dataengineeranalytics-task1

September 29, 2024

Step:1 Import Libraries

[17]:
```
import pandas as pd                          # For data manipulation and analysis
import mysql.connector                       # For connecting to MySQL database
from mysql.connector import Error            # For handling MySQL errors
import matplotlib.pyplot as plt              # For visualizations
import seaborn as sns                        # For advanced data visualization
from datetime import timedelta               # For manipulating time data
```

Step:2 Create Conncection With Mysql Database

[18]:
```
def create_connection():
    try:
        # Establish a connection to the MySQL database
        connection = mysql.connector.connect(
            host='host',  # Database host
            database='database_name',  # Database name
            user='username',       # Database user
            password='password'    # Database password
        )
        # Check if the connection is successful
        if connection.is_connected():
            return connection
    except Error as e:
        # Print any error that occurs during the connection attempt
        print(f"Error: {e}")
    # Return None if the connection was not successful
    return None
```

Step:3 Create Flights Table In Database

[19]:
```
def create_flights_table(connection):
    cursor = connection.cursor()

    # Drop the flights table if it already exists
    cursor.execute('DROP TABLE IF EXISTS flights')

    # Create a new flights table with the specified columns
    cursor.execute('''
```

```
    CREATE TABLE flights (
        id INT AUTO_INCREMENT PRIMARY KEY,  # Primary key with auto-increment
        FlightNumber VARCHAR(10),  # Flight number
        DepartureDateTime DATETIME,  # Departure date and time
        ArrivalDateTime DATETIME,  # Arrival date and time
        Airline VARCHAR(50),  # Airline name
        DelayMinutes INT,  # Delay in minutes
        FlightDuration INT,  # Flight duration in minutes
        DayOfWeek VARCHAR(10)  # Day of the week
    )
    ''')

    # Commit the transaction to save changes
    connection.commit()
```

Step:4 Clean And Normalize Data

[20]:
```
def clean_and_normalize_data(df):
    # Convert date and time columns
    df['DepartureDateTime'] = pd.to_datetime(df['DepartureDate'] + ' ' +␣
 ↪df['DepartureTime'])
    df['ArrivalDateTime'] = pd.to_datetime(df['ArrivalDate'] + ' ' +␣
 ↪df['ArrivalTime'])

    # Remove duplicate entries
    df = df.drop_duplicates()

    # Handle missing values in DelayMinutes with mean
    df['DelayMinutes'] = df['DelayMinutes'].fillna(df['DelayMinutes'].mean())

    #df['DelayMinutes'] = df['DelayMinutes'].fillna(0)


    # Calculate flight duration
    df['FlightDuration'] = (df['ArrivalDateTime'] - df['DepartureDateTime']).dt.
 ↪total_seconds() / 60

    # Correct inconsistent time entries
    mask = df['ArrivalDateTime'] <= df['DepartureDateTime']
    df.loc[mask, 'ArrivalDateTime'] += timedelta(days=1)
    df['FlightDuration'] = (df['ArrivalDateTime'] - df['DepartureDateTime']).dt.
 ↪total_seconds() / 60

    # Add day of week
    df['DayOfWeek'] = df['DepartureDateTime'].dt.day_name()
```

```
    return df[['FlightNumber', 'DepartureDateTime', 'ArrivalDateTime',␣
↪'Airline', 'DelayMinutes', 'FlightDuration', 'DayOfWeek']]
```

Step:5 Insert Data Into Database Table

[21]:
```
def insert_data(connection, df):
    cursor = connection.cursor()
    for _, row in df.iterrows():
        cursor.execute('''
        INSERT INTO flights (FlightNumber, DepartureDateTime, ArrivalDateTime,␣
↪Airline, DelayMinutes, FlightDuration, DayOfWeek)
        VALUES (%s, %s, %s, %s, %s, %s, %s)
        ''', tuple(row))
    connection.commit()
```

Step:6 Key Insights From Analysis

[22]:
```
def analyze_delays(df):
    ␣
↪print("=================================================================================")
    print("Key Insights :")
    ␣
↪print("=================================================================================")
    print("1. Average delay by airline:")
    airline_delays = df.groupby('Airline')['DelayMinutes'].mean().
↪sort_values(ascending=False)
    print(airline_delays)
    ␣
↪print("=================================================================================")
    print("\n2. Correlation between departure time and delay:")
    df['DepartureHour'] = df['DepartureDateTime'].dt.hour
    correlation = df['DepartureHour'].corr(df['DelayMinutes'])
    print(f"Correlation coefficient: {correlation:.2f}")
    ␣
↪print("=================================================================================")
    print("\n3. Average delay by day of week:")
    day_delays = df.groupby('DayOfWeek')['DelayMinutes'].mean().
↪sort_values(ascending=False)
    print(day_delays)
    ␣
↪print("=================================================================================")
    print("\n4. Flights with longest delays (top 5):")
    long_delays = df.nlargest(5, 'DelayMinutes')[['FlightNumber', 'Airline',␣
↪'DelayMinutes']]
    print(long_delays)
    ␣
↪print("=================================================================================")
```

```
    print("\n5. Airlines with most frequent delays (>15 minutes):")
    frequent_delays = df[df['DelayMinutes'] > 15]['Airline'].value_counts()
    print(frequent_delays)
    ␣
↪print("================================================================================")
    print("\n6. Average flight duration by airline:")
    avg_duration = df.groupby('Airline')['FlightDuration'].mean().
↪sort_values(ascending=False)
    print(avg_duration)
    ␣
↪print("================================================================================")
```

Step:7 Visualize Delay Analysis

[23]:
```
def visualize_delays(df):
    # Barplot: Average Delay by Airline
    plt.figure(figsize=(12, 6))
    sns.barplot(x='Airline', y='DelayMinutes', data=df)
    plt.title('Average Delay by Airline')
    plt.ylabel('Delay (minutes)')
    plt.xticks(rotation=45)
    plt.tight_layout()
    plt.savefig('average_delay_by_airline.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying

    # Histogram: Delay Distribution
    plt.figure(figsize=(12, 6))
    sns.histplot(data=df, x='DelayMinutes', bins=20, kde=True)
    plt.title('Delay Distribution')
    plt.xlabel('Delay (minutes)')
    plt.ylabel('Frequency')
    plt.tight_layout()
    plt.savefig('delay_distribution.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying

    # Boxplot: Delay Distribution by Day of Week
    plt.figure(figsize=(12, 6))
    sns.boxplot(x='DayOfWeek', y='DelayMinutes', data=df)
    plt.title('Delay Distribution by Day of Week')
    plt.ylabel('Delay (minutes)')
    plt.xticks(rotation=45)
    plt.tight_layout()
    plt.savefig('delay_by_day_of_week.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying
```

```
    # Scatterplot: Delay vs Departure Hour
    plt.figure(figsize=(12, 6))
    sns.scatterplot(x='DepartureHour', y='DelayMinutes', data=df, hue='Airline')
    plt.title('Delay vs Departure Hour')
    plt.xlabel('Departure Hour')
    plt.ylabel('Delay (minutes)')
    plt.tight_layout()
    plt.savefig('delay_vs_departure_hour.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying

    #Plot Graph for Flight Number And Their Max Delays after flitering max␣
↪delay from delayminutes
    plt.figure(figsize=(12, 6))
    df1 = df.groupby('FlightNumber')['DelayMinutes'].max().nlargest(10)
    df1.plot(kind='bar')
    plt.title('Flight Number And Their Max Delays')
    plt.xlabel('Flight Number')
    plt.ylabel('Max Delay (minutes)')
    plt.tight_layout()
    plt.savefig('flight_number_max_delays.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying

    #Plot Pie Chart Airlines with Most Frequent Delays >15 minutes
    plt.figure(figsize=(12, 6))
    df2 = df[df['DelayMinutes'] > 15]['Airline'].value_counts()
    df2.plot(kind='pie', autopct='%1.1f%%')
    plt.title('Airlines with Most Frequent Delays (>15 minutes)')
    plt.tight_layout()
    plt.savefig('airlines_most_frequent_delays.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying

    #Plot Graph Average Flight Duration by Airline
    plt.figure(figsize=(12, 6))
    df3 = df.groupby('Airline')['FlightDuration'].mean().
↪sort_values(ascending=False)
    df3.plot(kind='bar')
    plt.title('Average Flight Duration by Airline')
    plt.xlabel('Airline')
    plt.ylabel('Average Flight Duration (minutes)')
    plt.tight_layout()
    plt.savefig('average_flight_duration_by_airline.png')  # Save before show
    plt.show()  # Display the plot
    plt.close()  # Close after displaying
```

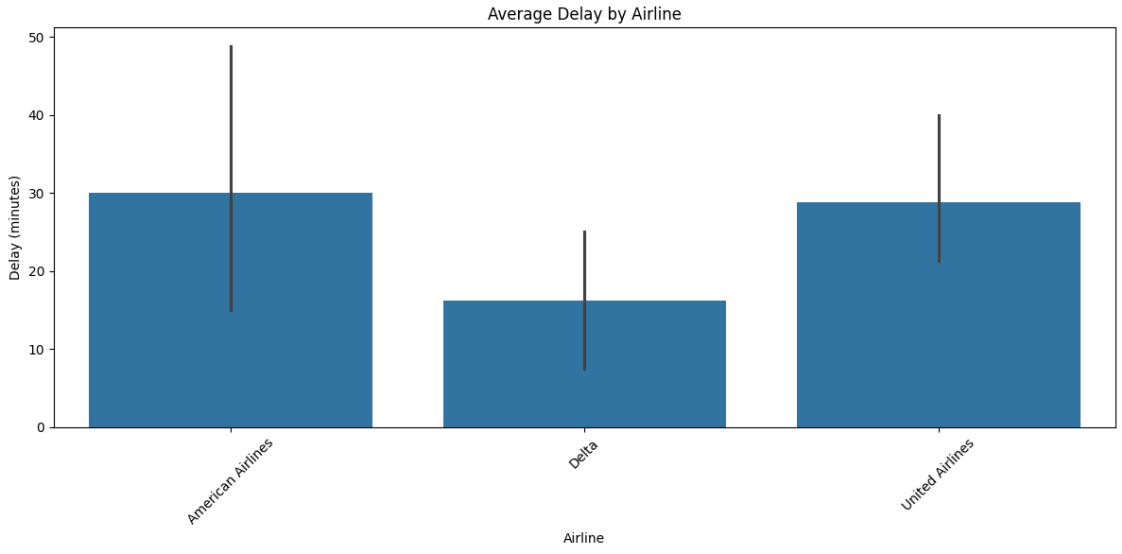
Step:8 Calling All The Functions From Main()

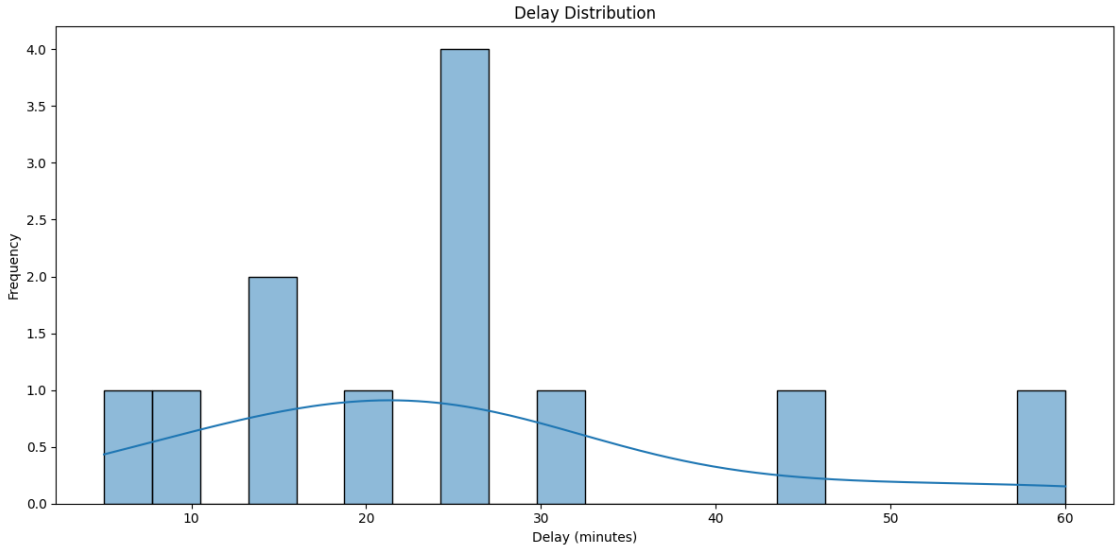
[24]:
```
def main():
    # Read CSV file
    df = pd.read_csv('aviation_data.csv')

    # Get a summary of the CSV data
    summary = df.describe(include='all')
    print(summary)

    # Clean and normalize data
    cleaned_df = clean_and_normalize_data(df)

    # Export cleaned dataset as CSV
    cleaned_df.to_csv('cleaned_aviation_data.csv', index=False)
    print("Cleaned dataset exported as 'cleaned_aviation_data.csv'")

    # Create MySQL connection
    connection = create_connection()
    if connection is None:
        return

    # Create flights table
    create_flights_table(connection)

    # Insert data into MySQL
    insert_data(connection, cleaned_df)

    # Perform data analysis
    analyze_delays(cleaned_df)

    # Create visualizations
    visualize_delays(cleaned_df)

    # Close MySQL connection
    connection.close()

    print("Data processing and analysis complete. Visualizations saved as PNG␣
 ↪files.")

if __name__ == "__main__":
    main()
```

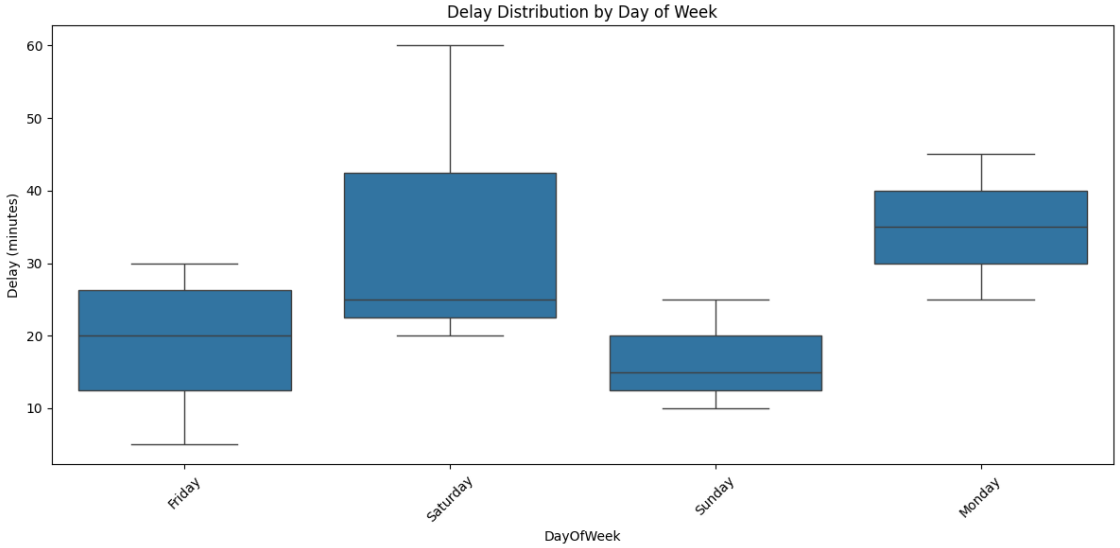
```
       FlightNumber DepartureDate DepartureTime ArrivalDate ArrivalTime  \
count            12            12            12          12          12
unique            3             4             9           4           9
top          AA1234    09/01/2023      08:30 AM  09/01/2023    10:45 AM
freq              4             4             3           4           2
```

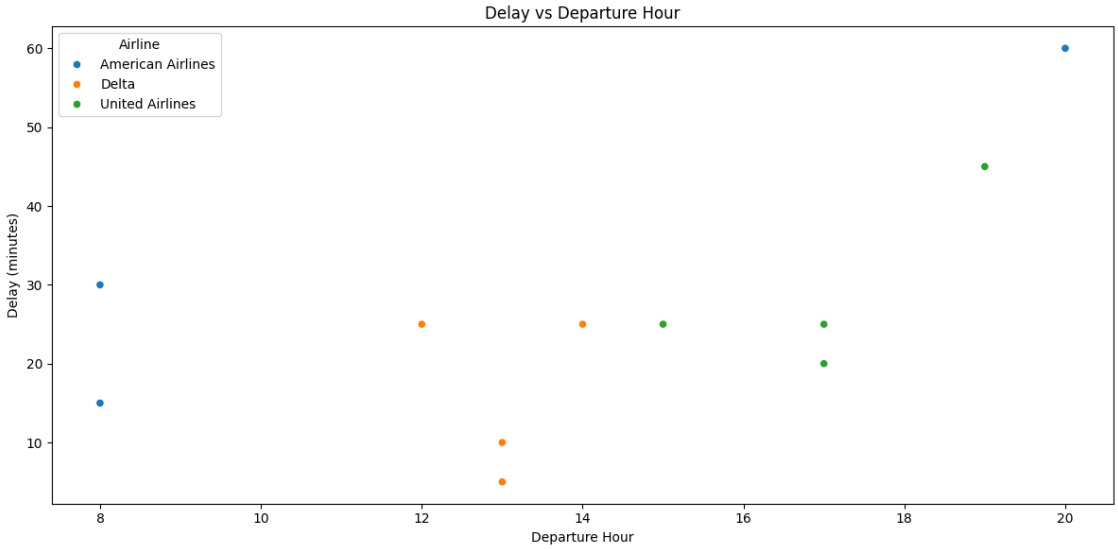
```
mean             NaN           NaN           NaN         NaN         NaN
std              NaN           NaN           NaN         NaN         NaN
min              NaN           NaN           NaN         NaN         NaN
25%              NaN           NaN           NaN         NaN         NaN
50%              NaN           NaN           NaN         NaN         NaN
75%              NaN           NaN           NaN         NaN         NaN
max              NaN           NaN           NaN         NaN         NaN

                  Airline  DelayMinutes
count                  12     10.000000
unique                  3           NaN
top     American Airlines           NaN
freq                    4           NaN
mean                  NaN     25.000000
std                   NaN     16.666667
min                   NaN      5.000000
25%                   NaN     15.000000
50%                   NaN     22.500000
75%                   NaN     28.750000
max                   NaN     60.000000
Cleaned dataset exported as 'cleaned_aviation_data.csv'
================================================================================
===
Key Insights :
================================================================================
===
1. Average delay by airline:
Airline
American Airlines    30.00
United Airlines      28.75
Delta                16.25
Name: DelayMinutes, dtype: float64
================================================================================
===

2. Correlation between departure time and delay:
Correlation coefficient: 0.61
================================================================================
===

3. Average delay by day of week:
DayOfWeek
Monday      35.000000
Saturday    35.000000
Friday      18.750000
Sunday      16.666667
Name: DelayMinutes, dtype: float64
================================================================================
```

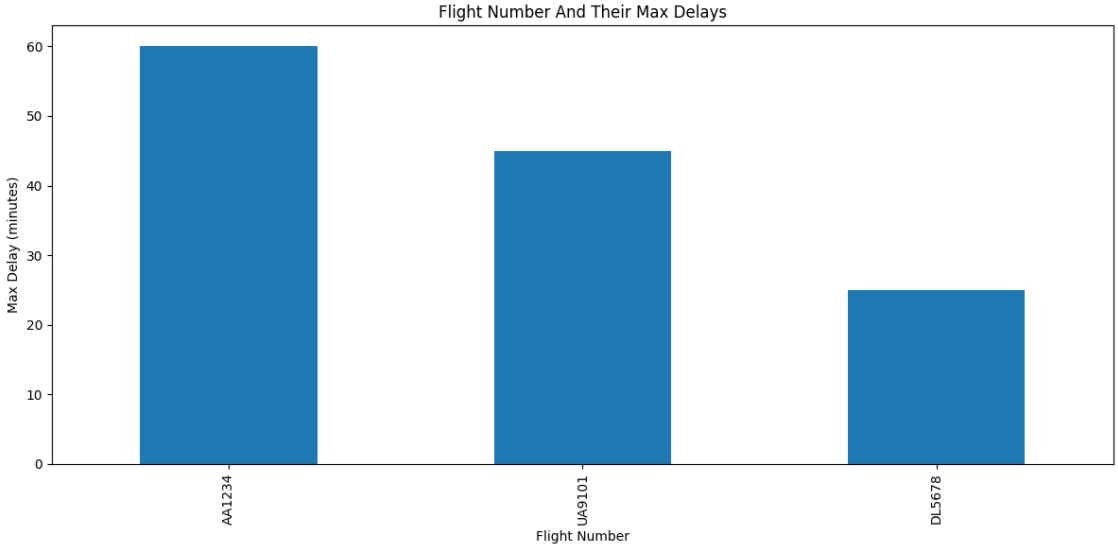
```
===

4. Flights with longest delays (top 5):
   FlightNumber            Airline  DelayMinutes
6        AA1234  American Airlines          60.0
11       UA9101    United Airlines          45.0
3        AA1234  American Airlines          30.0
2        UA9101    United Airlines          25.0
4        DL5678              Delta          25.0
================================================================================
===

5. Airlines with most frequent delays (>15 minutes):
Airline
United Airlines      4
American Airlines    2
Delta                2
Name: count, dtype: int64
================================================================================
===

6. Average flight duration by airline:
Airline
American Airlines    483.75
Delta                136.25
United Airlines      136.25
Name: FlightDuration, dtype: float64
================================================================================
===
```

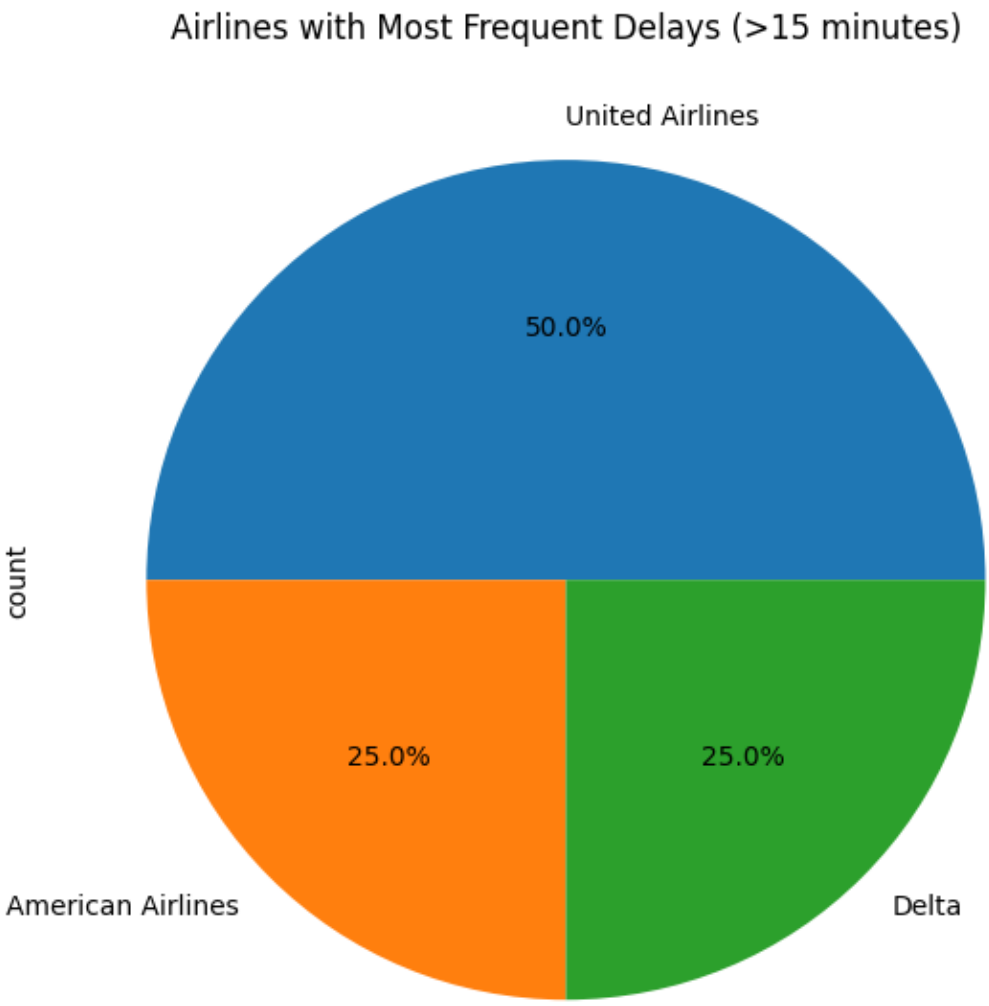


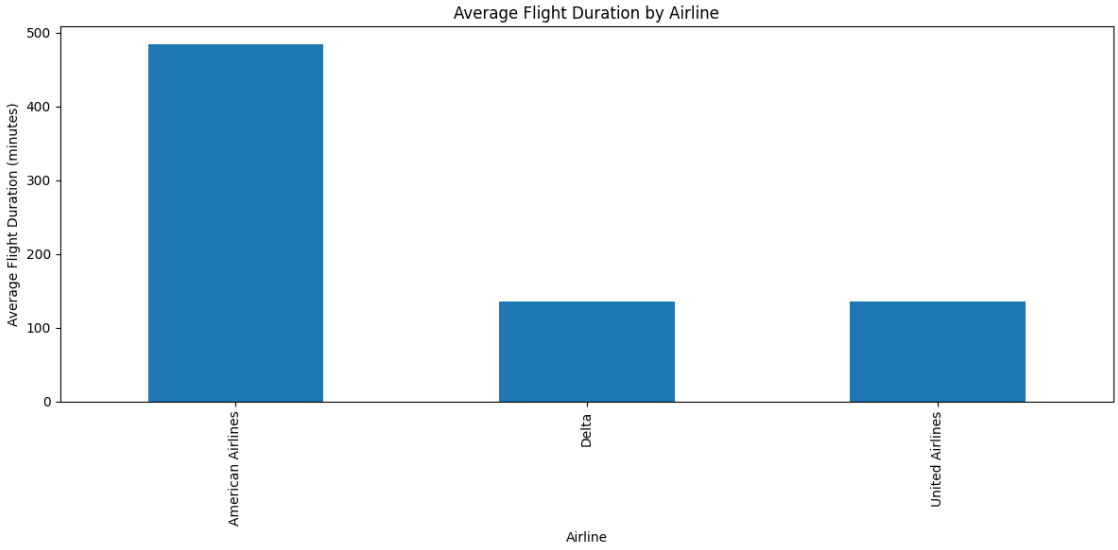

Delay Distribution
Frequency
Delay (minutes)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
10
20
30
40
50
60


Delay Distribution by Day of Week
Delay (minutes)
DayOfWeek
10
20
30
40
50
60
Friday
Saturday
Sunday
Monday


Delay vs Departure Hour
Airline
American Airlines
Delta
United Airlines
Delay (minutes)
Departure Hour
60
50
40
30
20
10
8
10
12
14
16
18
20


Flight Number And Their Max Delays
Max Delay (minutes)
Flight Number
60
50
40
30
20
10
0
AA1234
UA9101
DL5678


Airlines with Most Frequent Delays (>15 minutes)
United Airlines
50.0%
count
25.0%
25.0%
American Airlines
Delta




```
Data processing and analysis complete. Visualizations saved as PNG files.
```