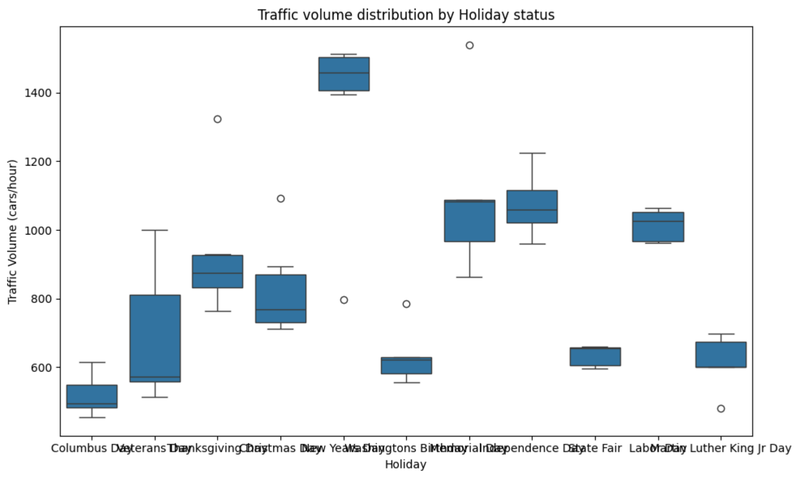
.Interquartile range (IQR) measures the variation in the middle of the distribution (the middle 50% of the data)

.The IQR is smaller than the overall range, indicating that outliers increase the overall variance.

C. Grouped box plots by holiday (Comparison of holidays vs regular days)

```
plt.figure(figsize=(10,6))
sns.boxplot(x="holiday", y="traffic_volume", data=df)
plt.title("Traffic volume distribution by Holiday status")
```

```
plt.xlabel("Holiday")
plt.ylabel("Traffic Volume (cars/hour)")
plt.tight_layout()
plt.show()
```



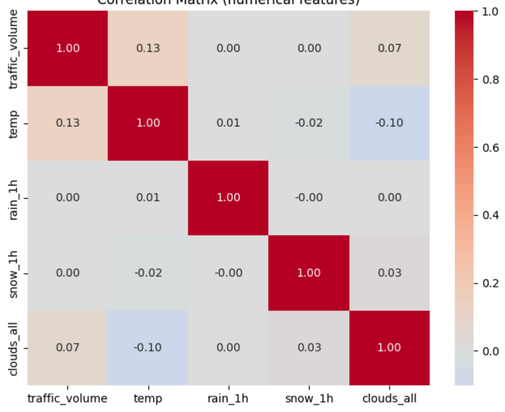
Note:

.Yes, there is a big difference in distribution between regular days and holidays.

.Ordinary days have a higher mean and lower variance compared to holidays

Correlation Matrix and Heatmap

```
num_cols = ["traffic_volume","temp","rain_1h","snow_1h","clouds_all"]
corr = df[num_cols].corr()
plt.figure(figsize=(8,6))
sns.heatmap(corr, annot=True, fmt=".2f", cmap="coolwarm", center=0)
plt.title("Correlation Matrix (numerical features)")
plt.show()
```



Task A: Correlation Matrix and Heatmap

1_In the summer (high heat), people may reduce driving during the hot peak hours.

2_The causality paradox:

.People are on vacation and may travel out of town. .Using alternative means of transportation: In good weather, people may prefer walking or cycling.

.Peak hours: traffic is usually higher in the morning and evening when the temperature is moderate.

```
import plotly.express as px
fig = px.scatter(df.sample(5000, random_state=1), x="temp", y="traffic_volume",
                 hover_data=["weather_description","date_time","holiday"],
                 title="Traffic Volume vs Temperature (sampled points)")
fig.update_layout(xaxis_title="Temp (Kelvin)", yaxis_title="Traffic Volume (cars/hour)")
fig.show()
```