airline-revenue-optimization

July 3, 2024

[36]:
```
import sqlite3
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.dates as mdates
import seaborn as sns
import json

import warnings
warnings.filterwarnings('ignore')
```

[37]:
```
pip install seaborn
```

```
Defaulting to user installation because normal site-packages is not
writeableNote: you may need to restart the kernel to use updated packages.

Requirement already satisfied: seaborn in c:\programdata\anaconda3\lib\site-
packages (0.11.2)
Requirement already satisfied: pandas>=0.23 in
c:\programdata\anaconda3\lib\site-packages (from seaborn) (1.4.2)
Requirement already satisfied: scipy>=1.0 in c:\programdata\anaconda3\lib\site-
packages (from seaborn) (1.7.3)
Requirement already satisfied: matplotlib>=2.2 in
c:\programdata\anaconda3\lib\site-packages (from seaborn) (3.5.1)
Requirement already satisfied: numpy>=1.15 in
c:\users\user\appdata\roaming\python\python39\site-packages (from seaborn)
(1.22.4)
Requirement already satisfied: kiwisolver>=1.0.1 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(1.3.2)
Requirement already satisfied: pillow>=6.2.0 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(9.0.1)
Requirement already satisfied: fonttools>=4.22.0 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(4.25.0)
Requirement already satisfied: pyparsing>=2.2.1 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
```

```
(3.0.4)
Requirement already satisfied: python-dateutil>=2.7 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(2.8.2)
Requirement already satisfied: packaging>=20.0 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(21.3)
Requirement already satisfied: cycler>=0.10 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(0.11.0)
Requirement already satisfied: pytz>=2020.1 in
c:\users\user\appdata\roaming\python\python39\site-packages (from
pandas>=0.23->seaborn) (2023.3.post1)
Requirement already satisfied: six>=1.5 in c:\programdata\anaconda3\lib\site-
packages (from python-dateutil>=2.7->matplotlib>=2.2->seaborn) (1.16.0)
```

[38]:
```
conn = sqlite3.connect('airlines_db.sqlite')
cursor = conn.cursor()
```

[39]:
```
tables = pd.read_sql("""SELECT *
                        FROM sqlite_master
                        WHERE type='table';""", conn)
tables
```

[39]:

	type	name	tbl_name	rootpage	\
0	table	aircrafts_data	aircrafts_data	2	
1	table	airports_data	airports_data	3	
2	table	boarding_passes	boarding_passes	4	
3	table	bookings	bookings	5	
4	table	flights	flights	6	
5	table	seats	seats	7	
6	table	ticket_flights	ticket_flights	8	
7	table	tickets	tickets	9	

	sql
0	CREATE TABLE aircrafts_data (\r\n aircraft_…
1	CREATE TABLE airports_data (\r\n airport_co…
2	CREATE TABLE boarding_passes (\r\n ticket_n…
3	CREATE TABLE bookings (\r\n book_ref charac…
4	CREATE TABLE flights (\r\n flight_id intege…
5	CREATE TABLE seats (\r\n aircraft_code char…
6	CREATE TABLE ticket_flights (\r\n ticket_no…
7	CREATE TABLE tickets (\r\n ticket_no charac…

[40]:
```
aircrafts_data = pd.read_sql_query("select * from aircrafts_data", conn)
aircrafts_data
```

[40]:

	aircraft_code	model	range
0	773	{"en": "Boeing 777-300", "ru": " 777-300"}	11100
1	763	{"en": "Boeing 767-300", "ru": " 767-300"}	7900
2	SU9	{"en": "Sukhoi Superjet-100", "ru": " …	3000
3	320	{"en": "Airbus A320-200", "ru": " A320-…	5700
4	321	{"en": "Airbus A321-200", "ru": " A321-…	5600
5	319	{"en": "Airbus A319-100", "ru": " A319-…	6700
6	733	{"en": "Boeing 737-300", "ru": " 737-300"}	4200
7	CN1	{"en": "Cessna 208 Caravan", "ru": " 208…	1200
8	CR2	{"en": "Bombardier CRJ-200", "ru": " …	2700

[6]:
```
airports_data = pd.read_sql_query("""SELECT * FROM airports_data""", conn)

airports_data
```

[6]:

	airport_code	airport_name	city	coordinates	timezone
0	YKS	{"en": "Yakutsk Airport", "ru": " "}	{"en": "Yakutsk", "ru": " "}	(129.77099609375,62.0932998657226562)	Asia/Yakutsk
1	MJZ	{"en": "Mirny Airport", "ru": " "}	{"en": "Mirnyj", "ru": " "}	(114.03900146484375,62.534698486328125)	Asia/Yakutsk
2	KHV	{"en": "Khabarovsk-Novy Airport", "ru": " …	{"en": "Khabarovsk", "ru": " "}	(135.18800354004,48.5279998779300001)	Asia/Vladivostok
3	PKC	{"en": "Yelizovo Airport", "ru": " "}	{"en": "Petropavlovsk", "ru": " -…	(158.453994750976562,53.1679000854492188)	Asia/Kamchatka
4	UUS	{"en": "Yuzhno-Sakhalinsk Airport", "ru": " …	{"en": "Yuzhno-Sakhalinsk", "ru": " - …	(142.718002319335938,46.8886985778808594)	Asia/Sakhalin
..	…	…	…		
99	MMK	{"en": "Murmansk Airport", "ru": " "}	{"en": "Murmansk", "ru": " "}		
100	ABA	{"en": "Abakan Airport", "ru": " "}	{"en": "Abakan", "ru": " "}		
101	BAX	{"en": "Barnaul Airport", "ru": " "}	{"en": "Barnaul", "ru": " "}		
102	AAQ	{"en": "Anapa Vityazevo Airport", "ru": " …	{"en": "Anapa", "ru": " "}		
103	CNN	{"en": "Chulman Airport", "ru": " "}	{"en": "Neryungri", "ru": " "}		

```
..                                                  …                 …
99   (32.7508010864257812,68.7817001342773438)     Europe/Moscow
100  (91.3850021362304688,53.7400016784667969)  Asia/Krasnoyarsk
101   (83.5384979248046875,53.363800048828125)  Asia/Krasnoyarsk
102   (37.3473014831539984,45.002101898192997)     Europe/Moscow
103  (124.914001464839998,56.9138984680179973)      Asia/Yakutsk

[104 rows x 5 columns]
```

[41]:
```
airports_data = pd.read_sql_query("""SELECT * FROM airports_data""", conn)

airports_data
```

[41]:
```
    airport_code                                    airport_name  \
0            YKS          {"en": "Yakutsk Airport", "ru": "    "}
1            MJZ            {"en": "Mirny Airport", "ru": "    "}
2            KHV  {"en": "Khabarovsk-Novy Airport", "ru": "   …
3            PKC        {"en": "Yelizovo Airport", "ru": "     "}
4            UUS  {"en": "Yuzhno-Sakhalinsk Airport", "ru": "  …
..           …                                                 …
99           MMK       {"en": "Murmansk Airport", "ru": "     "}
100          ABA           {"en": "Abakan Airport", "ru": "    "}
101          BAX         {"en": "Barnaul Airport", "ru": "     "}
102          AAQ  {"en": "Anapa Vityazevo Airport", "ru": "   …
103          CNN         {"en": "Chulman Airport", "ru": "     "}

                                             city  \
0                   {"en": "Yakutsk", "ru": "    "}
1                    {"en": "Mirnyj", "ru": "    "}
2              {"en": "Khabarovsk", "ru": "     "}
3    {"en": "Petropavlovsk", "ru": "       - …
4    {"en": "Yuzhno-Sakhalinsk", "ru": "  -   …
..                                              …
99               {"en": "Murmansk", "ru": "     "}
100                  {"en": "Abakan", "ru": "    "}
101                {"en": "Barnaul", "ru": "     "}
102                    {"en": "Anapa", "ru": "   "}
103              {"en": "Neryungri", "ru": "     "}

                                  coordinates          timezone
0        (129.77099609375,62.0932998657226562)      Asia/Yakutsk
1       (114.03900146484375,62.534698486328125)      Asia/Yakutsk
2         (135.18800354004,48.5279998779300001)  Asia/Vladivostok
3    (158.453994750976562,53.1679000854492188)    Asia/Kamchatka
4    (142.718002319335938,46.8886985778808594)      Asia/Sakhalin
..                                          …                 …
99   (32.7508010864257812,68.7817001342773438)     Europe/Moscow
```

```
100  (91.3850021362304688,53.7400016784667969)  Asia/Krasnoyarsk
101   (83.5384979248046875,53.363800048828125)  Asia/Krasnoyarsk
102   (37.3473014831539984,45.002101898192997)     Europe/Moscow
103  (124.914001464839998,56.9138984680179973)      Asia/Yakutsk

[104 rows x 5 columns]
```

[42]:
```
boarding_passes =  pd.read_sql_query("""SELECT * FROM boarding_passes""",conn)

boarding_passes
```

[42]:
```
            ticket_no  flight_id  boarding_no seat_no
0       0005435212351      30625            1      2D
1       0005435212386      30625            2      3G
2       0005435212381      30625            3      4H
3       0005432211370      30625            4      5D
4       0005435212357      30625            5     11A
…                 …          …            …      …
579681  0005434302871      19945           85     20F
579682  0005432892791      19945           86     21C
579683  0005434302869      19945           87     20E
579684  0005432802476      19945           88     21F
579685  0005432802482      19945           89     21E

[579686 rows x 4 columns]
```

[43]:
```
bookings  =  pd.read_sql_query("""SELECT * FROM bookings""", conn)

bookings
```

[43]:
```
        book_ref               book_date  total_amount
0         00000F  2017-07-05 03:12:00+03        265700
1         000012  2017-07-14 09:02:00+03         37900
2         000068  2017-08-15 14:27:00+03         18100
3         000181  2017-08-10 13:28:00+03        131800
4         0002D8  2017-08-07 21:40:00+03         23600
…           …                      …            …
262783    FFFEF3  2017-07-17 07:23:00+03         56000
262784    FFFF2C  2017-08-08 05:55:00+03         10800
262785    FFFF43  2017-07-20 20:42:00+03         78500
262786    FFFFA8  2017-08-08 04:45:00+03         28800
262787    FFFFF7  2017-07-01 22:12:00+03         73600

[262788 rows x 3 columns]
```

[44]:
```
flights =  pd.read_sql_query("""SELECT * FROM flights""",conn)
flights
```

[44]:
```
       flight_id flight_no     scheduled_departure       scheduled_arrival  \
0           1185    PG0134  2017-09-10 09:50:00+03  2017-09-10 14:55:00+03
1           3979    PG0052  2017-08-25 14:50:00+03  2017-08-25 17:35:00+03
2           4739    PG0561  2017-09-05 12:30:00+03  2017-09-05 14:15:00+03
3           5502    PG0529  2017-09-12 09:50:00+03  2017-09-12 11:20:00+03
4           6938    PG0461  2017-09-04 12:25:00+03  2017-09-04 13:20:00+03
…           …       …                       …                       …
33116      33117    PG0063  2017-08-02 19:25:00+03  2017-08-02 20:10:00+03
33117      33118    PG0063  2017-07-28 19:25:00+03  2017-07-28 20:10:00+03
33118      33119    PG0063  2017-09-08 19:25:00+03  2017-09-08 20:10:00+03
33119      33120    PG0063  2017-08-01 19:25:00+03  2017-08-01 20:10:00+03
33120      33121    PG0063  2017-08-26 19:25:00+03  2017-08-26 20:10:00+03

      departure_airport arrival_airport     status aircraft_code  \
0                   DME             BTK  Scheduled           319
1                   VKO             HMA  Scheduled           CR2
2                   VKO             AER  Scheduled           763
3                   SVO             UFA  Scheduled           763
4                   SVO             ULV  Scheduled           SU9
…                 …             …       …           …
33116               SKX             SVO    Arrived           CR2
33117               SKX             SVO    Arrived           CR2
33118               SKX             SVO  Scheduled           CR2
33119               SKX             SVO    Arrived           CR2
33120               SKX             SVO  Scheduled           CR2

             actual_departure          actual_arrival
0                          \N                      \N
1                          \N                      \N
2                          \N                      \N
3                          \N                      \N
4                          \N                      \N
…                        …                       …
33116  2017-08-02 19:25:00+03  2017-08-02 20:10:00+03
33117  2017-07-28 19:30:00+03  2017-07-28 20:15:00+03
33118                      \N                      \N
33119  2017-08-01 19:26:00+03  2017-08-01 20:12:00+03
33120                      \N                      \N

[33121 rows x 10 columns]
```

[45]:
```
seats  =  pd.read_sql_query("""SELECT * FROM seats""",conn)

seats
```

[45]:
```
     aircraft_code seat_no fare_conditions
0              319      2A        Business
```

```
1              319      2C        Business
2              319      2D        Business
3              319      2F        Business
4              319      3A        Business
…              …        …         …
1334           773      48H         Economy
1335           773      48K         Economy
1336           773      49A         Economy
1337           773      49C         Economy
1338           773      49D         Economy

[1339 rows x 3 columns]
```

[48]:
```
ticket_flights  =  pd.read_sql_query("""SELECT * FROM ticket_flights""",conn)

ticket_flights.head()
```

[48]:
```
        ticket_no  flight_id fare_conditions  amount
0  0005432159776      30625        Business   42100
1  0005435212351      30625        Business   42100
2  0005435212386      30625        Business   42100
3  0005435212381      30625        Business   42100
4  0005432211370      30625        Business   42100
```

[49]:
```
tickets  =  pd.read_sql_query("""SELECT * FROM tickets""",conn)

tickets.head()
```

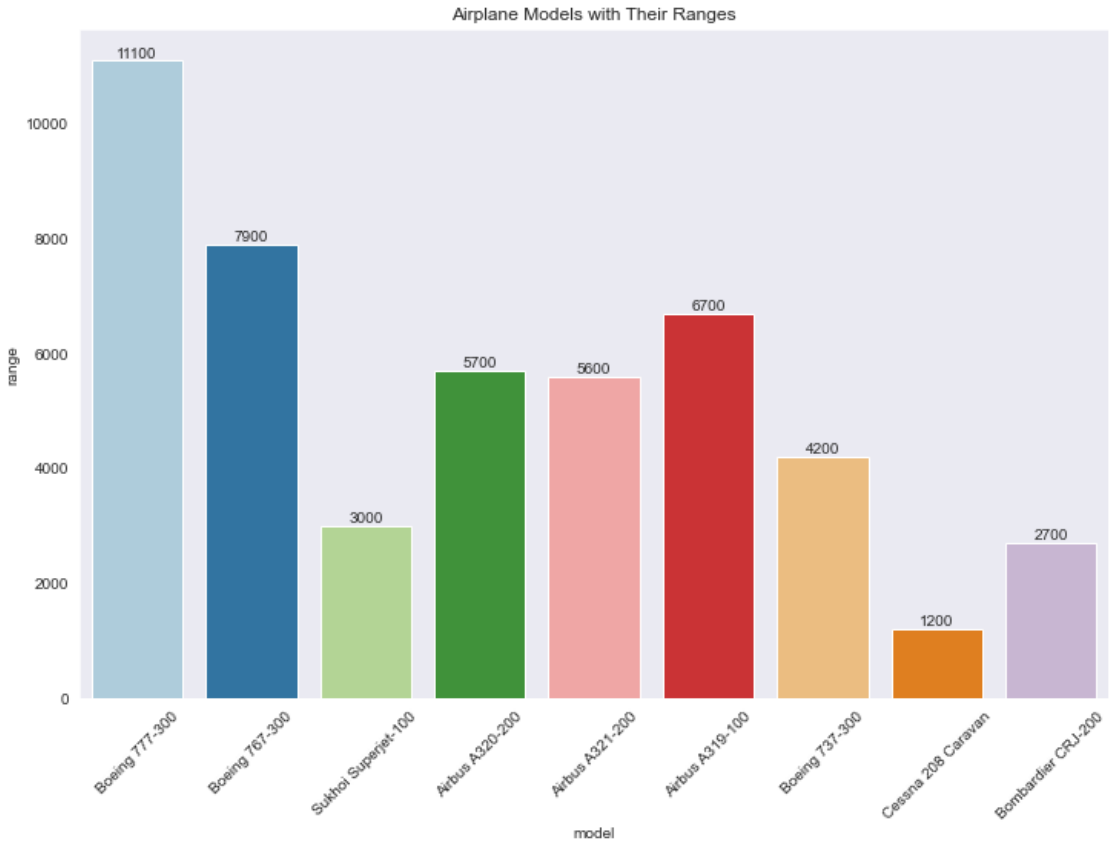
[49]:
```
        ticket_no book_ref passenger_id
0  0005432000987   06B046  8149 604011
1  0005432000988   06B046  8499 420203
2  0005432000989   E170C3  1011 752484
3  0005432000990   E170C3  4849 400049
4  0005432000991   F313DD  6615 976589
```

[50]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import json

# Assuming 'aircrafts_data' is your DataFrame containing the aircraft data

# Print the initial 'model' column to see what the data looks like
print("Initial 'model' column:")
print(aircrafts_data['model'].head())

# Define a function to safely load JSON or return None for non-JSON values
```

```
def safe_load_json(x):
    try:
        return json.loads(x)['en']
    except (json.JSONDecodeError, TypeError, KeyError):
        return None

# Test the function with sample data
print("Testing safe_load_json function:")
print(safe_load_json('{"en": "Boeing 737"}'))  # Expected output: Boeing 737
print(safe_load_json('{"wrong_key": "value"}'))  # Expected output: None
print(safe_load_json('Invalid JSON'))  # Expected output: None

# Apply the function to the 'model' column
aircrafts_data['model'] = aircrafts_data['model'].apply(safe_load_json)

# Print the 'model' column after applying the function
print("Modified 'model' column:")
print(aircrafts_data['model'].head())

# Drop rows where 'model' is None (indicating it was not valid JSON or missing␣
 ↪'en' field)
aircrafts_data = aircrafts_data.dropna(subset=['model'])

# Ensure 'range' is numeric
aircrafts_data['range'] = pd.to_numeric(aircrafts_data['range'],␣
 ↪errors='coerce')

# Check the data after conversion and dropping NaN values
print("Data after cleaning:")
print(aircrafts_data.head())
print(aircrafts_data.info())

# Plot the data
sns.set_style('dark')
fig, axes = plt.subplots(figsize=(12, 8))
ax = sns.barplot(x='model', y='range', data=aircrafts_data, palette='Paired')
for container in ax.containers:
    ax.bar_label(container)
plt.title('Airplane Models with Their Ranges')
plt.xticks(rotation=45)
plt.show()
```

```
Initial 'model' column:
0      {"en": "Boeing 777-300", "ru": "    777-300"}
1      {"en": "Boeing 767-300", "ru": "    767-300"}
2    {"en": "Sukhoi Superjet-100", "ru": "      …
3    {"en": "Airbus A320-200", "ru": "     A320-…
```

```
4    {"en": "Airbus A321-200", "ru": "     A321-…
Name: model, dtype: object
Testing safe_load_json function:
Boeing 737
None
None
Modified 'model' column:
0         Boeing 777-300
1         Boeing 767-300
2    Sukhoi Superjet-100
3        Airbus A320-200
4        Airbus A321-200
Name: model, dtype: object
Data after cleaning:
  aircraft_code                model  range
0           773       Boeing 777-300  11100
1           763       Boeing 767-300   7900
2           SU9  Sukhoi Superjet-100   3000
3           320      Airbus A320-200   5700
4           321      Airbus A321-200   5600
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9 entries, 0 to 8
Data columns (total 3 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   aircraft_code  9 non-null      object
 1   model          9 non-null      object
 2   range          9 non-null      int64
dtypes: int64(1), object(2)
memory usage: 344.0+ bytes
None
```

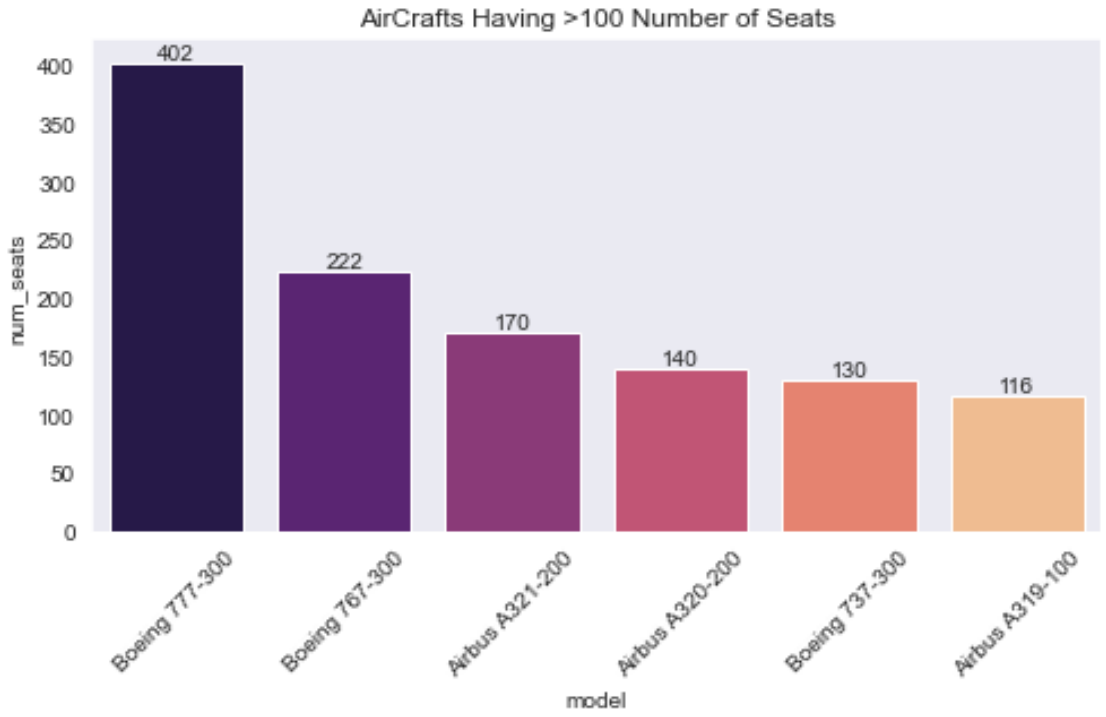


[30]:
```
df1  =  pd.read_sql_query("""SELECT s.aircraft_code, JSON_EXTRACT(model, '$.
 ↪en') AS model, COUNT(*) AS num_seats
                           FROM seats AS s
                           JOIN aircrafts_data AS a
                           ON s.aircraft_code = a.aircraft_code
                           GROUP BY s.aircraft_code
                           HAVING num_seats > 100
                           ORDER BY num_seats DESC""", conn)

df1
```

[30]:

	aircraft_code	model	num_seats
0	773	Boeing 777-300	402
1	763	Boeing 767-300	222
2	321	Airbus A321-200	170
3	320	Airbus A320-200	140
4	733	Boeing 737-300	130
5	319	Airbus A319-100	116

[22]:
```
sns.set_style('dark')
plt.figure(figsize = (8,4))
ax  =  sns.barplot(x = 'model', y = 'num_seats', data = df1, palette = 'magma')

for container in ax.containers:
    ax.bar_label(container)

plt.title('AirCrafts Having >100 Number of Seats')
plt.xticks(rotation = 45)
plt.show()
```



[24]:
```
tickets = pd.read_sql_query("""select ticket_no, SUBSTR(book_date,1,10) AS␣
 ↪date, total_amount from tickets inner join bookings
                    on tickets.book_ref = bookings.book_ref
                    group by date
                    order by date""", conn)

tickets.head(30)
```

[24]:

	ticket_no	date	total_amount
0	0005432628587	2017-06-21	52000
1	0005432984533	2017-06-22	123000
2	0005432150056	2017-06-23	64700
3	0005432056234	2017-06-24	13000

4	0005432034471	2017-06-25	6000
5	0005432045579	2017-06-26	14900
6	0005432002041	2017-06-27	17600
7	0005432003645	2017-06-28	99800
8	0005432000989	2017-06-29	24700
9	0005432000999	2017-06-30	6200
10	0005432002042	2017-07-01	18600
11	0005432002051	2017-07-02	17600
12	0005432000991	2017-07-03	30900
13	0005432000997	2017-07-04	6200
14	0005432000987	2017-07-05	12400
15	0005432000996	2017-07-06	6200
16	0005432000994	2017-07-07	13000
17	0005432002050	2017-07-08	18200
18	0005432001008	2017-07-09	6800
19	0005432002069	2017-07-10	48500
20	0005432001010	2017-07-11	6200
21	0005432001005	2017-07-12	6200
22	0005432001006	2017-07-13	12400
23	0005432002066	2017-07-14	17600
24	0005432001019	2017-07-15	18500
25	0005432001011	2017-07-16	6200
26	0005432001014	2017-07-17	13000
27	0005432001016	2017-07-18	24700
28	0005432001012	2017-07-19	6200
29	0005432001036	2017-07-20	6200

[25]:
```
tickets1 = pd.read_sql_query("""select SUBSTR(book_date,1,10) AS date,␣
 ↪COUNT(ticket_no) AS tickets, total_amount AS ticket_amount,␣
 ↪sum(total_amount) AS amount_sum from tickets inner join bookings
                    on tickets.book_ref = bookings.book_ref
                    group by date
                    order by date""", conn)
# tickets1 = tickets1.set_index('date', drop=True)

tickets1
```

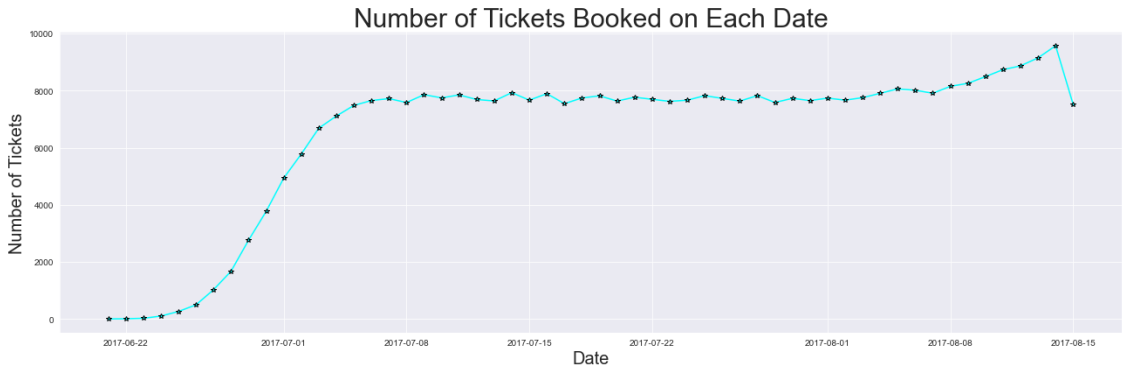
[25]:

	date	tickets	ticket_amount	amount_sum
0	2017-06-21	6	52000	916100
1	2017-06-22	12	123000	1536300
2	2017-06-23	28	64700	3114800
3	2017-06-24	106	13000	10279900
4	2017-06-25	266	6000	24652200
5	2017-06-26	499	14900	48710400
6	2017-06-27	1028	17600	88733500
7	2017-06-28	1678	99800	147624200
8	2017-06-29	2765	24700	248677900

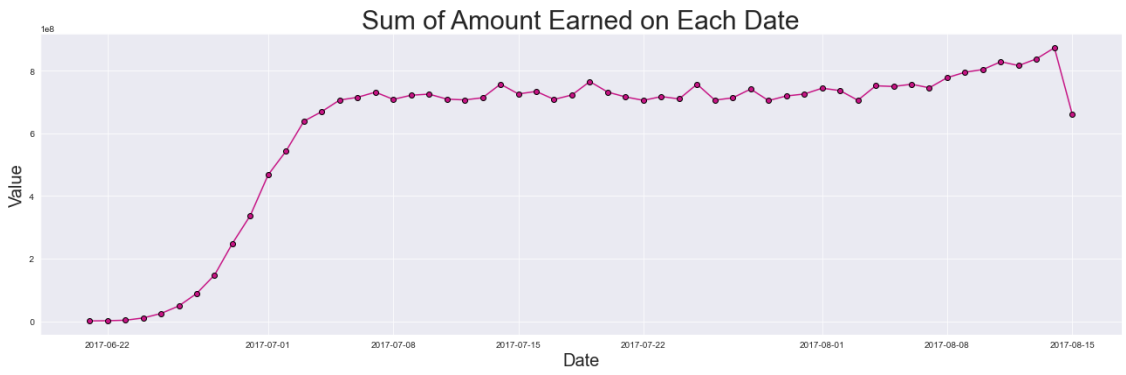
9	2017-06-30	3772	6200	337783200
10	2017-07-01	4936	18600	467702400
11	2017-07-02	5780	17600	543578700
12	2017-07-03	6686	30900	638962700
13	2017-07-04	7112	6200	669644600
14	2017-07-05	7484	12400	706500000
15	2017-07-06	7656	6200	715167600
16	2017-07-07	7722	13000	731683400
17	2017-07-08	7586	18200	708620300
18	2017-07-09	7860	6800	721829900
19	2017-07-10	7749	48500	725347200
20	2017-07-11	7852	6200	709394800
21	2017-07-12	7691	6200	706910000
22	2017-07-13	7641	12400	713833500
23	2017-07-14	7932	17600	757260400
24	2017-07-15	7668	18500	725966500
25	2017-07-16	7896	6200	733996100
26	2017-07-17	7546	13000	708451100
27	2017-07-18	7745	24700	722665100
28	2017-07-19	7821	6200	765583400
29	2017-07-20	7637	6200	731881400
30	2017-07-21	7771	18200	716349900
31	2017-07-22	7698	12400	705445900
32	2017-07-23	7627	18500	717578600
33	2017-07-24	7667	18600	709982200
34	2017-07-25	7826	12400	757098900
35	2017-07-26	7730	12400	706142400
36	2017-07-27	7636	12400	713584000
37	2017-07-28	7827	13000	741530900
38	2017-07-29	7588	12400	704732300
39	2017-07-30	7732	6200	719543000
40	2017-07-31	7653	6200	725615700
41	2017-08-01	7740	33300	744266100
42	2017-08-02	7669	12400	736683600
43	2017-08-03	7756	18500	705766100
44	2017-08-04	7908	6200	751993000
45	2017-08-05	8064	13000	749763200
46	2017-08-06	8016	35200	756903500
47	2017-08-07	7910	12400	745631800
48	2017-08-08	8153	12400	777964800
49	2017-08-09	8258	6200	795323800
50	2017-08-10	8493	12400	804007000
51	2017-08-11	8737	6200	828839200
52	2017-08-12	8870	17600	816555000
53	2017-08-13	9151	6200	838152000
54	2017-08-14	9574	30900	873462400
55	2017-08-15	7519	17600	660696300

[26]:
```
tickets1['date'] = pd.to_datetime(tickets1['date'])
```

[27]:
```
plt.figure(figsize=(18, 6))

plt.plot(tickets1.date, tickets1.tickets, label='Tickets', color='cyan',␣
 ↪scalex=True, marker='*', markeredgecolor = 'black')

plt.title('Number of Tickets Booked on Each Date', fontsize=30)
plt.xlabel('Date', fontsize=20)
plt.ylabel('Number of Tickets', fontsize=20)
plt.grid('dark')
plt.tight_layout()  # Ensures all elements fit within the figure area
plt.show()
```



[28]:
```
plt.figure(figsize=(18, 6))

# Plot the 'amount_sum' line
plt.plot(tickets1.date, tickets1.amount_sum, label='Amount Sum',␣
 ↪color='mediumvioletred', marker='o', markeredgecolor='black')

plt.title('Sum of Amount Earned on Each Date', fontsize=30)
plt.xlabel('Date', fontsize=20)
plt.ylabel('Value', fontsize=20)
plt.grid('dark')
plt.tight_layout()

plt.show()
```



[29]:
```
df2 = pd.read_sql_query("""SELECT a.aircraft_code, JSON_EXTRACT(model, '$.en')␣
↪AS model,
                           tf.fare_conditions AS class, avg(tf.amount) AS␣
↪avg_amount
                           FROM aircrafts_data AS a
                           JOIN flights AS f
                           ON a.aircraft_code = f.aircraft_code
                           JOIN ticket_flights AS tf
                           ON f.flight_id = tf.flight_id
                           GROUP BY model, class
                           ORDER BY avg_amount DESC""", conn)

df2
```

[29]:

	aircraft_code	model	class	avg_amount
0	319	Airbus A319-100	Business	113550.557703
1	763	Boeing 767-300	Business	82839.842866
2	773	Boeing 777-300	Business	57779.909435
3	733	Boeing 737-300	Business	41865.626175
4	319	Airbus A319-100	Economy	38311.402347
5	321	Airbus A321-200	Business	34435.662664
6	SU9	Sukhoi Superjet-100	Business	33487.849829
7	773	Boeing 777-300	Comfort	32740.552889
8	763	Boeing 767-300	Economy	27594.721829
9	773	Boeing 777-300	Economy	19265.225693
10	733	Boeing 737-300	Economy	13985.152000
11	CR2	Bombardier CRJ-200	Economy	13207.661102
12	321	Airbus A321-200	Economy	11534.974764
13	SU9	Sukhoi Superjet-100	Economy	11220.183400
14	CN1	Cessna 208 Caravan	Economy	6568.552345

[30]:
```
sns.set_style('dark')
plt.figure(figsize = (10,5))
```

```
ax  =  sns.barplot(x = 'model', y = 'avg_amount', hue = 'class', data = df2,␣
 ↪palette = 'cool')

for container in ax.containers:
    ax.bar_label(container)

plt.title('Average Price of Flights by Classes')
plt.xticks(rotation = 45)
plt.show()
```

[31]:
```
revenue  =  pd.read_sql_query("""SELECT aircraft_code, model, ticket_count,␣
 ↪total_revenue, total_revenue/ticket_count AS avg_revenue_per_ticket FROM
                                (SELECT a.aircraft_code, JSON_EXTRACT(model,␣
 ↪'$.en') AS model,
                                COUNT(*) AS ticket_count, SUM(tf.amount) AS␣
 ↪total_revenue FROM aircrafts_data AS a
                                JOIN flights AS f
                                ON a.aircraft_code = f.aircraft_code
                                JOIN ticket_flights AS tf
                                ON f.flight_id = tf.flight_id
                                GROUP BY a.aircraft_code)""", conn)
revenue
```

[31]:

	aircraft_code	model	ticket_count	total_revenue	avg_revenue_per_ticket
0	319	Airbus A319-100	52853	2706163100	51201
1	321	Airbus A321-200	107129	1638164100	15291
2	733	Boeing 737-300	86102	1426552100	16568
3	763	Boeing 767-300	124774	4371277100	35033
4	773	Boeing 777-300	144376	3431205500	23765
5	CN1	Cessna 208 Caravan	14672	96373800	6568
6	CR2	Bombardier CRJ-200	150122	1982760500	13207
7	SU9	Sukhoi Superjet-100	365698	5114484700	13985

[32]:

```
# Define the SQL query to create the view

# Drop the existing table 'bh' if it exists
drop_table_query = "DROP VIEW IF EXISTS flight_booked_seats;"
cursor.execute(drop_table_query)

# Create the view 'bbh'
create_view_query = """
CREATE VIEW flight_booked_seats AS
SELECT aircraft_code, flights.flight_id, COUNT(*) as seats_count
FROM boarding_passes
INNER JOIN flights
ON boarding_passes.flight_id=flights.flight_id
GROUP BY aircraft_code, flights.flight_id;
"""
cursor.execute(create_view_query)

# Commit the changes to the database
conn.commit()

# Now you can read the view data using a SELECT query
f_b_s = pd.read_sql_query("SELECT * FROM flight_booked_seats", conn)

f_b_s
```

[32]:

	aircraft_code	flight_id	seats_count
0	319	1162	51

```
1               319       1166           54
2               319       1167           57
3               319       1168           60
4               319       1170           58
…               …         …              …
11513           SU9       32925          12
11514           SU9       32928          25
11515           SU9       32931          12
11516           SU9       32933          16
11517           SU9       32937           6

[11518 rows x 3 columns]
```

[33]:
```
# Define the SQL query to create the view

# Drop the existing table 'num_seats' if it exists
drop_table_query = "DROP VIEW IF EXISTS num_seats;"
cursor.execute(drop_table_query)

# Create the view 'num_seats'
create_view_query = """
CREATE VIEW num_seats AS
SELECT s.aircraft_code, JSON_EXTRACT(model, '$.en') AS model, COUNT(*) AS␣
 ↪num_seats
                            FROM seats AS s
                            JOIN aircrafts_data AS a
                            ON s.aircraft_code = a.aircraft_code
                            GROUP BY s.aircraft_code

                            ORDER BY num_seats DESC;
"""
cursor.execute(create_view_query)

# Commit the changes to the database
conn.commit()

# Now you can read the view data using a SELECT query
num_seats = pd.read_sql_query("SELECT * FROM num_seats", conn)

num_seats
```

[33]:

	aircraft_code	model	num_seats
0	773	Boeing 777-300	402
1	763	Boeing 767-300	222
2	321	Airbus A321-200	170
3	320	Airbus A320-200	140
4	733	Boeing 737-300	130

```
5           319      Airbus A319-100        116
6           SU9  Sukhoi Superjet-100         97
7           CR2   Bombardier CRJ-200         50
8           CN1   Cessna 208 Caravan         12
```

[34]:
```
occupancy_rate  =  pd.read_sql_query("""SELECT a.aircraft_code, model, b.
 ↪num_seats, ROUND(AVG(a.seats_count)) AS booked_seats, AVG(a.seats_count)/b.
 ↪num_seats AS occupancy_rate
                                      FROM flight_booked_seats AS a
                                      JOIN num_seats AS b
                                      ON a.aircraft_code = b.aircraft_code
                                      GROUP BY a.aircraft_code
                                      ORDER BY occupancy_rate DESC""", conn)
occupancy_rate
```

[34]:

	aircraft_code	model	num_seats	booked_seats	occupancy_rate
0	773	Boeing 777-300	402	265.0	0.659019
1	733	Boeing 737-300	130	80.0	0.617350
2	SU9	Sukhoi Superjet-100	97	57.0	0.585692
3	321	Airbus A321-200	170	89.0	0.522407
4	763	Boeing 767-300	222	114.0	0.513231
5	CN1	Cessna 208 Caravan	12	6.0	0.500369
6	319	Airbus A319-100	116	54.0	0.461924
7	CR2	Bombardier CRJ-200	50	21.0	0.429657

[35]:
```
occupancy_rate['Inc occupancy_rate']  =  occupancy_rate['occupancy_rate']  + ␣
 ↪occupancy_rate['occupancy_rate'] * 0.1

occupancy_rate
```

[35]:

	aircraft_code	model	num_seats	booked_seats	occupancy_rate	\
0	773	Boeing 777-300	402	265.0	0.659019	
1	733	Boeing 737-300	130	80.0	0.617350	
2	SU9	Sukhoi Superjet-100	97	57.0	0.585692	
3	321	Airbus A321-200	170	89.0	0.522407	
4	763	Boeing 767-300	222	114.0	0.513231	
5	CN1	Cessna 208 Caravan	12	6.0	0.500369	
6	319	Airbus A319-100	116	54.0	0.461924	
7	CR2	Bombardier CRJ-200	50	21.0	0.429657	

	Inc occupancy_rate
0	0.724921
1	0.679085
2	0.644261
3	0.574648
4	0.564554
5	0.550406

```
6            0.508116
7            0.472623
```

[38]:
```
total_revenue = pd.read_sql_query("""SELECT aircraft_code, SUM(amount) as␣
 ↪total_revenue  FROM ticket_flights
                      JOIN flights
                      ON ticket_flights.flight_id=flights.flight_id
                      GROUP BY aircraft_code""", conn)

total_revenue
```

[38]:

	aircraft_code	total_revenue
0	319	2706163100
1	321	1638164100
2	733	1426552100
3	763	4371277100
4	773	3431205500
5	CN1	96373800
6	CR2	1982760500
7	SU9	5114484700

[39]:
```
# Set the float formatting options
pd.options.display.float_format = '{:.1f}'.format


occupancy_rate['Inc Total Annual Turnover']  =  (total_revenue['total_revenue']/
 ↪occupancy_rate['occupancy_rate']) * occupancy_rate['Inc occupancy_rate']

occupancy_rate
```

[39]:

	aircraft_code	model	num_seats	booked_seats	occupancy_rate	\
0	773	Boeing 777-300	402	265.0	0.7	
1	733	Boeing 737-300	130	80.0	0.6	
2	SU9	Sukhoi Superjet-100	97	57.0	0.6	
3	321	Airbus A321-200	170	89.0	0.5	
4	763	Boeing 767-300	222	114.0	0.5	
5	CN1	Cessna 208 Caravan	12	6.0	0.5	
6	319	Airbus A319-100	116	54.0	0.5	
7	CR2	Bombardier CRJ-200	50	21.0	0.4	

	Inc occupancy_rate	Inc Total Annual Turnover
0	0.7	2976779410.0
1	0.7	1801980510.0
2	0.6	1569207310.0
3	0.6	4808404810.0
4	0.6	3774326050.0
5	0.6	106011180.0

```
6                0.5              2181036550.0
7                0.5              5625933170.0
```

[ ]: