Passenger Behavior And Booking Trends In The Airline Industry

August 3, 2025

[69]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[70]:
```
df = pd.read_csv('../data/airlines_customer_booking_dataset.csv',␣
 ↪encoding='ISO-8859-1')
print(df.head())
print(df.info())
```

```
   num_passengers sales_channel  trip_type  purchase_lead  length_of_stay  \
0               2      Internet  RoundTrip            262              19
1               1      Internet  RoundTrip            112              20
2               2      Internet  RoundTrip            243              22
3               1      Internet  RoundTrip             96              31
4               2      Internet  RoundTrip             68              22

   flight_hour flight_day   route booking_origin  wants_extra_baggage  \
0            7        Sat  AKLDEL    New Zealand                    1
1            3        Sat  AKLDEL    New Zealand                    0
2           17        Wed  AKLDEL          India                    1
3            4        Sat  AKLDEL    New Zealand                    0
4           15        Wed  AKLDEL          India                    1

   wants_preferred_seat  wants_in_flight_meals  flight_duration  \
0                     0                      0             5.52
1                     0                      0             5.52
2                     1                      0             5.52
3                     0                      1             5.52
4                     0                      1             5.52

   booking_complete
0                 0
1                 0
2                 0
3                 0
4                 0
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 50000 entries, 0 to 49999
Data columns (total 14 columns):
 #   Column                 Non-Null Count  Dtype  
---  ------                 --------------  -----  
 0   num_passengers         50000 non-null  int64  
 1   sales_channel          50000 non-null  object 
 2   trip_type              50000 non-null  object 
 3   purchase_lead          50000 non-null  int64  
 4   length_of_stay         50000 non-null  int64  
 5   flight_hour            50000 non-null  int64  
 6   flight_day             50000 non-null  object 
 7   route                  50000 non-null  object 
 8   booking_origin         50000 non-null  object 
 9   wants_extra_baggage    50000 non-null  int64  
 10  wants_preferred_seat   50000 non-null  int64  
 11  wants_in_flight_meals  50000 non-null  int64  
 12  flight_duration        50000 non-null  float64
 13  booking_complete       50000 non-null  int64  
dtypes: float64(1), int64(8), object(5)
memory usage: 5.3+ MB
None
```

[71]:
```
# Missing values are checked for each column
print("Missing values:\n", df.isna().sum())
```

```
Missing values:
 num_passengers           0
sales_channel             0
trip_type                 0
purchase_lead             0
length_of_stay            0
flight_hour               0
flight_day                0
route                     0
booking_origin            0
wants_extra_baggage       0
wants_preferred_seat      0
wants_in_flight_meals     0
flight_duration           0
booking_complete          0
dtype: int64
```

[72]:
```
#number of bookings by sales channel
booking_count_by_channel = df["sales_channel"].value_counts()
print(booking_count_by_channel)
```

```
sales_channel
Internet    44382
Mobile       5618
Name: count, dtype: int64
```

[73]:
```
#average number of passengers by trip type
avg_passengers_by_trip = df.groupby("trip_type")["num_passengers"].mean()
print(avg_passengers_by_trip)
```

```
trip_type
CircleTrip    1.568966
OneWay        1.565891
RoundTrip     1.591490
Name: num_passengers, dtype: float64
```

[74]:
```
#the top 10 most booked routes
top_routes = df["route"].value_counts().nlargest(10)
print(top_routes)
```

```
route
AKLKUL    2680
PENTPE     924
MELSGN     842
ICNSIN     801
DMKKIX     744
ICNSYD     695
DMKPER     679
DPSICN     666
DMKOOL     655
MELPEN     649
Name: count, dtype: int64
```

[75]:
```
#average length of stay grouped by booking origin country
avg_stay_by_origin = df.groupby("booking_origin")["length_of_stay"].mean()
print(avg_stay_by_origin)
```

```
booking_origin
(not set)               17.083333
Afghanistan              2.000000
Algeria                  6.000000
Argentina               27.333333
Australia               29.186381
                            ...
United Arab Emirates    26.285714
United Kingdom          23.895954
```

```
United States            18.440789
Vanuatu                   4.000000
Vietnam                  32.917526
Name: length_of_stay, Length: 104, dtype: float64
```

[76]:
```
#total number of completed bookings
completed_bookings = len(df[df["booking_complete"] == 1])
print(f"Completed Bookings: {completed_bookings}")
```

```
Completed Bookings: 7478
```

[77]:
```
#average flight duration by flight departure hour
avg_duration_by_hour = df.groupby("flight_hour")["flight_duration"].mean()
print(avg_duration_by_hour)
```

```
flight_hour
0     7.633613
1     7.366400
2     7.266556
3     7.215721
4     7.184879
5     7.260915
6     7.271757
7     7.277738
8     7.262622
9     7.346718
10    7.412269
11    7.458823
12    7.349845
13    7.135692
14    7.001825
15    6.881746
16    6.923924
17    7.067956
18    6.919909
19    7.466983
20    7.696630
21    7.938483
22    7.878618
23    7.913803
Name: flight_duration, dtype: float64
```

[78]:
```
#number of bookings by flight day
booking_count_by_day = df["flight_day"].value_counts()
print(booking_count_by_day)
```

```
flight_day
Mon    8102
Wed    7674
Tue    7673
Thu    7424
Fri    6761
Sun    6554
Sat    5812
Name: count, dtype: int64
```

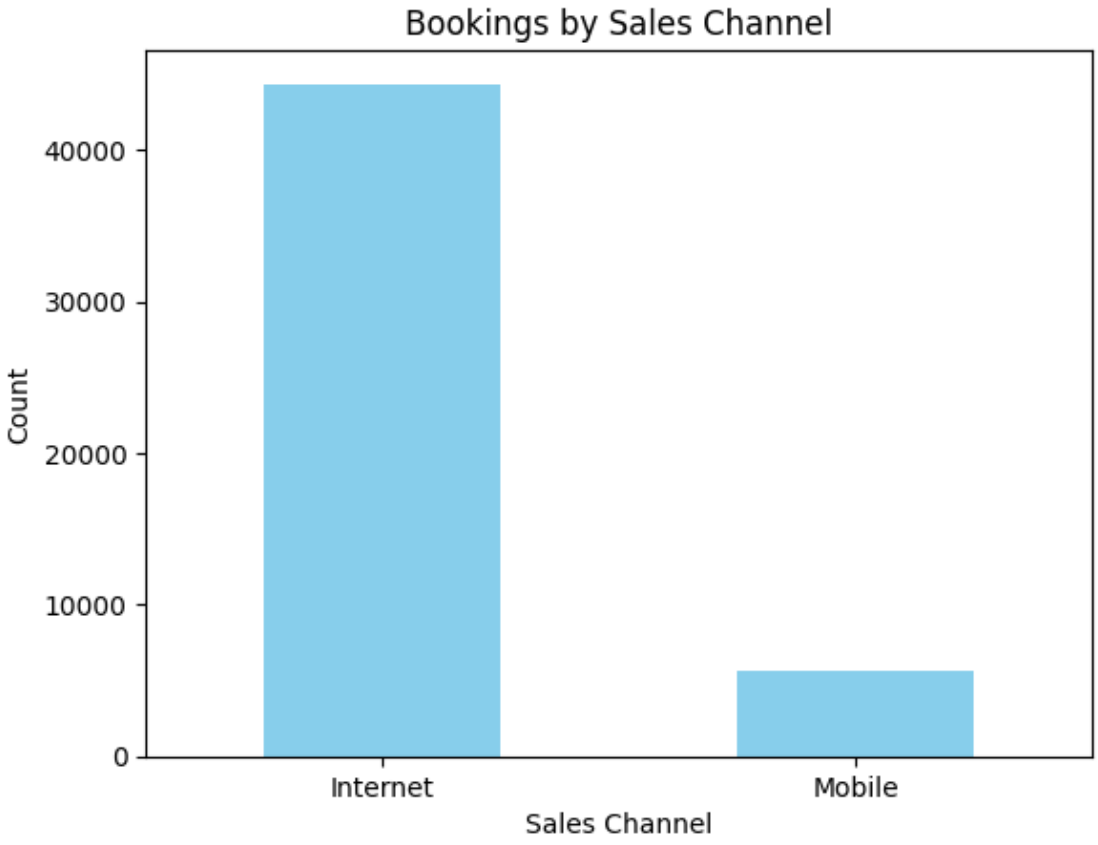
[79]:
```
#maximum number of passengers in a single booking
max_passengers = df["num_passengers"].max()
print(f"Max Passengers: {max_passengers}")
```

```
Max Passengers: 9
```

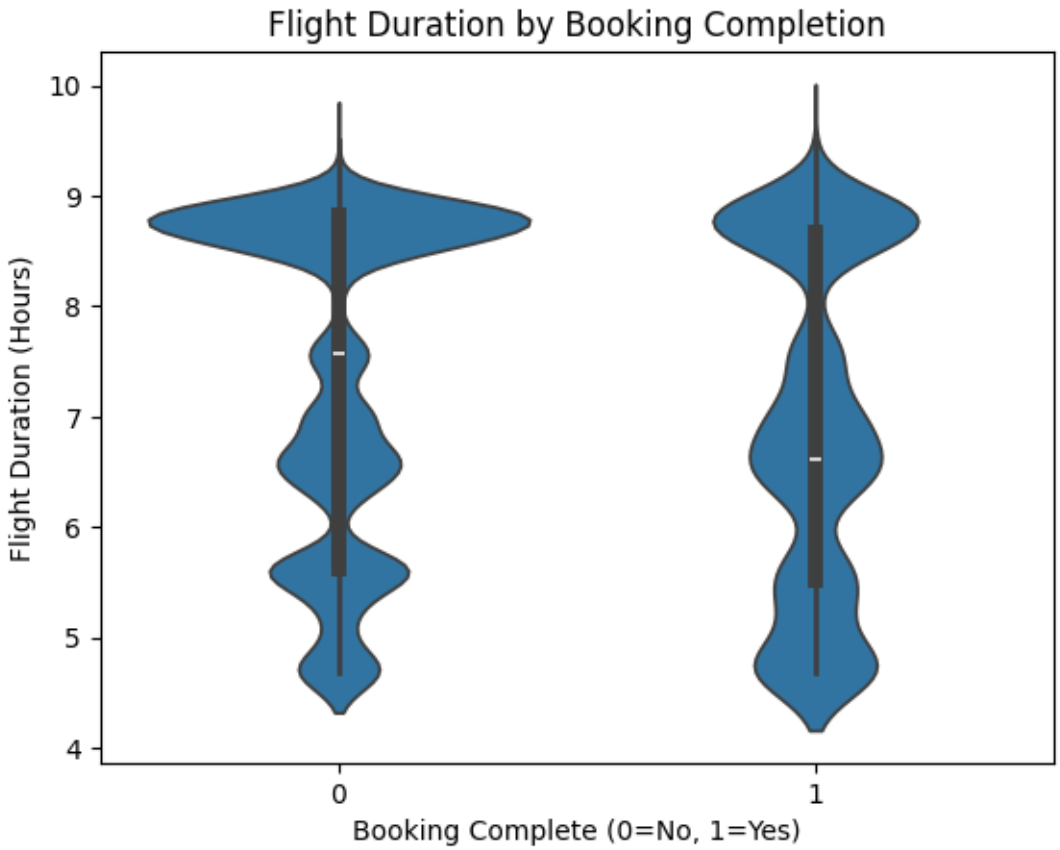
[80]:
```
#average purchase lead time by trip type
avg_lead_by_trip = df.groupby("trip_type")["purchase_lead"].mean()
print(avg_lead_by_trip)
```

```
trip_type
CircleTrip    95.293103
OneWay        91.547804
RoundTrip     84.864557
Name: purchase_lead, dtype: float64
```

[81]:
```
df["sales_channel"].value_counts().plot(kind="bar", color="skyblue")
plt.title("Bookings by Sales Channel")
plt.xlabel("Sales Channel")
plt.ylabel("Count")
plt.xticks(rotation=0)
plt.show()
```



[82]:
```
sns.violinplot(x="booking_complete", y="flight_duration", data=df)
plt.title("Flight Duration by Booking Completion")
plt.xlabel("Booking Complete (0=No, 1=Yes)")
plt.ylabel("Flight Duration (Hours)")
plt.show()
```



[83]:
```
#total number of bookings that requested extra baggage
extra_baggage_count = len(df[df["wants_extra_baggage"] == 1])
print(f"Bookings with Extra Baggage: {extra_baggage_count}")
```

```
Bookings with Extra Baggage: 33439
```

[84]:
```
#average stay duration by route
avg_stay_by_route = df.groupby("route")["length_of_stay"].mean()
print(avg_stay_by_route)
```

```
route
AKLDEL    32.700000
AKLHGH    17.000000
AKLHND    17.500000
AKLICN    27.828571
AKLKIX    73.750000
             ...
TRZWUH    61.615385
TRZXIY    49.666667
TWUWUH     4.500000
TWUXIY    22.571429
URTXIY     5.000000
Name: length_of_stay, Length: 799, dtype: float64
```

[85]:
```
#number of bookings by booking origin country
origin_count = df["booking_origin"].value_counts()
print(origin_count)
```

```
booking_origin
Australia               17872
Malaysia                 7174
South Korea              4559
Japan                    3885
China                    3387
                        ...
Ghana                       1
Gibraltar                   1
Guatemala                   1
Algeria                     1
Svalbard & Jan Mayen        1
Name: count, Length: 104, dtype: int64
```

[86]:
```
#average flight duration by trip type
avg_duration_by_trip = df.groupby("trip_type")["flight_duration"].mean()
print(avg_duration_by_trip)
```

```
trip_type
CircleTrip    7.764828
OneWay        7.966770
RoundTrip     7.271030
Name: flight_duration, dtype: float64
```

[87]:
```
#top 5 days with the highest number of bookings
top_days = df["flight_day"].value_counts().nlargest(5)
print(top_days)
```

```
flight_day
Mon    8102
Wed    7674
Tue    7673
Thu    7424
Fri    6761
Name: count, dtype: int64
```

[88]:
```
#average number of passengers in completed bookings
avg_passengers_completed = df[df["booking_complete"] == 1]["num_passengers"].
 ↪mean()
print(f"Avg Passengers in Completed Bookings: {avg_passengers_completed:.2f}")
```

```
Avg Passengers in Completed Bookings: 1.65
```

[89]:
```
#bookings with in-flight meal requests
meal_count = len(df[df["wants_in_flight_meals"] == 1])
print(f"Bookings with In-Flight Meals: {meal_count}")
```

```
Bookings with In-Flight Meals: 21357
```

[90]:
```
#minimum flight duration by route
min_duration_by_route = df.groupby("route")["flight_duration"].min()
print(min_duration_by_route)
```

```
route
AKLDEL    5.52
AKLHGH    5.07
AKLHND    7.57
AKLICN    6.62
AKLKIX    7.00
          ...
TRZWUH    5.13
TRZXIY    5.00
TWUWUH    5.13
TWUXIY    5.00
URTXIY    5.00
Name: flight_duration, Length: 799, dtype: float64
```

[91]:
```
#average number of passengers by flight departure hour
avg_passengers_by_hour = df.groupby("flight_hour")["num_passengers"].mean()
print(avg_passengers_by_hour)
```

```
flight_hour
0     1.547758
1     1.573480
2     1.541635
3     1.589077
4     1.573338
5     1.575588
6     1.568852
7     1.570697
8     1.610111
9     1.602171
10    1.580875
11    1.588424
12    1.589314
13    1.581748
14    1.656195
15    1.675470
16    1.658317
17    1.707317
18    1.640091
19    1.522034
20    1.539855
21    1.521851
22    1.518135
23    1.547667
Name: num_passengers, dtype: float64
```

[92]:
```
#total bookings requesting preferred seat
preferred_seat_count = len(df[df["wants_preferred_seat"] == 1])
print(f"Bookings with Preferred Seat: {preferred_seat_count}")
```

```
Bookings with Preferred Seat: 14848
```

[93]:
```
#average purchase lead by booking origin
avg_lead_by_origin = df.groupby("booking_origin")["purchase_lead"].mean()
print(avg_lead_by_origin)
```

```
booking_origin
(not set)                80.035714
Afghanistan             191.000000
Algeria                  27.000000
Argentina                80.333333
Australia                78.579622
                            ...
United Arab Emirates     55.928571
```

```
United Kingdom          78.624277
United States           69.554825
Vanuatu                 11.000000
Vietnam                 69.422680
Name: purchase_lead, Length: 104, dtype: float64
```

[94]:
```
#maximum number of passengers in a completed booking
max_passengers_completed = df[df["booking_complete"] == 1]["num_passengers"].
 ↪max()
print(f"Max Passengers in Completed Booking: {max_passengers_completed}")
```

```
Max Passengers in Completed Booking: 9
```

[95]:
```
#average flight duration for incomplete bookings
avg_duration_incomplete = df[df["booking_complete"] == 0]["flight_duration"].
 ↪mean()
print(f"Avg Duration in Incomplete Bookings: {avg_duration_incomplete:.2f}␣
 ↪hours")
```

```
Avg Duration in Incomplete Bookings: 7.34 hours
```

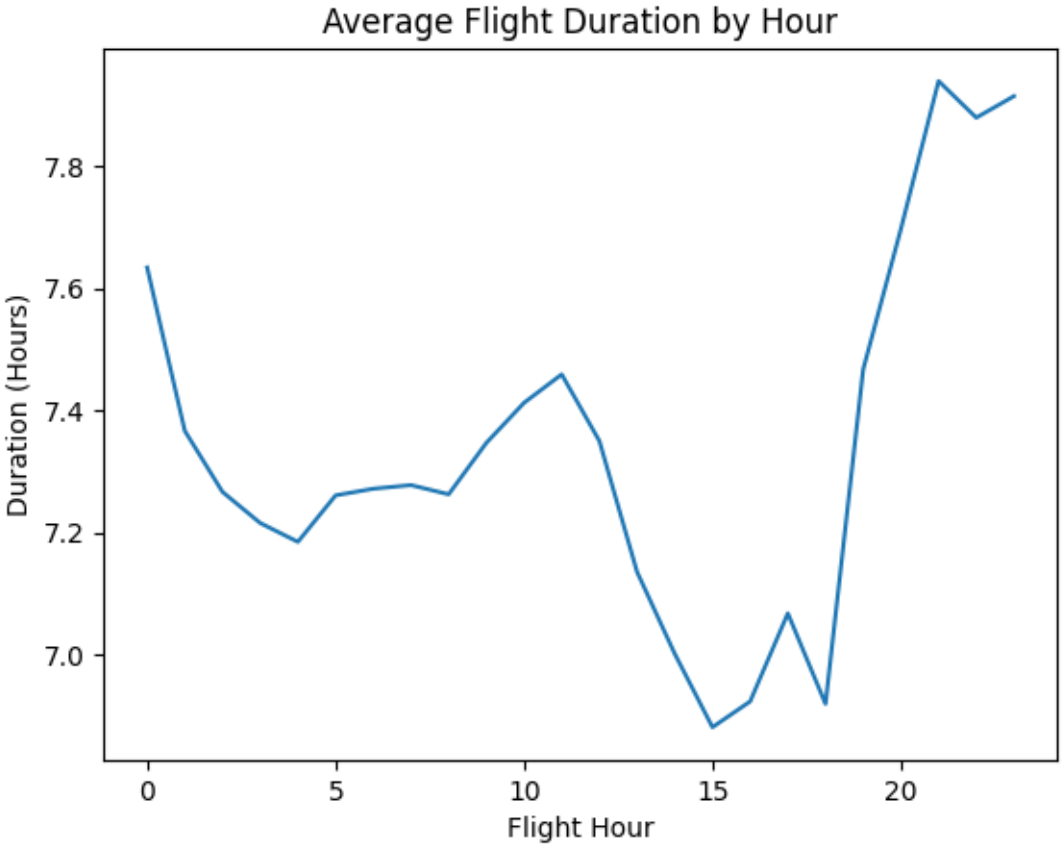
[96]:
```
#average number of passengers in bookings with extra baggage
avg_passengers_with_baggage = df[df["wants_extra_baggage"] ==␣
 ↪1]["num_passengers"].mean()
print(f"Avg Passengers with Extra Baggage: {avg_passengers_with_baggage:.2f}")
```

```
Avg Passengers with Extra Baggage: 1.68
```

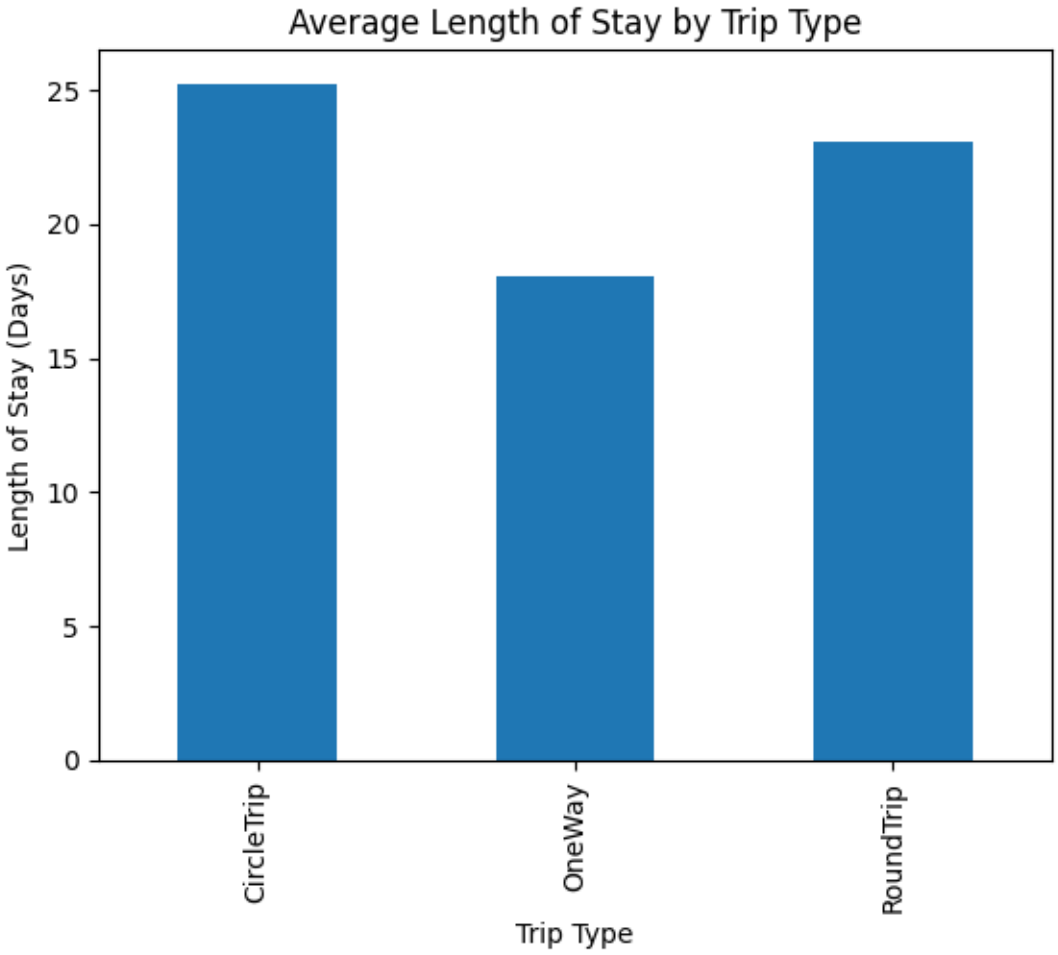
[97]:
```
#top 10 countries with highest number of completed bookings
completed_by_origin = df[df["booking_complete"] == 1].
 ↪groupby("booking_origin")["booking_complete"].count().nlargest(10)
print(completed_by_origin)
```

```
booking_origin
Malaysia       2468
Australia       900
China           694
Indonesia       615
Japan           478
Thailand        470
South Korea     462
Singapore       299
Taiwan          224
India           131
Name: booking_complete, dtype: int64
```

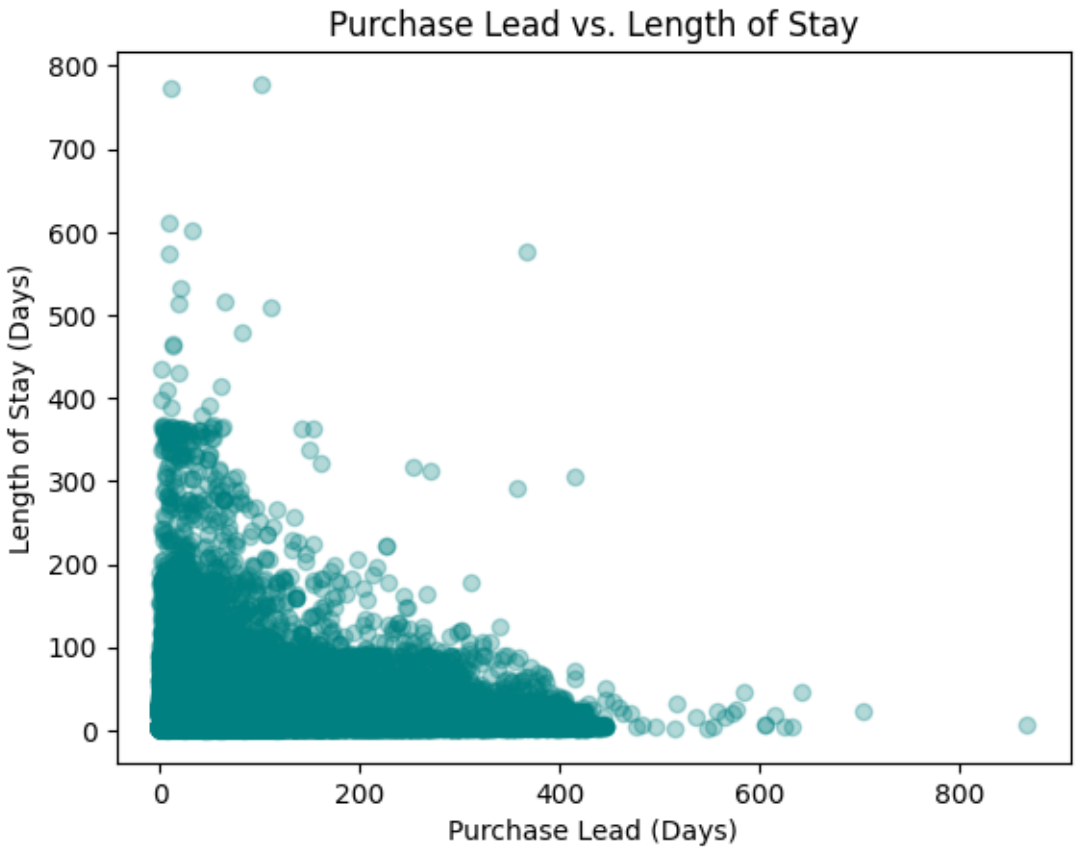
[98]:
```
df.groupby("flight_hour")["flight_duration"].mean().plot(kind="line")
plt.title("Average Flight Duration by Hour")
plt.xlabel("Flight Hour")
plt.ylabel("Duration (Hours)")
plt.show()
```



[99]:
```
df.groupby("trip_type")["length_of_stay"].mean().plot(kind="bar")
plt.title("Average Length of Stay by Trip Type")
plt.xlabel("Trip Type")
plt.ylabel("Length of Stay (Days)")
plt.show()
```



[100]:
```
plt.scatter(df["purchase_lead"], df["length_of_stay"], alpha=0.3, color="teal")
plt.title("Purchase Lead vs. Length of Stay")
plt.xlabel("Purchase Lead (Days)")
plt.ylabel("Length of Stay (Days)")
plt.show()
```



[101]:
```
numeric_cols = df.select_dtypes(include=["int64", "float64"])
correlation = numeric_cols.corr()
sns.heatmap(correlation, annot=True, cmap="coolwarm", fmt=".2f")
plt.title("Correlation Matrix")
plt.show()
```