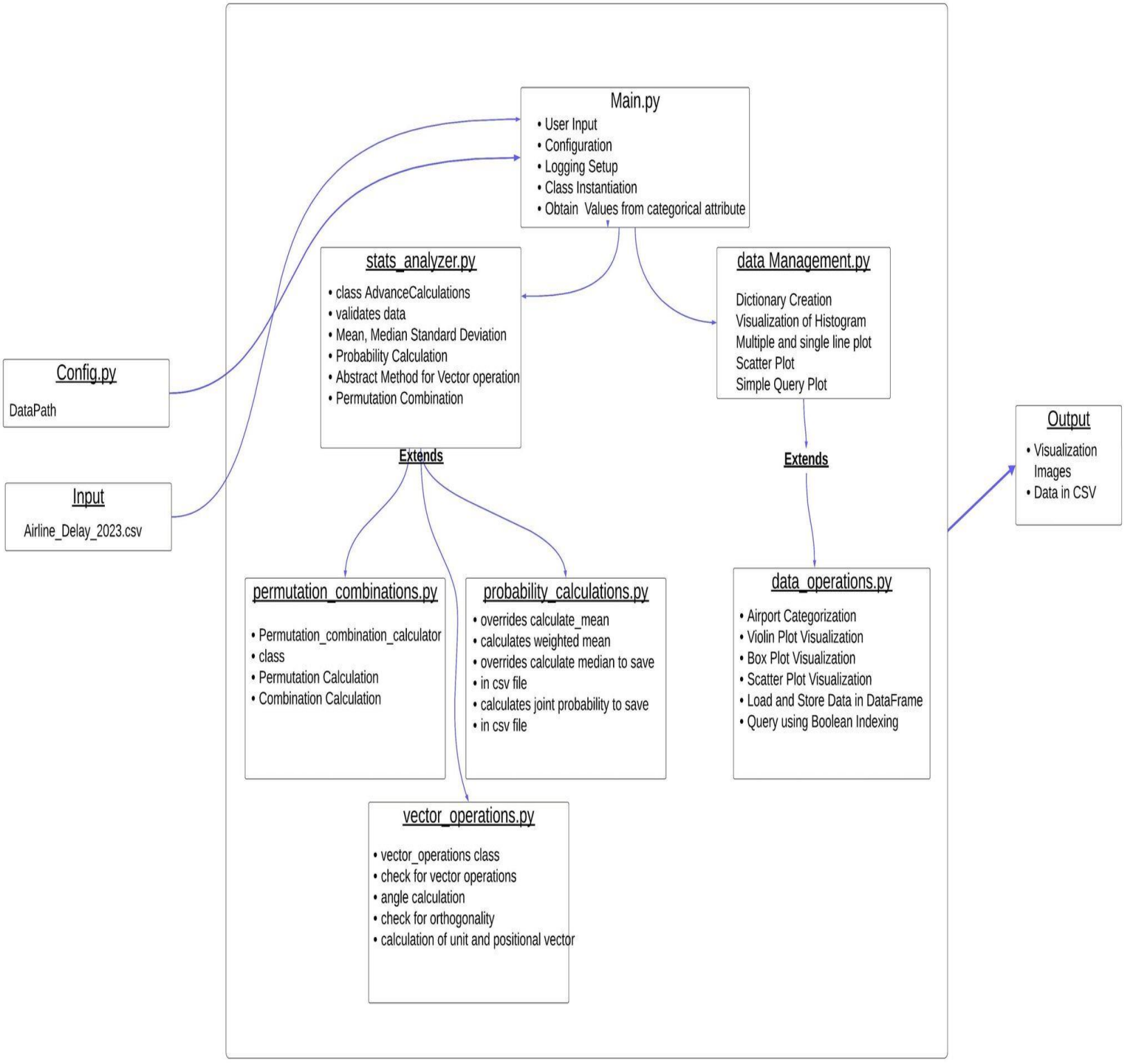
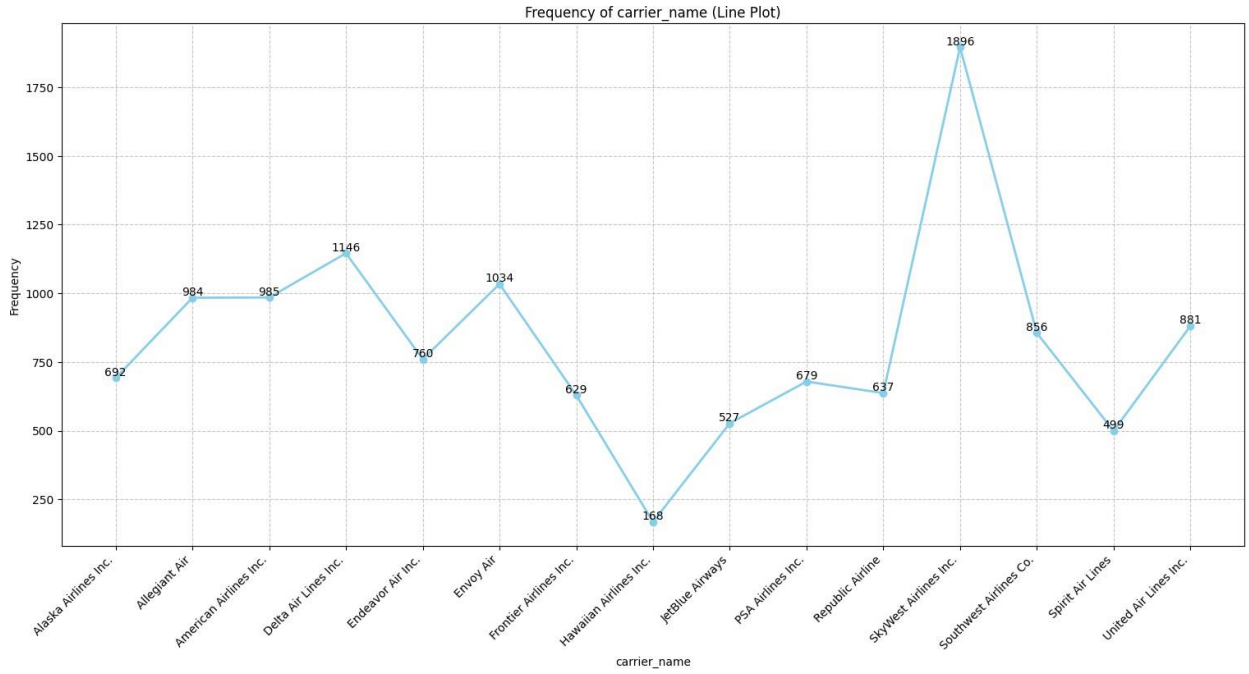
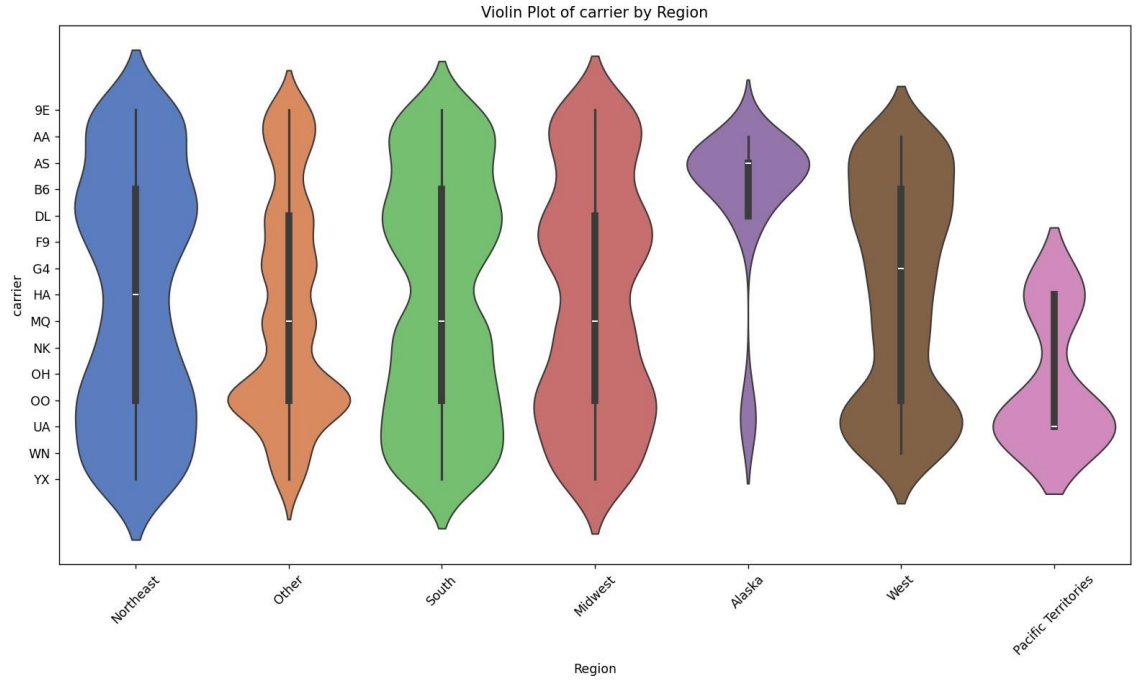
# PA3 METADATA

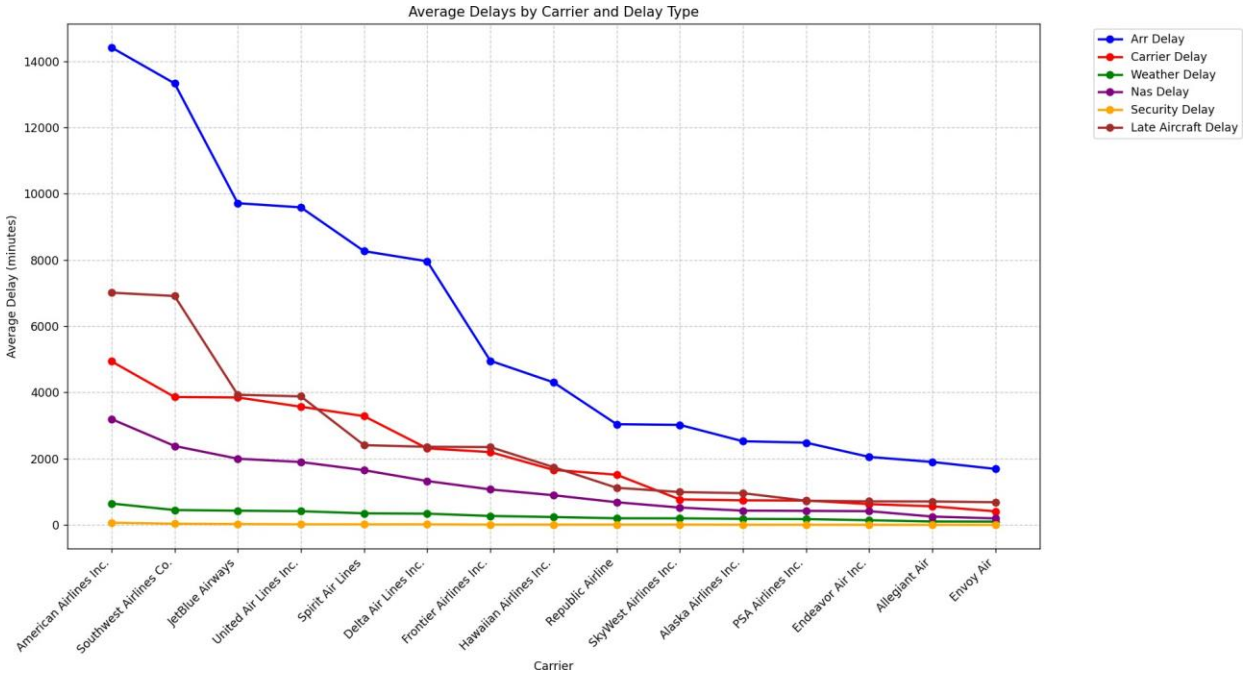
## Module Communication Flow Diagram

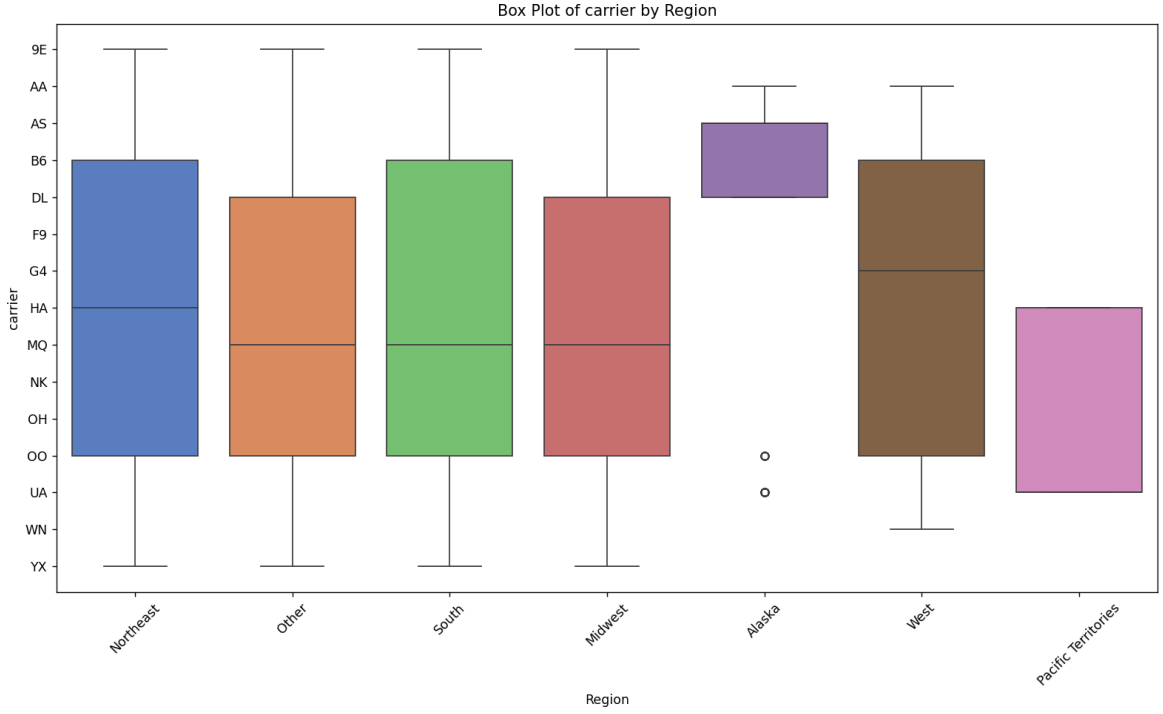


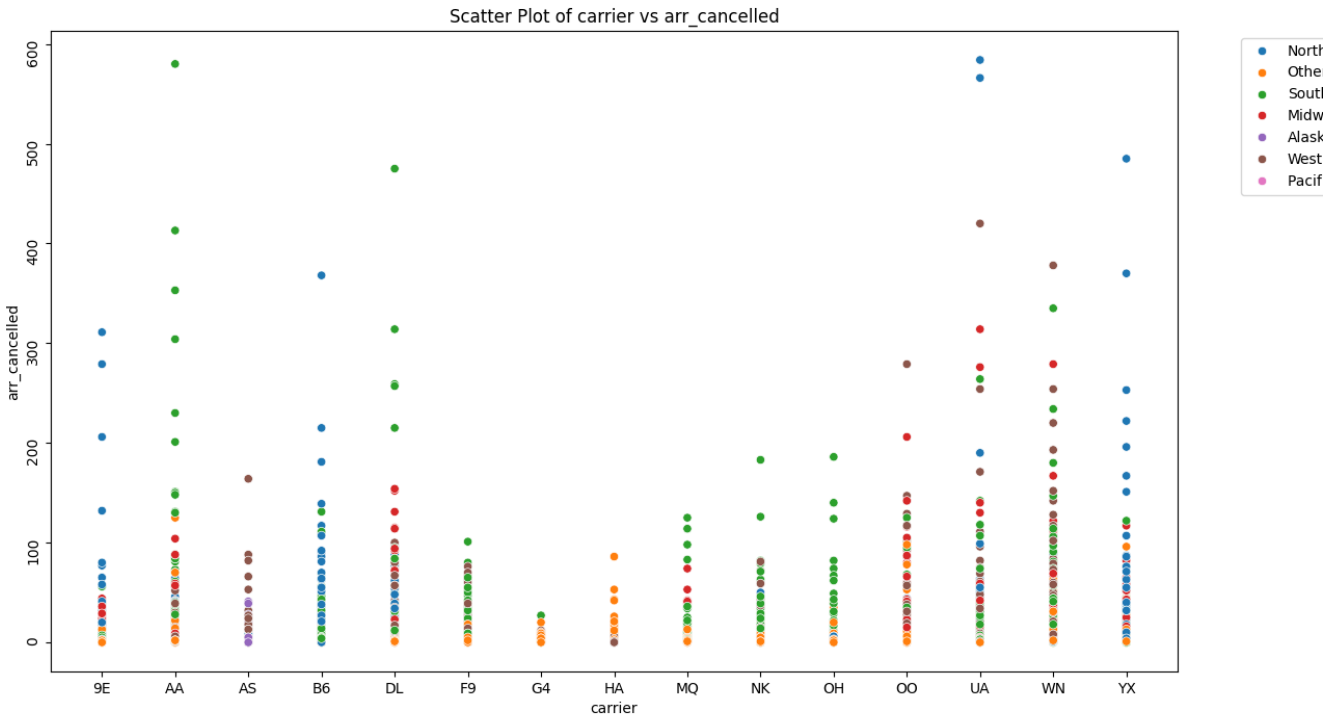
# Output images

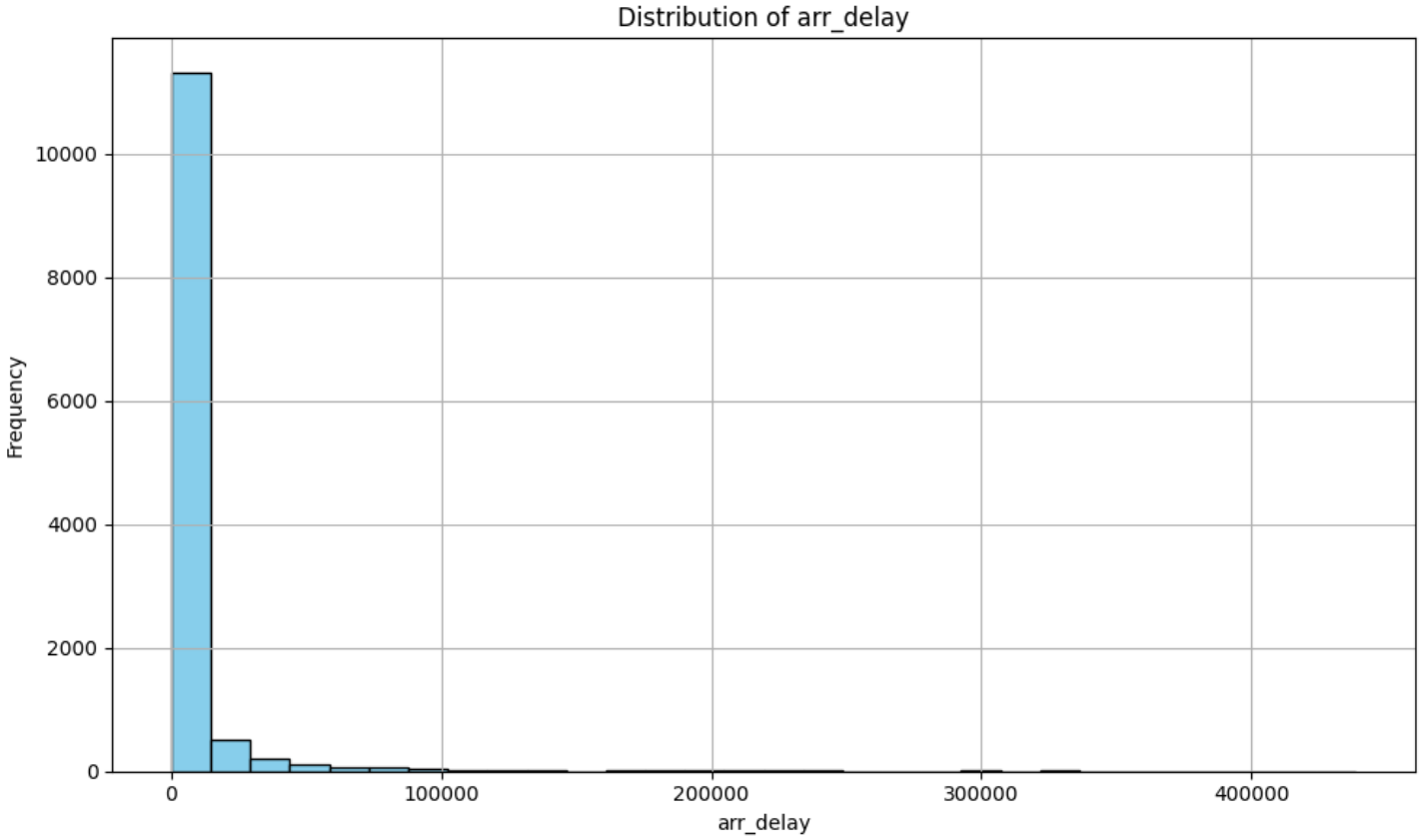



Average Delays by Carrier and Delay Type
Arr Delay
Carrier Delay
Weather Delay
Nas Delay
Security Delay
Late Aircraft Delay
Average Delay (minutes)
0
2000
4000
6000
8000
10000
12000
14000
American Airlines Inc.
Southwest Airlines Co.
JetBlue Airways
United Air Lines Inc.
Spirit Air Lines
Delta Air Lines Inc.
Frontier Airlines Inc.
Hawaiian Airlines Inc.
Republic Airline
SkyWest Airlines Inc.
Alaska Airlines Inc.
PSA Airlines Inc.
Endeavor Air Inc.
Allegiant Air
Envoy Air
Carrier


Box Plot of carrier by Region
carrier
9E
AA
AS
B6
DL
F9
G4
HA
MQ
NK
OH
OO
UA
WN
YX
Northeast
Other
South
Midwest
Alaska
West
Pacific Territories
Region


Scatter Plot of carrier vs arr_cancelled
arr_cancelled
carrier
0
100
200
300
400
500
600
9E
AA
AS
B6
DL
F9
G4
HA
MQ
NK
OH
OO
UA
WN
YX
North
Othe
South
Midw
Alask
West
Pacif


Distribution of arr_delay
Frequency
arr_delay
0
2000
4000
6000
8000
10000
0
100000
200000
300000
400000

Output > permutation_n15_r2.csv

```
1   Calculation_Type,n,r,Result
2   permutation,15,2,210
3
```

Output > combination_n15_r2.csv

```
1   Calculation_Type,n,r,Result
2   combination,15,2,105
3
```

Output > arr_delay_arr_flights_vector_operations.csv

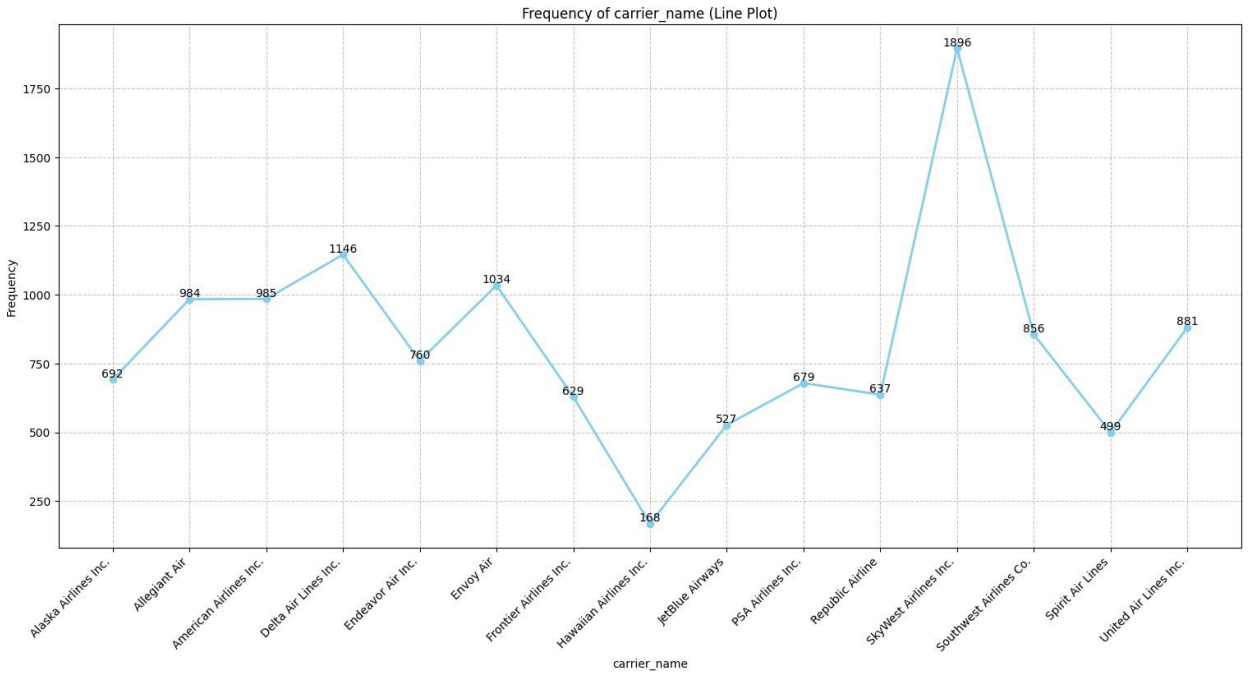
```
1   Operation,Result
2   Addition,[1464.  861.  828. ...    6. 1400.  853.]
3   Subtraction,[1286.  737.  704. ...   -6. 1294.  689.]
4   Dot Product,234380329537.0
5   Element-wise Multiplication,[122375.  49538.  47492. ...      0.  71391.  63222.]
6   Vector 1 Magnitude,2117283.7155043725
7   Vector 2 Magnitude,120117.33324545629
8   Angle (radians),0.39864664107656117
9   Angle (degrees),22.840770050753516
10  Orthogonal,False
11
```

```
Result saved to Output\carrier_arr_delay_joint_probability.csv
arr_delay  0.0       15.0      16.0      17.0      18.0      ...  335957.0  337375.0  376057.0  416577.0  438783.0
carrier                                                      ...
9E         0.004445  0.000000  0.000000  0.000081  0.000242  ...  0.000000  0.000000  0.000000  0.000000  0.000000
AA         0.000162  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000081  0.000081  0.000081  0.000081
AS         0.000727  0.000000  0.000000  0.000000  0.000081  ...  0.000000  0.000000  0.000000  0.000000  0.000000
B6         0.000162  0.000000  0.000000  0.000000  0.000081  ...  0.000000  0.000000  0.000000  0.000000  0.000000
DL         0.001131  0.000000  0.000081  0.000000  0.000162  ...  0.000081  0.000000  0.000000  0.000000  0.000000
F9         0.000647  0.000000  0.000000  0.000081  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
G4         0.002829  0.000081  0.000162  0.000000  0.000242  ...  0.000000  0.000000  0.000000  0.000000  0.000000
HA         0.000081  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
```

# Logs Records

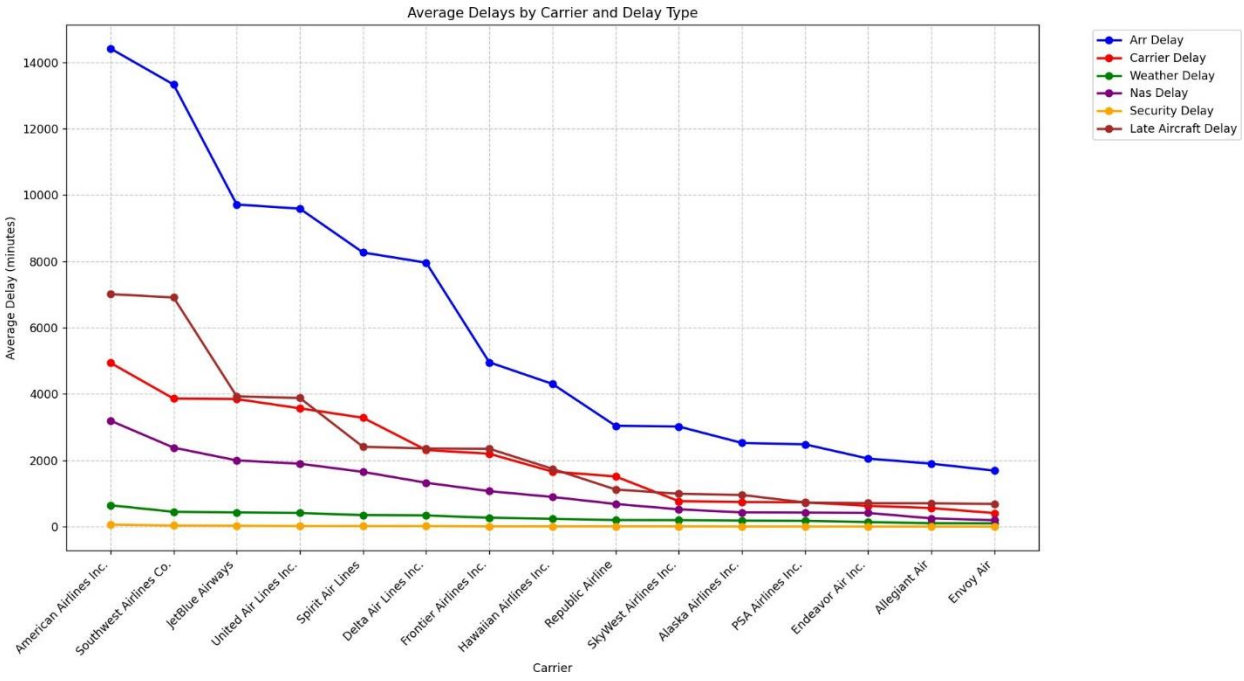
```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 1
Enter the column name for carrier frequencies (e.g., 'carrier_name'): carrier_name
```



```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 2
```



```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 3
Enter the carrier name: Envoy Air
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 3
Enter the carrier name: Envoy Air
The total number of recorded arrival delays for 'Envoy Air' is: 1022
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 4
Enter the column name to query (e.g., 'arr_delay'): arr_delay
Enter the condition and value (e.g., '> 10'):  > 10
```

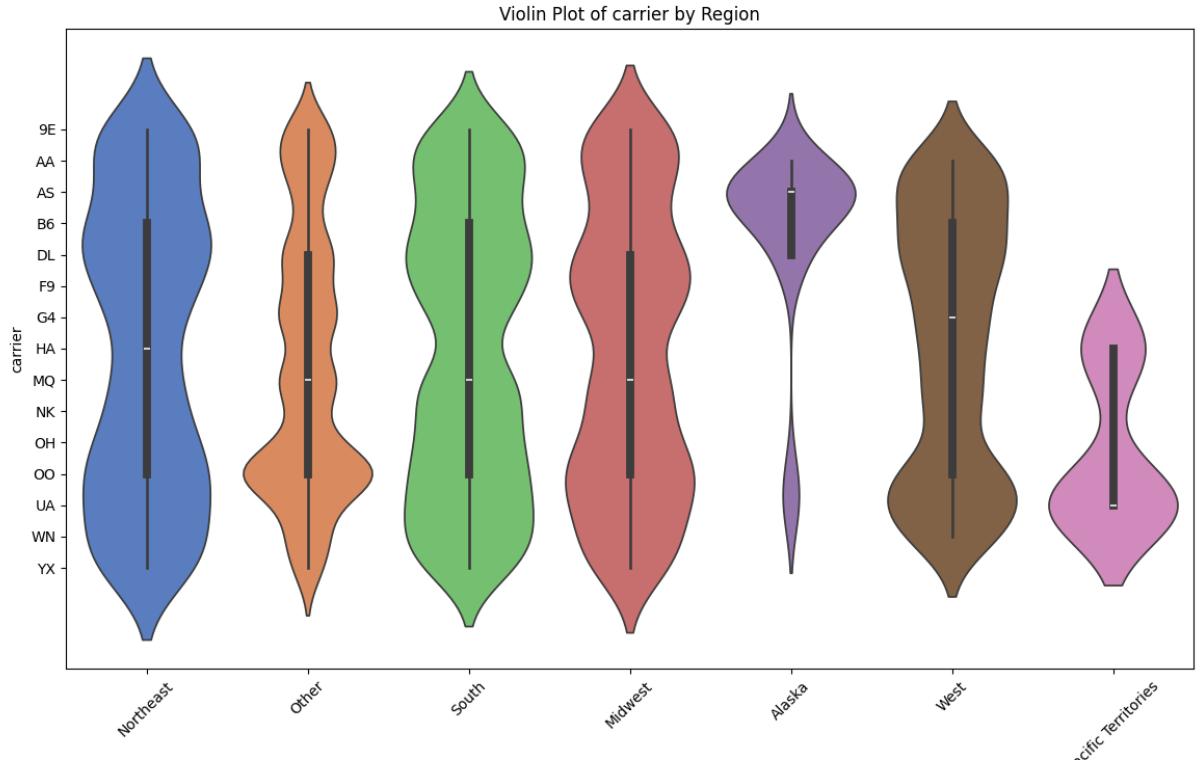
```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 4
Enter the column name to query (e.g., 'arr_delay'): arr_delay
Enter the condition and value (e.g., '> 10'):  > 10
Query returned 12045 rows.
       year  month carrier       carrier_name  ... weather_delay nas_delay  security_delay  late_aircraft_delay
0      2023      8      9E  Endeavor Air Inc.  ...         761.0     118.0             0.0                425.0
1      2023      8      9E  Endeavor Air Inc.  ...           1.0      62.0             0.0                518.0
2      2023      8      9E  Endeavor Air Inc.  ...         188.0      78.0             0.0                444.0
3      2023      8      9E  Endeavor Air Inc.  ...         320.0     388.0             0.0                218.0
4      2023      8      9E  Endeavor Air Inc.  ...           0.0     134.0             0.0                768.0
...     ...    ...     ...                ...  ...           ...       ...             ...                  ...
12367  2023      1      YX   Republic Airline  ...           0.0     421.0             0.0                 52.0
12368  2023      1      YX   Republic Airline  ...           0.0     704.0             0.0                813.0
12369  2023      1      YX   Republic Airline  ...         134.0     369.0             0.0                639.0
12371  2023      1      YX   Republic Airline  ...          50.0     292.0             0.0                926.0
12372  2023      1      YX   Republic Airline  ...           0.0     272.0             0.0                398.0

[12045 rows x 21 columns]
```

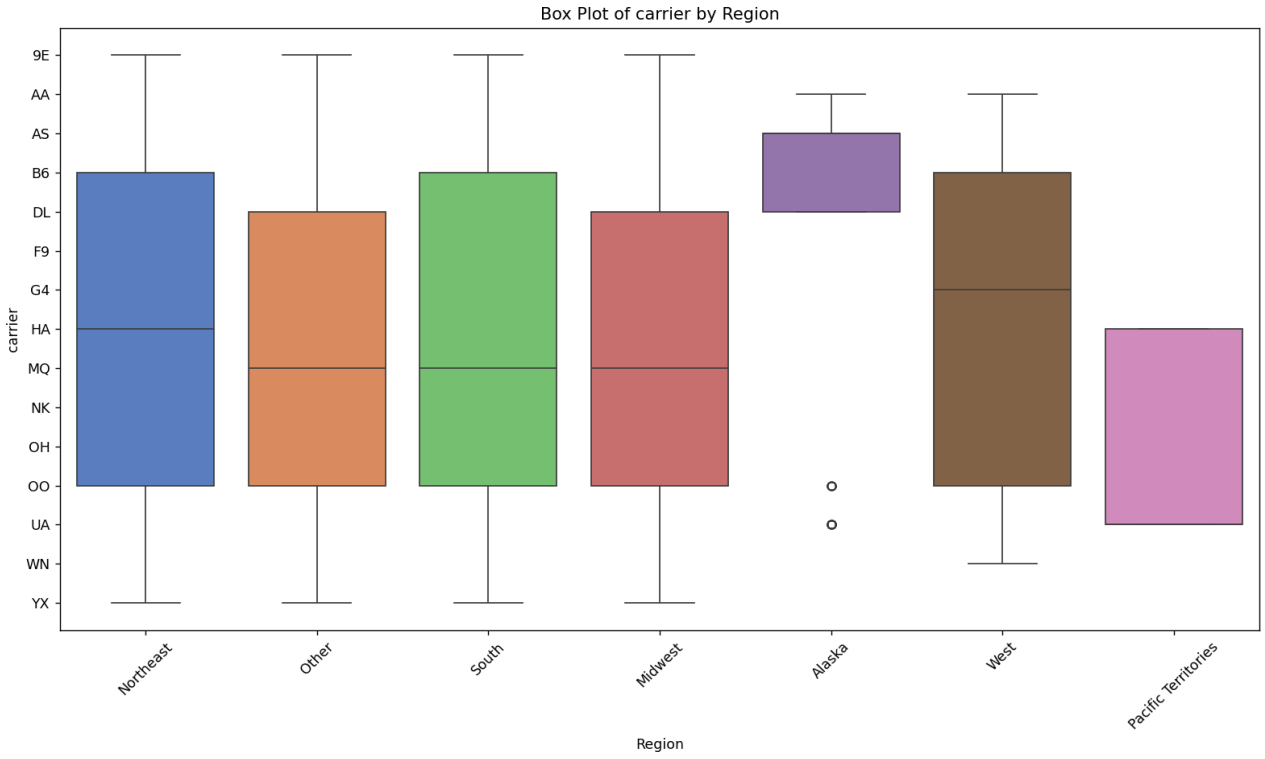
```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 5
Enter the column name for the violin plot (e.g., 'arr_delay'): carrier
```



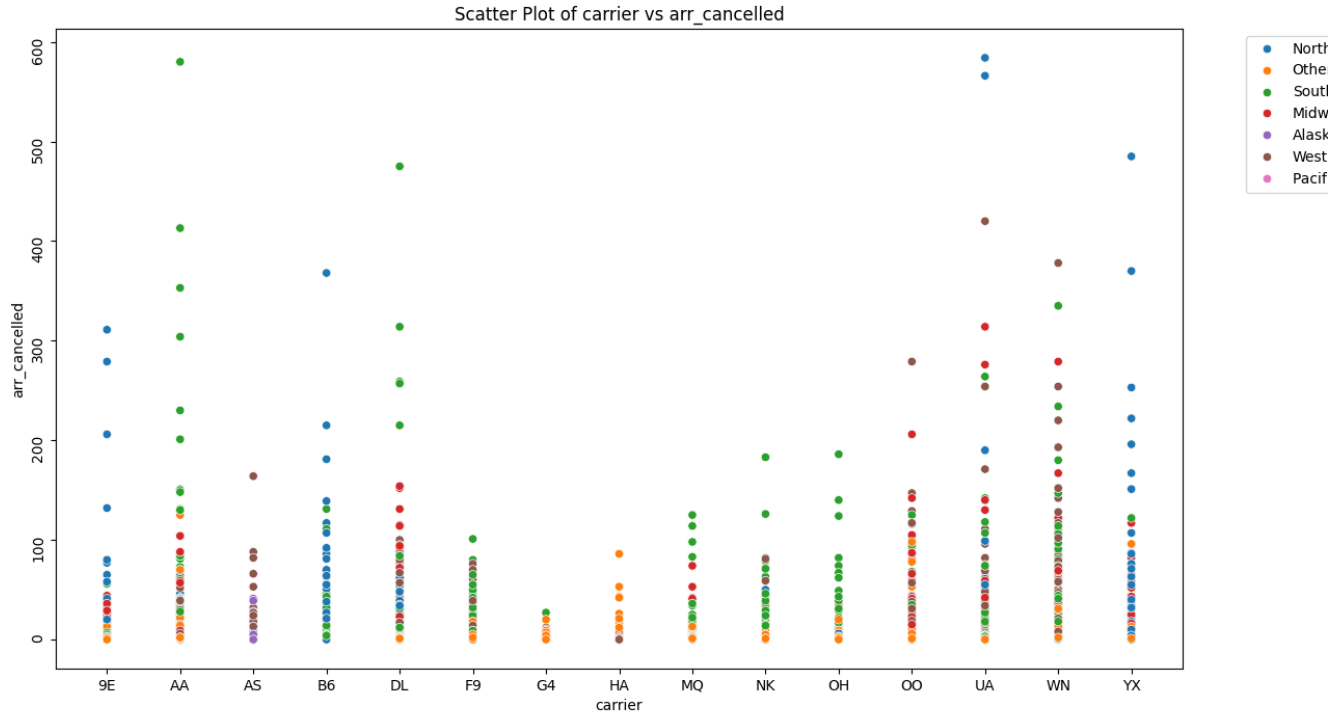
```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 6
Enter the column name for the box plot (e.g., 'weather_delay'): carrier
```



```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 7
Enter the x-axis column name (e.g., 'arr_delay'): carrier
Enter the y-axis column name (e.g., 'weather_delay'): arr_cancelled
```



```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 8
```

```
Enter your choice (1-15): 8

Mean Calculation Options:
1. Calculate Simple Mean
2. Calculate Weighted Mean
Enter your choice (1-2): 1
Enter the column name for simple mean (e.g., 'arr_delay'): arr_delay
Mean of column 'arr_delay' : 5865.656819101579
Mean of arr_delay: 5865.656819101579
```

```
Enter your choice (1-15): 8

Mean Calculation Options:
1. Calculate Simple Mean
2. Calculate Weighted Mean
Enter your choice (1-2): 2
Enter the column name for weighted mean (e.g., 'arr_delay'): arr_delay
Enter the weights column (e.g., 'weight'): weather_ct
Result saved to Output\arr_delay_weighted_mean.csv
Weighted Mean of arr_delay with weights from weather_ct: 53818.849448908484
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
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3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
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6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 9
```

```
Enter your choice (1-15): 9
Enter the column name for median (e.g., 'arr_delay'): arr_delay
Median of column 'arr_delay' : 1347.0
Median of arr_delay: 1347.0
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 10
Enter the column name for standard deviation (e.g., 'weather_delay'): weather_ct
```

```
Enter your choice (1-15): 10
Enter the column name for standard deviation (e.g., 'weather_delay'): weather_ct
Standard Deviatian of column 'weather_ct' : 9.546002894905264
Standard Deviation of weather_ct: 9.546002894905264
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
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6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 11

Probability Calculations Menu:
1. Calculate Joint Probability
2. Calculate Conditional Probability
3. Calculate Joint Counts
4. Back to Main Menu
Enter your choice (1-4): 1
Enter the first column for joint probability (e.g., 'carrier'): carrier
Enter the second column for joint probability (e.g., 'arr_delay'): arr_delay
```
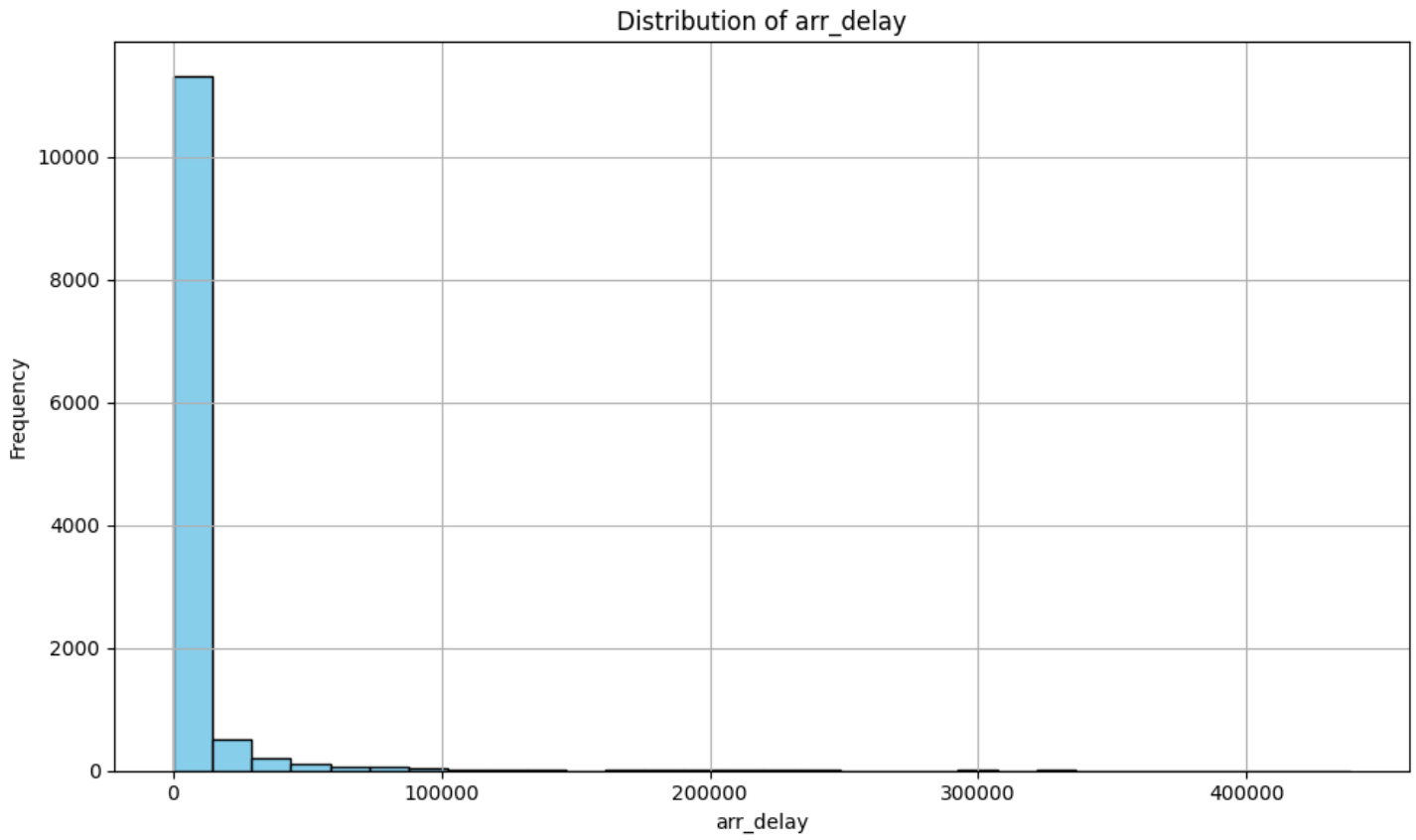

```
Result saved to Output\carrier_arr_delay_joint_probability.csv
arr_delay  0.0       15.0      16.0      17.0      18.0      ...  335957.0  337375.0  376057.0  416577.0  438783.0
carrier                                                      ...
9E         0.004445  0.000000  0.000000  0.000081  0.000242  ...  0.000000  0.000000  0.000000  0.000000  0.000000
AA         0.000162  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000081  0.000081  0.000081  0.000081
AS         0.000727  0.000000  0.000000  0.000000  0.000081  ...  0.000000  0.000000  0.000000  0.000000  0.000000
B6         0.000162  0.000000  0.000000  0.000000  0.000081  ...  0.000000  0.000000  0.000000  0.000000  0.000000
DL         0.001131  0.000000  0.000081  0.000000  0.000162  ...  0.000081  0.000000  0.000000  0.000000  0.000000
F9         0.000647  0.000000  0.000000  0.000081  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
G4         0.002829  0.000081  0.000162  0.000000  0.000242  ...  0.000000  0.000000  0.000000  0.000000  0.000000
HA         0.000081  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
MQ         0.004122  0.000162  0.000323  0.000081  0.000162  ...  0.000000  0.000000  0.000000  0.000000  0.000000
NK         0.000162  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
OH         0.001778  0.000081  0.000081  0.000081  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
OO         0.005011  0.000323  0.000404  0.000000  0.000081  ...  0.000000  0.000000  0.000000  0.000000  0.000000
UA         0.000404  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
WN         0.000000  0.000000  0.000000  0.000000  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000
YX         0.003394  0.000081  0.000081  0.000081  0.000000  ...  0.000000  0.000000  0.000000  0.000000  0.000000

[15 rows x 5858 columns]
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 12

Available numeric columns:
year, month, arr_flights, arr_del15, carrier_ct, weather_ct, nas_ct, security_ct, late_aircraft_ct, arr_cancelled, arr_diverted,
 arr_delay, carrier_delay, weather_delay, nas_delay, security_delay, late_aircraft_delay
Enter the first numeric column (e.g., 'arr_delay'): arr_delay
Enter the second numeric column (e.g., 'arr_flights'): arr_flights
```

Output > arr_delay_arr_flights_vector_operations.csv

```
1   Operation,Result
2   Addition,[1464.  861.  828. ...    6. 1400.  853.]
3   Subtraction,[1286.  737.  704. ...   -6. 1294.  689.]
4   Dot Product,234380329537.0
5   Element-wise Multiplication,[122375.  49538.  47492. ...      0.  71391.  63222.]
6   Vector 1 Magnitude,2117283.7155043725
7   Vector 2 Magnitude,120117.33324545629
8   Angle (radians),0.39864664107656117
9   Angle (degrees),22.840770050753516
10  Orthogonal,False
11
```

```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 13
Available columns for histogram:
year, month, carrier, carrier_name, airport, airport_name, arr_flights, arr_del15, carrier_ct, weather_ct, nas_ct, security_ct,
late_aircraft_ct, arr_cancelled, arr_diverted, arr_delay, carrier_delay, weather_delay, nas_delay, security_delay, late_aircraft
_delay, region
Enter the column name for the histogram (e.g., 'arr_delay'): arr_delay
```



```
--- Airport Data Analysis Menu ---
1. View carrier frequencies (Parent - visualize_column)
2. View all delay types comparison (Parent - visualize_delays)
3. Query arrival delays by carrier (Parent - query_arrival_delays_by_carrier)
4. Query data with condition (Child - query_data)
5. View distribution of a column using violin plot (Child - plot_violin)
6. View distribution of a column using box plot (Child - plot_box)
7. View relationship between two columns using scatter plot (Child - plot_scatter)
8. Calculate the mean of a column (includes weighted mean)
9. Calculate the median of a column
10. Calculate the standard deviation of a column
11. Perform probability calculations (ProbabilityCalculations)
12. Perform vector operations
13. Show delay histogram (Parent - visualize_delay_histogram)
14. Perform permutation & combination on categorical data
15. Exit

Enter your choice (1-15): 14

Combinatorics Analysis Menu:
1. Analyze Categorical Column
2. Back to Main Menu
Enter your choice (1-2): 1

Available categorical columns:
carrier, carrier_name, airport, airport_name
Enter the categorical column name to analyze: carrier

Number of unique values in carrier: 15
Unique values: ['9E' 'AA' 'AS' 'B6' 'DL' 'F9' 'G4' 'HA' 'MQ' 'NK' 'OH' 'OO' 'UA' 'WN'
 'YX']

Enter r (number of items to select): 2
```

Output > combination_n15_r2.csv

```
1   Calculation_Type,n,r,Result
2   combination,15,2,105
3
```

Output > permutation_n15_r2.csv

```
1   Calculation_Type,n,r,Result
2   permutation,15,2,210
3
```

## Test Data:

| year | month | carrier | carrier_na | airport | airport_name | arr_flights | arr_del15 | carrier_ct | weather_ct | nas_ct | security_ct | late_aircraft_ct | arr_cancelled | arr_diverted | arr_delay | carrier_delay | weather_delay | nas_delay | air_delay | late_aircraft_delay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2023 | 8 | 9E | Endeavor | ABE | Allentown/Bethle | 89 | 13 | 2.25 | 1.6 | 3.16 | 0 | 5.99 | 2 | 1 | 1375 | 71 | 761 | 118 | air_delay | 425 |
| 2023 | 8 | 9E | Endeavor | ABY | Albany, GA: Soutl | 62 | 10 | 1.97 | 0.04 | 0.57 | 0 | 7.42 | 0 | 1 | 799 | 218 | 1 | 62 | | 518 |
| 2023 | 8 | 9E | Endeavor | AEX | Alexandria, LA: Al | 62 | 10 | 2.73 | 1.18 | 1.8 | 0 | 4.28 | 1 | 0 | 766 | 56 | 188 | 78 | 0 | 444 |
| 2023 | 8 | 9E | Endeavor | AGS | Augusta, GA: Aug | 66 | 12 | 3.69 | 2.27 | 4.47 | 0 | 1.57 | 1 | 1 | 1397 | 471 | 320 | 388 | 0 | 218 |
| 2023 | 8 | 9E | Endeavor | ALB | Albany, NY: Alba | 92 | 22 | 7.76 | 0 | 2.96 | 0 | 11.28 | 2 | 0 | 1530 | 628 | 0 | 134 | 0 | 768 |
| 2023 | 8 | 9E | Endeavor | ATL | Atlanta, GA: Hart | 1636 | 256 | 55.98 | 27.81 | 63.64 | 0 | 108.57 | 32 | 11 | 29768 | 9339 | 4557 | 4676 | 0 | 11196 |
| 2023 | 8 | 9E | Endeavor | AUS | Austin, TX: Austir | 75 | 12 | 5.62 | 0.97 | 4.41 | 0 | 1 | 0 | 0 | 843 | 535 | 170 | 111 | 0 | 27 |
| 2023 | 8 | 9E | Endeavor | AVL | Asheville, NC: Asl | 59 | 7 | 3.32 | 0 | 0.42 | 0 | 3.26 | 2 | 0 | 324 | 117 | 0 | 25 | 0 | 182 |
| 2023 | 8 | 9E | Endeavor | AZO | Kalamazoo, MI: K | 62 | 13 | 6.53 | 0.94 | 3.54 | 0 | 1.99 | 0 | 0 | 707 | 470 | 77 | 87 | 0 | 73 |
| 2023 | 8 | 9E | Endeavor | BDL | Hartford, CT: Brac | 30 | 4 | 0 | 0.82 | 0 | 0 | 3.18 | 1 | 0 | 1421 | 0 | 532 | 0 | 0 | 889 |
| 2023 | 8 | 9E | Endeavor | BGM | Binghamton, NY: | 58 | 10 | 2.78 | 0 | 3.18 | 0 | 4.03 | 1 | 0 | 1604 | 207 | 0 | 1049 | 0 | 348 |
| 2023 | 8 | 9E | Endeavor | BGR | Bangor, ME: Bang | 124 | 13 | 8.42 | 1 | 0.5 | 0 | 3.08 | 3 | 0 | 1207 | 282 | 650 | 18 | 0 | 257 |
| 2023 | 8 | 9E | Endeavor | BHM | Birmingham, AL: | 84 | 17 | 4.11 | 0 | 4.24 | 0 | 8.65 | 2 | 2 | 1124 | 208 | 0 | 164 | 0 | 752 |
| 2023 | 8 | 9E | Endeavor | BNA | Nashville, TN: Na | 166 | 25 | 6.02 | 2.91 | 11.4 | 0 | 4.68 | 2 | 0 | 1465 | 362 | 308 | 523 | 0 | 272 |
| 2023 | 8 | 9E | Endeavor | BQK | Brunswick, GA: B | 62 | 14 | 7.46 | 0.2 | 3.1 | 0 | 3.24 | 2 | 2 | 2641 | 1238 | 184 | 771 | 0 | 448 |
| 2023 | 8 | 9E | Endeavor | BTV | Burlington, VT: Bu | 147 | 30 | 11.85 | 0 | 11 | 0 | 7.16 | 3 | 0 | 1628 | 714 | 0 | 324 | 0 | 590 |
| 2023 | 8 | 9E | Endeavor | BUF | Buffalo, NY: Buffa | 154 | 25 | 7.96 | 0 | 10.66 | 0 | 6.38 | 2 | 0 | 1065 | 289 | 0 | 448 | 0 | 328 |
| 2023 | 8 | 9E | Endeavor | BWI | Baltimore, MD: Ba | 62 | 13 | 1.92 | 0 | 3.82 | 0.2 | 7.05 | 2 | 0 | 900 | 89 | 0 | 203 | 28 | 580 |
| 2023 | 8 | 9E | Endeavor | CAE | Columbia, SC: Co | 92 | 20 | 3.74 | 0 | 9.41 | 0 | 6.85 | 1 | 0 | 1375 | 398 | 0 | 448 | 0 | 529 |
| 2023 | 8 | 9E | Endeavor | CHA | Chattanooga, TN | 119 | 17 | 5.23 | 3.1 | 1.96 | 0 | 6.71 | 1 | 0 | 1108 | 341 | 174 | 82 | 0 | 511 |
| 2023 | 8 | 9E | Endeavor | CHO | Charlottesville, V | 139 | 17 | 4.17 | 2.6 | 6.67 | 0 | 3.55 | 2 | 1 | 891 | 226 | 118 | 348 | 0 | 199 |
| 2023 | 8 | 9E | Endeavor | CHS | Charleston, SC: C | 137 | 16 | 4.88 | 0.41 | 5.35 | 0 | 5.35 | 4 | 0 | 935 | 322 | 12 | 330 | 0 | 271 |
| 2023 | 8 | 9E | Endeavor | CLE | Cleveland, OH: Cl | 323 | 62 | 24.42 | 3.4 | 8.65 | 0 | 25.53 | 6 | 3 | 4601 | 1792 | 851 | 304 | 0 | 1654 |
| 2023 | 8 | 9E | Endeavor | CLT | Charlotte, NC: Ch | 232 | 38 | 9.94 | 1 | 13.46 | 0 | 13.6 | 9 | 1 | 2617 | 752 | 49 | 753 | 0 | 1063 |
| 2023 | 8 | 9E | Endeavor | CMH | Columbus, OH: Jo | 99 | 15 | 5.5 | 1 | 3.79 | 0 | 4.71 | 2 | 0 | 971 | 275 | 23 | 109 | 0 | 564 |
| 2023 | 8 | 9E | Endeavor | CRW | Charleston/Dunb | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 8 | 9E | Endeavor | CSG | Columbus, GA: Co | 79 | 10 | 2.12 | 1.69 | 0.35 | 0 | 5.84 | 2 | 0 | 1280 | 828 | 59 | 17 | 0 | 376 |
| 2023 | 8 | 9E | Endeavor | CVG | Cincinnati, OH: C | 637 | 109 | 29.44 | 3.89 | 28.21 | 0 | 47.45 | 8 | 0 | 8481 | 2548 | 122 | 1248 | 0 | 4563 |
| 2023 | 8 | 9E | Endeavor | CWA | Mosinee, WI: Cen | 62 | 12 | 4.59 | 0 | 0.2 | 0 | 7.21 | 0 | 0 | 878 | 460 | 0 | 5 | 0 | 413 |
| 2023 | 8 | 9E | Endeavor | DAY | Dayton, OH: Jame | 27 | 5 | 1.08 | 0 | 2.14 | 0 | 1.77 | 0 | 0 | 418 | 92 | 0 | 118 | 0 | 208 |
| 2023 | 8 | 9E | Endeavor | DCA | Washington, DC: | 205 | 29 | 8.52 | 0.57 | 11.44 | 0 | 8.48 | 3 | 0 | 2886 | 749 | 46 | 1240 | 0 | 851 |
| 2023 | 8 | 9E | Endeavor | DHN | Dothan, AL: Doth | 62 | 11 | 2 | 0 | 7.29 | 0 | 1.71 | 0 | 0 | 456 | 43 | 0 | 316 | 0 | 97 |
| 2023 | 8 | 9E | Endeavor | DLH | Duluth, MN: Dulu | 55 | 2 | 0.19 | 0 | 0.07 | 0 | 1.74 | 0 | 0 | 153 | 8 | 0 | 3 | 0 | 142 |
| 2023 | 8 | 9E | Endeavor | DSM | Des Moines, IA: D | 218 | 52 | 18.56 | 0 | 10.92 | 0 | 22.52 | 1 | 0 | 3728 | 1539 | 0 | 646 | 0 | 1543 |
| 2023 | 8 | 9E | Endeavor | DTW | Detroit, MI: Detro | 1607 | 262 | 61.84 | 13.84 | 58.28 | 0 | 128.03 | 19 | 5 | 24485 | 6954 | 1146 | 4936 | 0 | 11449 |
| 2023 | 8 | 9E | Endeavor | EVV | Evansville, IN: Ev | 79 | 14 | 4.58 | 2 | 4.39 | 0 | 3.03 | 1 | 0 | 1105 | 762 | 64 | 111 | 0 | 168 |

**Source:** https://www.kaggle.com/datasets/sriharshaeedala/airline-delay

**GitHub Url:** https://github.com/Subeen9/Airport-Delay-cmps-340

## Work Report:

| Date | Task Name | Status | Person |
|---|---|---|---|
| 11/25/2024 | Parent Class 2 (Base design and implementation) | Completed | Subin |
| 11/25/2024 | Child 2.1 (Probability, mean, median,sd) | Completed | Niraj |
| 11/25/2024 | Child 2.1(Permutation and Combination) | Completed | Aakash |
| 11/25/2024 | Child 2.1 (Vector Operation) | Completed | Satyam |
| 11/26/2024 | Module Communication Diagram | Completed | Subin, Satyam |
| 11/26/2024 | PDF Reporting | Completed | Aakash, Niraj |