

AIRLINES FLIGHTS DATA

Import libraries

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

```
data = pd.read_csv ("content/airlines_flights_data.csv")
data
```

	index	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	
1	1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	
2	2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	
3	3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	
4	4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy	2.33	
...
300148	300148	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	
300149	300149	Vistara	UK-826	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	
			UK-								

** Cleaning the data**

```
data = data.drop ( columns = "index" , inplace = True )
data
```

	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_left	p
0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	1	
1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	1	
2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	1	
3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	1	
4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy	2.33	1	
...
300148	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	49	6
300149	Vistara	UK-826	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	49	7
		UK-									

Data Exploration & insights

Head

```
data.head ()
```

	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_left	price
0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	1	5953
1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	1	5953
2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	1	5956
3	Vistara	UK-	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	1	5955

Tail

data . tail ()											
	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_left	p
300148	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	49	6
300149	Vistara	UK-826	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	49	7
300150	Vistara	UK-832	Chennai	Early_Morning	one	Night	Hyderabad	Business	13.83	49	7

Data Information

data . info ()											
<class 'pandas.core.frame.DataFrame'>											
RangeIndex: 300153 entries, 0 to 300152											
Data columns (total 11 columns):											
# Column											
# Column Non-Null Count Dtype											
0 airline 300153 non-null object											
1 flight 300153 non-null object											
2 source_city 300153 non-null object											
3 departure_time 300153 non-null object											
4 stops 300153 non-null object											
5 arrival_time 300153 non-null object											
6 destination_city 300153 non-null object											
7 class 300153 non-null object											
8 duration 300153 non-null float64											
9 days_left 300153 non-null int64											
10 price 300153 non-null int64											
dtypes: float64(1), int64(2), object(8)											
memory usage: 25.2+ MB											

Data Description

data . describe ()											
	duration	days_left	price								
count	300153.000000	300153.000000	300153.000000								
mean	12.221021	26.004751	20889.660523								
std	7.191997	13.561004	22697.767366								
min	0.830000	1.000000	1105.000000								
25%	6.830000	15.000000	4783.000000								
50%	11.250000	26.000000	7425.000000								
75%	16.170000	38.000000	42521.000000								
max	49.830000	49.000000	123071.000000								

NULL

data . isnull () . sum ()											

```

0
airline    0
flight     0
source_city 0
departure_time 0
stops      0
arrival_time 0
destination_city 0
class       0
duration    0
days_left   0
price      0

dtype: int64

```

Duplicate

```

data [ data . duplicated ()]

airline flight source_city departure_time stops arrival_time destination_city class duration days_left price

```

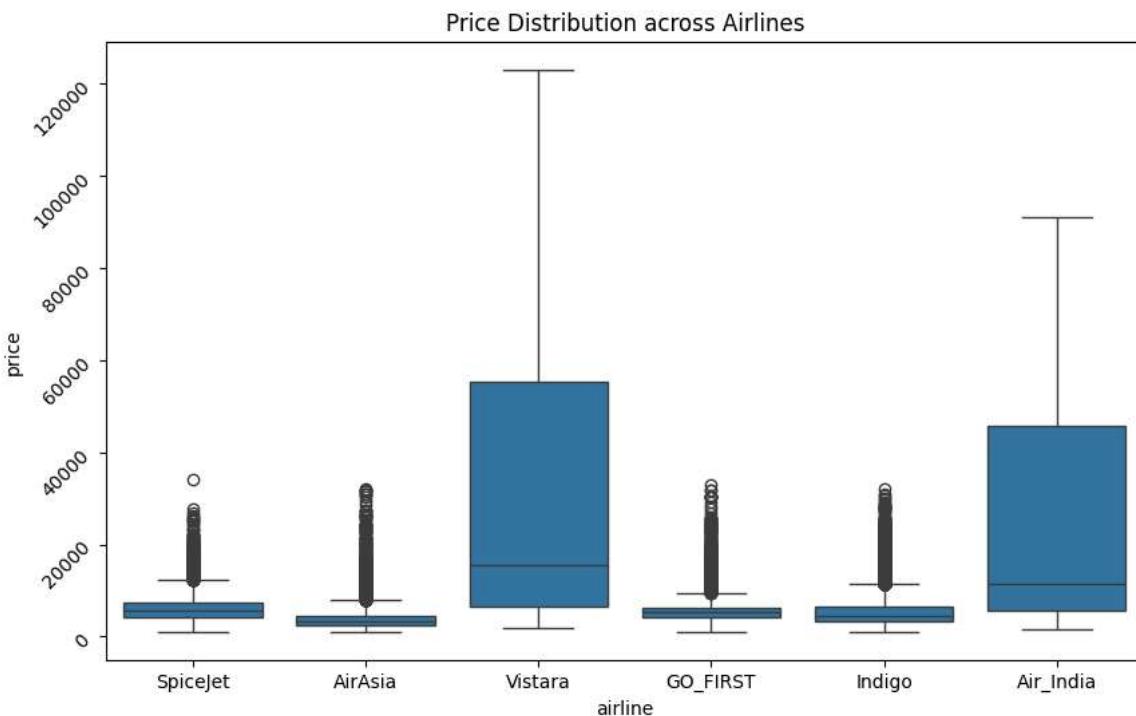
DATA VISUALISATION

1.Price Distribution across Airlines

```

plt.figure(figsize=(10,6))
sns.boxplot(data=data,x='airline',y='price')
plt.yticks(rotation=45)
plt.title('Price Distribution across Airlines')
plt.show()

```



2.Average Price: Economy vs. Business Class

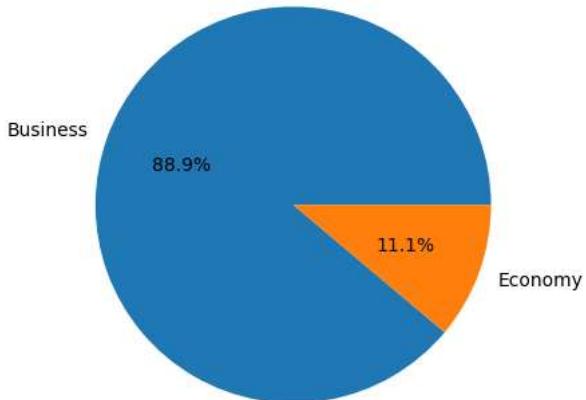
```

q2=data.groupby('class')['price'].mean()
values= q2.values
label= q2.index
plt.pie(values,labels=label,autopct='%1.1f%%')

```

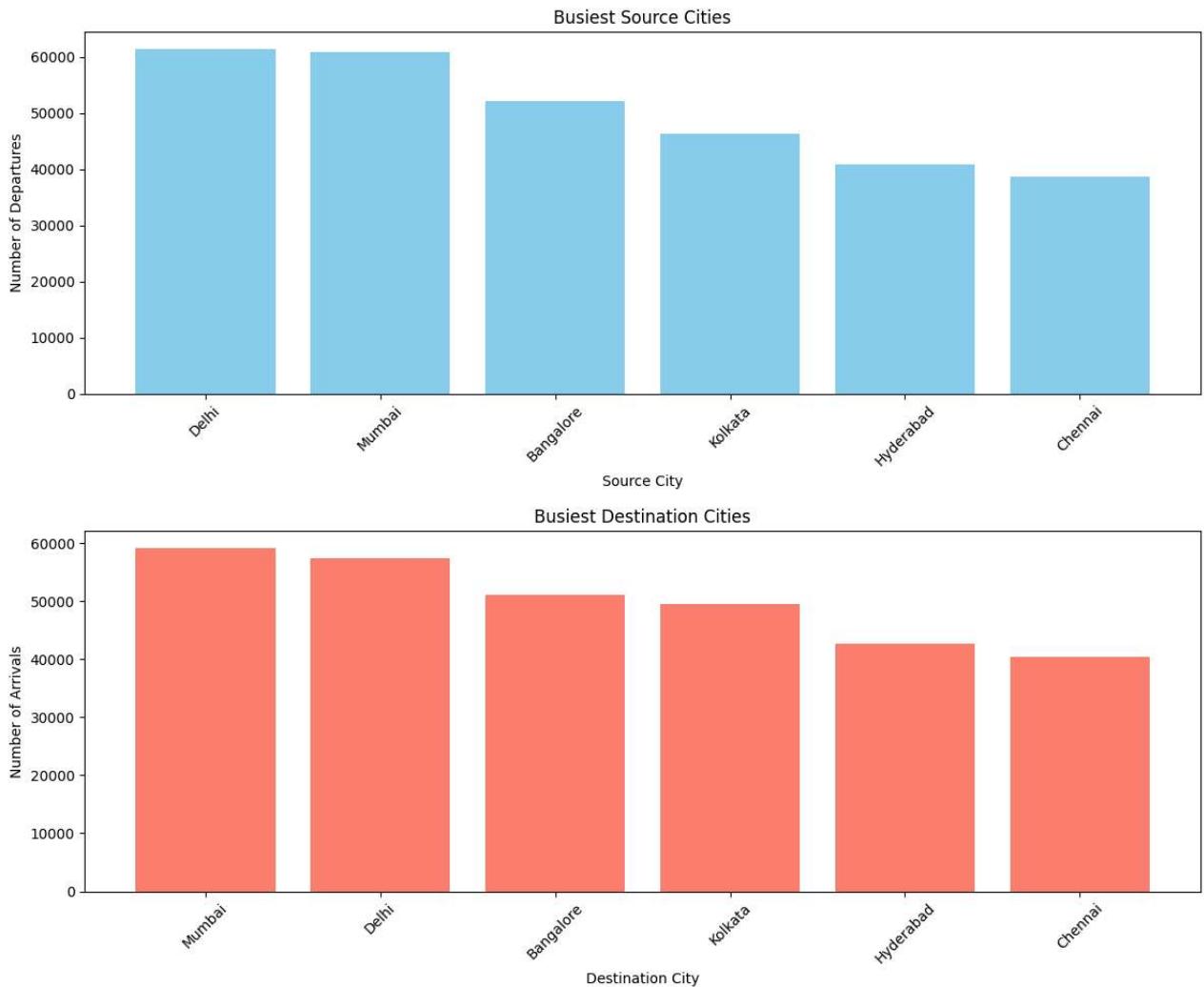
```
plt.title("Average Price: Economy vs. Business Class")
plt.show()
```

Average Price: Economy vs. Business Class



3.Busiest Source & Destination Cities

```
source_counts = data['source_city'].value_counts()
destination_counts = data['destination_city'].value_counts()
plt.figure(figsize=(12,5))
plt.bar(source_counts.index, source_counts.values, color='skyblue')
plt.title("Busiest Source Cities")
plt.xlabel("Source City")
plt.ylabel("Number of Departures")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
plt.figure(figsize=(12,5))
plt.bar(destination_counts.index, destination_counts.values, color='salmon')
plt.title("Busiest Destination Cities")
plt.xlabel("Destination City")
plt.ylabel("Number of Arrivals")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



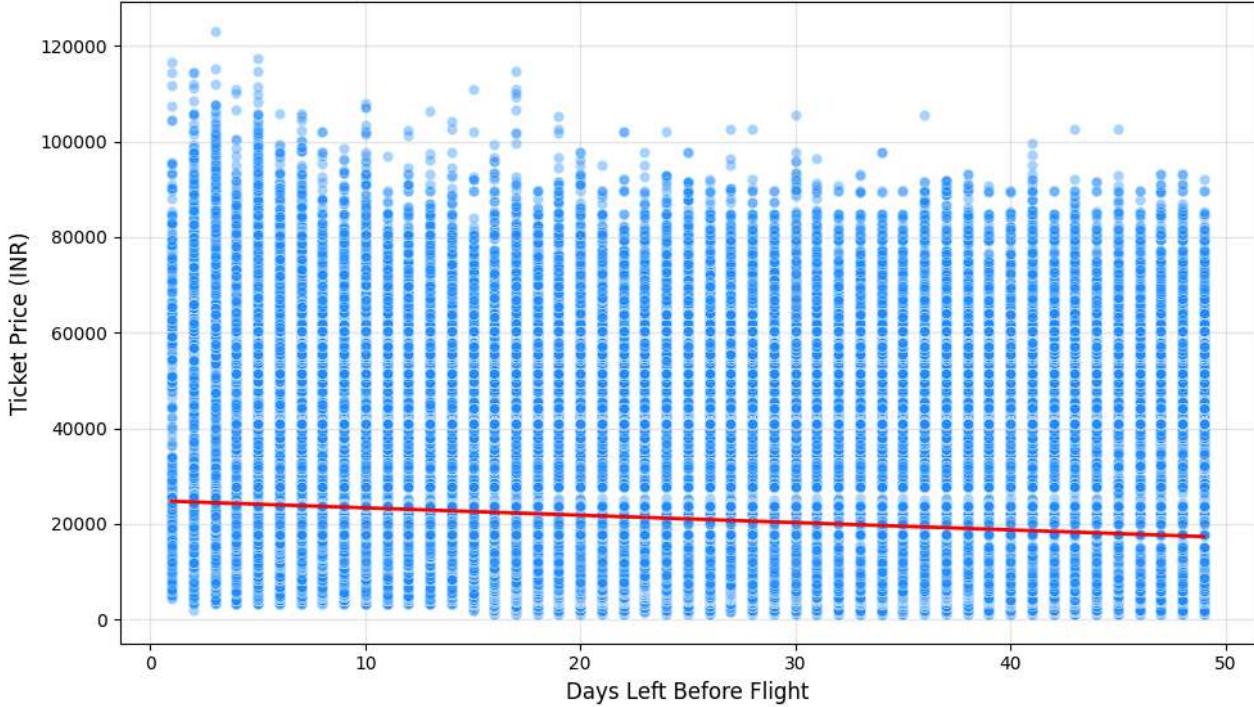
4.Days Left vs. Ticket Price Trend

```

data.columns = data.columns.str.strip()
plt.figure(figsize=(10,6))
sns.scatterplot(x="days_left", y="price", data=data, alpha=0.4, color="dodgerblue")
sns.regplot(x="days_left", y="price", data=data, scatter=False, color="red", line_kws={'color':'red', 'lw':2})
plt.title("Days Left vs. Ticket Price Trend", fontsize=16)
plt.xlabel("Days Left Before Flight", fontsize=12)
plt.ylabel("Ticket Price (INR)", fontsize=12)
plt.grid(True, alpha=0.3)
plt.tight_layout()
plt.show()

```

Days Left vs. Ticket Price Trend



5.Stops vs. Price Comparison

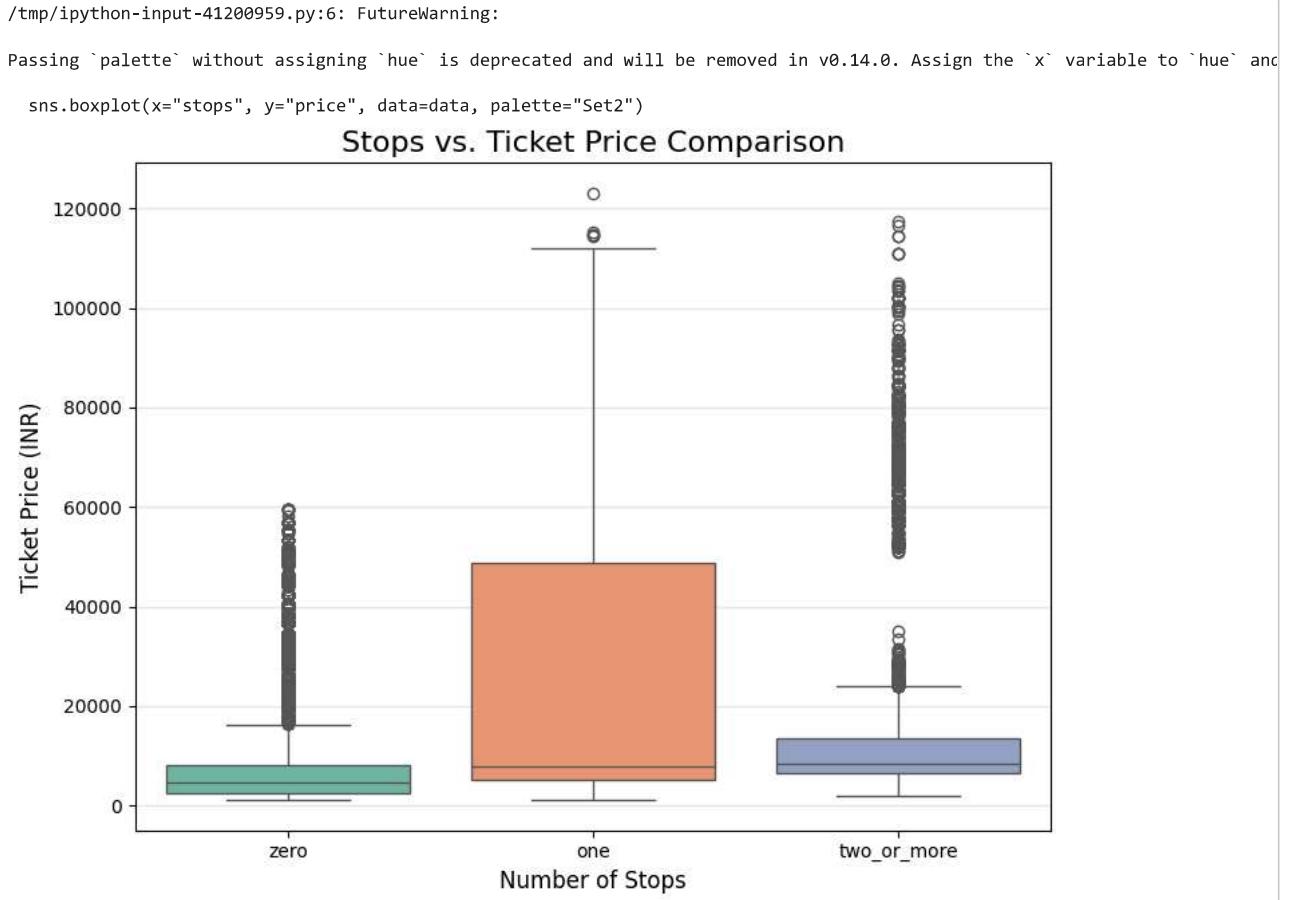
```

data.columns = data.columns.str.strip()

# Plot Stops vs Price as a boxplot

plt.figure(figsize=(8,6))
sns.boxplot(x="stops", y="price", data=data, palette="Set2")
plt.title("Stops vs. Ticket Price Comparison", fontsize=16)
plt.xlabel("Number of Stops", fontsize=12)
plt.ylabel("Ticket Price (INR)", fontsize=12)
plt.grid(axis="y", alpha=0.3)
plt.tight_layout()
plt.show()

```



6. Duration Impact on Ticket Pricing

```
data.columns = data.columns.str.strip()

# Plot Duration vs Price

plt.figure(figsize=(10,6))
sns.scatterplot(x="duration", y="price", data=data, alpha=0.4, color="teal", edgecolor='none')
sns.regplot(x="duration", y="price", data=data, scatter=False, color="red", line_kws={'color':'red', 'lw':2})
plt.title("Duration Impact on Ticket Pricing", fontsize=16)
plt.xlabel("Flight Duration (Hours)", fontsize=12)
plt.ylabel("Ticket Price (INR)", fontsize=12)
plt.grid(True, alpha=0.3)
plt.tight_layout()
plt.show()
```



SQL QUERIES

```
! pip install pandasql
import pandasql as ps
```

```
Requirement already satisfied: pandasql in /usr/local/lib/python3.12/dist-packages (0.7.3)
Requirement already satisfied: numpy in /usr/local/lib/python3.12/dist-packages (from pandasql) (2.0.2)
Requirement already satisfied: pandas in /usr/local/lib/python3.12/dist-packages (from pandasql) (2.2.2)
Requirement already satisfied: sqlalchemy in /usr/local/lib/python3.12/dist-packages (from pandasql) (2.0.43)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.12/dist-packages (from pandas->pandasql) (2.2.3)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.12/dist-packages (from pandas->pandasql) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.12/dist-packages (from pandas->pandasql) (2025.2)
Requirement already satisfied: greenlet>=1 in /usr/local/lib/python3.12/dist-packages (from sqlalchemy->pandasql) (3.2.4)
Requirement already satisfied: typing-extensions>=4.6.0 in /usr/local/lib/python3.12/dist-packages (from sqlalchemy->pandasql) (4.6.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.12/dist-packages (from python-dateutil>=2.8.2->pandas->pandasql) (3.1.0)
```

- Find the average ticket price per airline

```
query_1 = """
SELECT airline,
AVG(price) AS avg_price
FROM data
GROUP BY airline
ORDER BY avg_price ASC ; """

result_1 = ps.sql(df(query_1, locals()))
display(result_1)
```

	airline	avg_price
0	AirAsia	4091.072742
1	Indigo	5324.216303
2	GO_FIRST	5652.007595
3	SpiceJet	6179.278881
4	Air_India	23507.019112
5	Vistara	30396.536302

- List the top 5 most expensive routes (source to destination)

```
query_2 = """
SELECT source_city,
destination_city,
```

```
AVG(price) AS expensive_routes
FROM data
GROUP BY source_city, destination_city
ORDER BY expensive_routes DESC
LIMIT 5;'''

result_2 = ps.sql(df(query_2,locals()))
display(result_2)
```

	source_city	destination_city	expensive_routes
0	Chennai	Bangalore	25081.850454
1	Kolkata	Chennai	23660.361040
2	Bangalore	Kolkata	23500.061229
3	Bangalore	Chennai	23321.850078
4	Mumbai	Bangalore	23147.873807

3. Which airline offers the lowest average ticket price for Business class?

```
query_3 = '''
SELECT airline,
AVG(price) AS low_avg_ticket_business_class_price
FROM data
WHERE class = 'Business'
GROUP BY airline
ORDER BY low_avg_ticket_business_class_price ASC;'''

result_3 = ps.sql(df(query_3,locals()))
display(result_3)
```

	airline	low_avg_ticket_business_class_price
0	Air_India	47131.039212
1	Vistara	55477.027777

4. Find routes with more than 50 flights and their average ticket prices

```
query_4 = '''
SELECT source_city,
destination_city,
COUNT(*) AS total_flights,
AVG(price) AS avg_price
FROM data
GROUP BY source_city, destination_city
HAVING COUNT(*) > 50
ORDER BY avg_price DESC;'''

result_4 = ps.sql(df(query_4,locals()))
display(result_4)
```

	source_city	destination_city	total_flights	avg_price
0	Chennai	Bangalore	6493	25081.850454
1	Kolkata	Chennai	6653	23660.361040
2	Bangalore	Kolkata	10028	23500.061229
3	Bangalore	Chennai	6410	23321.850078
4	Mumbai	Bangalore	12885	23147.873807
5	Bangalore	Mumbai	12939	23128.618672
6	Mumbai	Chennai	10130	22781.899112
7	Chennai	Mumbai	9338	22765.849647
8	Kolkata	Bangalore	9824	22744.808428
9	Chennai	Kolkata	6983	22669.932407
10	Mumbai	Kolkata	12602	22379.146723
11	Kolkata	Mumbai	11467	22078.883579
12	Hyderabad	Chennai	6395	21848.065989
13	Chennai	Hyderabad	6103	21591.345404
14	Kolkata	Hyderabad	7897	21500.011397
15	Hyderabad	Bangalore	7854	21347.177998
16	Bangalore	Hyderabad	8928	21226.121192
17	Mumbai	Hyderabad	10470	21004.046705
18	Hyderabad	Kolkata	7987	20823.893201
19	Delhi	Kolkata	11934	20566.409418
20	Hyderabad	Mumbai	10064	20080.865759
21	Kolkata	Delhi	10506	19422.354559
22	Delhi	Chennai	10780	19369.881354
23	Delhi	Mumbai	15289	19355.829812
24	Chennai	Delhi	9783	18981.863948
25	Mumbai	Delhi	14809	18725.320008
26	Delhi	Bangalore	14012	17880.216315
27	Bangalore	Delhi	13756	17723.313972
28	Delhi	Hyderabad	9328	17347.288379
29	Hyderabad	Delhi	8506	17243.945685

5. Compare average price difference between Economy and Business class per airline

```
query_5 = """
SELECT airline,
AVG(CASE WHEN class = 'Business' THEN price END) AS avg_business_price,
AVG(CASE WHEN class = 'Economy' THEN price END) AS avg_economy_price,
( AVG(CASE WHEN class = 'Business' THEN price END) -
AVG(CASE WHEN class = 'Economy' THEN price END)) AS price_difference
FROM data
GROUP BY airline
ORDER BY price_difference DESC;"""

result_5 = ps.sql(df(query_5, locals()))
display(result_5)
```

	airline	avg_business_price	avg_economy_price	price_difference
0	Vistara	55477.027777	7806.943645	47670.084132
1	Air_India	47131.039212	7313.682169	39817.357044
2	SpiceJet	NaN	6179.278881	NaN
3	Indigo	NaN	5324.216303	NaN
4	GO_FIRST	NaN	5652.007595	NaN
5	AirAsia	NaN	4091.072742	NaN

6. Which cities have the most incoming flights?

```
query_6 = """
SELECT destination_city AS city,
COUNT(*) AS incoming_flights
FROM data
GROUP BY destination_city
ORDER BY incoming_flights DESC;"""

result_6 = ps.sql(df(query_6, locals()))
display(result_6)
```

	city	incoming_flights
0	Mumbai	59097
1	Delhi	57360
2	Bangalore	51068
3	Kolkata	49534
4	Hyderabad	42726
5	Chennai	40368

7. Which cities have the most outgoing flights?

```
query_7 = """
SELECT source_city AS city,
COUNT(*) AS outgoing_flights
FROM data
GROUP BY source_city
ORDER BY outgoing_flights DESC;"""

result_7 = ps.sql(df(query_7, locals()))
display(result_7)
```

	city	outgoing_flights
0	Delhi	61343
1	Mumbai	60896
2	Bangalore	52061
3	Kolkata	46347
4	Hyderabad	40806
5	Chennai	38700

8. Find the busiest route (most number of flights)

```
query_8 = """
SELECT source_city,
destination_city,
COUNT(*) AS total_flights
FROM data
GROUP BY source_city, destination_city
ORDER BY total_flights DESC
LIMIT 1;"""

result_8 = ps.sql(df(query_8, locals()))
display(result_8)
```

	source_city	destination_city	total_flights
0	Delhi	Mumbai	15289

9. List the top 3 airlines with cheapest average prices for each route

```
query_9 = """
SELECT *
FROM (
SELECT source_city,
destination_city,
airline,
AVG(price) AS avg_price,
```

```

ROW_NUMBER() OVER (
    PARTITION BY source_city, destination_city
    ORDER BY AVG(price) ASC
) AS rn
FROM data
GROUP BY source_city, destination_city, airline
) ranked
WHERE rn <= 3
ORDER BY source_city, destination_city, avg_price;'''

result_9 = ps.sql(df(query_9, locals()))
display(result_9)

```

	source_city	destination_city	airline	avg_price	rn
0	Bangalore	Chennai	AirAsia	2073.043478	1
1	Bangalore	Chennai	Indigo	2363.326241	2
2	Bangalore	Chennai	SpiceJet	2613.310345	3
3	Bangalore	Delhi	AirAsia	4807.092426	1
4	Bangalore	Delhi	GO_FIRST	5524.702628	2
...
85	Mumbai	Hyderabad	GO_FIRST	4603.866889	2
86	Mumbai	Hyderabad	Indigo	5870.954610	3
87	Mumbai	Kolkata	AirAsia	3977.937365	1
88	Mumbai	Kolkata	GO_FIRST	6106.502609	2
89	Mumbai	Kolkata	SpiceJet	7065.210689	3

90 rows × 5 columns

10. Find flights with duration more than 5 hours but priced below average

```

query_10 = '''
SELECT flight,duration
FROM data
WHERE duration > 5
AND price < (SELECT AVG(price) FROM data)
ORDER BY price ASC;'''

result_10 = ps.sql(df(query_10, locals()))
display(result_10)

```

	flight	duration
0	6E-6137	5.25
1	6E-6113	5.92
2	6E-847	6.67
3	6E-804	6.75
4	6E-6113	7.00
...
169086	AI-885	11.50
169087	UK-995	6.58
169088	UK-852	10.08
169089	AI-773	17.67
169090	SG-406	10.75

169091 rows × 2 columns

11. Which flight class shows the highest average price variation (std deviation)?

```

query_11 = '''
SELECT class,
SQRT(AVG(price * price) - AVG(price) * AVG(price)) AS price_stddev
FROM data
GROUP BY class
ORDER BY price_stddev DESC
LIMIT 1;

```

```
...  
result_11 = ps.sql(df(query_11,locals()))  
display(result_11)
```

class	price_stddev	
0	Business	12969.245242

12. Find how ticket prices vary with number of days left before departure

```
query_12 = '''  
SELECT  
days_left,  
AVG(price) AS avg_price,  
MIN(price) AS min_price,  
MAX(price) AS max_price  
FROM data  
GROUP BY days_left  
ORDER BY days_left ASC;  
'''  
result_12 = ps.sql(df(query_12,locals()))  
display(result_12)
```

	days_left	avg_price	min_price	max_price
0	1	21591.867151	4452	116562
1	2	30211.299801	1977	114523
2	3	28976.083569	3361	123071
3	4	25730.905653	3362	110936
4	5	26679.773368	3361	117307
5	6	24856.493902	3361	105961
6	7	25588.367351	3361	105744
7	8	24895.883995	3361	102114
8	9	25726.246072	3197	98465
9	10	25572.819134	3197	107934
10	11	22990.656070	3197	97045
11	12	22505.803322	3361	102384
12	13	22498.885384	3361	106416
13	14	22678.002363	3197	104255
14	15	21952.540852	1998	110850
15	16	20503.546237	1105	99389

13. Which time of day (Morning, Evening, etc.) has the highest average ticket price?

```
query13="""
SELECT DEPARTURE_TIME, AVG(PRICE) AS HIGHEST_PRICE FROM data
GROUP BY DEPARTURE_TIME
ORDER BY HIGHEST_PRICE DESC
limit 1;
"""

result13 = ps.sql(df(query13, locals()))
display(result13)
```

22	departure_time	HIGHEST_PRICE	1443	97681
0	Night	23062.146808	1105	102114
24	25	19571.641791	1105	97681
25	26	19238.290278	1105	92193

14. Find Price trends by airline and travel class

```
query_14 = """
SELECT
airline,
class,
AVG(price) AS avg_price,
MIN(price) AS min_price,
MAX(price) AS max_price
FROM data
GROUP BY airline, class
ORDER BY airline, class;
"""

result_14 = ps.sql(df(query_14, locals()))
display(result_14)
```

	airline	class	avg_price	min_price	max_price
0	AirAsia	Economy	4091.072742	1105	31917