Analysis on the dataset related to Aviation Industry...

Importing Necessary Libraries

In [27]:
```python
import sqlite3
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
```

Database Connection

In [28]:
```python
connection = sqlite3.connect('travel.sqlite')
```

In [29]:
```python
# Extracting table names from the database.
table_list = pd.read_sql_query("SELECT name FROM sqlite_master where type = 'table'",connection)
print("Tables in the Database:")
print(table_list)
```

```
Tables in the Database:
              name
0   aircrafts_data
1    airports_data
2  boarding_passes
3         bookings
4          flights
5            seats
6   ticket_flights
7          tickets
```

In [30]:
```python
for table in table_list['name']:
    print(f'\nTable: {table}')
    columns_info = connection.execute(f"PRAGMA table_info({table})")
    for column in columns_info.fetchall():
        print(column[1:3])
```

```
Table: aircrafts_data
('aircraft_code', 'character(3)')
('model', 'jsonb')
('range', 'INTEGER')

Table: airports_data
('airport_code', 'character(3)')
('airport_name', 'jsonb')
('city', 'jsonb')
('coordinates', 'point')
('timezone', 'TEXT')

Table: boarding_passes
('ticket_no', 'character(13)')
('flight_id', 'INTEGER')
('boarding_no', 'INTEGER')
('seat_no', 'character varying(4)')

Table: bookings
('book_ref', 'character(6)')
('book_date', 'timestamp with time zone')
('total_amount', 'numeric(10,2)')

Table: flights
('flight_id', 'INTEGER')
('flight_no', 'character(6)')
('scheduled_departure', 'timestamp with time zone')
('scheduled_arrival', 'timestamp with time zone')
('departure_airport', 'character(3)')
('arrival_airport', 'character(3)')
('status', 'character varying(20)')
('aircraft_code', 'character(3)')
('actual_departure', 'timestamp with time zone')
('actual_arrival', 'timestamp with time zone')

Table: seats
('aircraft_code', 'character(3)')
('seat_no', 'character varying(4)')
('fare_conditions', 'character varying(10)')

Table: ticket_flights
('ticket_no', 'character(13)')
('flight_id', 'INTEGER')
('fare_conditions', 'character varying(10)')
('amount', 'numeric(10,2)')

Table: tickets
('ticket_no', 'character(13)')
('book_ref', 'character(6)')
('passenger_id', 'character varying(20)')
```

Data Exploration

In [31]:
```python
for table in table_list['name']:
    print('-'*50,f'{table}','-'*50)
    display(pd.read_sql_query(f"select * from {table} limit 5",connection))
```

-- aircrafts_data --

	aircraft_code	model	range
0	773	{"en": "Boeing 777-300", "ru": "Боинг 777-300"}	11100
1	763	{"en": "Boeing 767-300", "ru": "Боинг 767-300"}	7900
2	SU9	{"en": "Sukhoi Superjet-100", "ru": "Сухой Суп...	3000
3	320	{"en": "Airbus A320-200", "ru": "Аэробус A320-...	5700
4	321	{"en": "Airbus A321-200", "ru": "Аэробус A321-...	5600

-- airports_data --

	airport_code	airport_name	city	coordinates	timezone
0	YKS	{"en": "Yakutsk Airport", "ru": "Якутск"}	{"en": "Yakutsk", "ru": "Якутск"}	(129.77099609375,62.0932998657226562)	Asia/Yakutsk
1	MJZ	{"en": "Mirny Airport", "ru": "Мирный"}	{"en": "Mirnyj", "ru": "Мирный"}	(114.03900146484375,62.534698486328125)	Asia/Yakutsk
2	KHV	{"en": "Khabarovsk-Novy Airport", "ru": "Хабар...	{"en": "Khabarovsk", "ru": "Хабаровск"}	(135.18800354004,48.5279998779300001)	Asia/Vladivostok
3	PKC	{"en": "Yelizovo Airport", "ru": "Елизово"}	{"en": "Petropavlovsk", "ru": "Петропавловск-К...	(158.453994750976562,53.1679000854492188)	Asia/Kamchatka
4	UUS	{"en": "Yuzhno-Sakhalinsk Airport", "ru": "Хом...	{"en": "Yuzhno-Sakhalinsk", "ru": "Южно-Сахали...	(142.718002319335938,46.8886985778808594)	Asia/Sakhalin

-- boarding_passes --

	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

-- bookings --

	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

-- flights --

	flight_id	flight_no	scheduled_departure	scheduled_arrival	departure_airport	arrival_airport	status	aircraft_code	actual_departure	actual_arrival
0	1185	PG0134	2017-09-10 09:50:00+03	2017-09-10 14:55:00+03	DME	BTK	Scheduled	319	\N	\N
1	3979	PG0052	2017-08-25 14:50:00+03	2017-08-25 17:35:00+03	VKO	HMA	Scheduled	CR2	\N	\N
2	4739	PG0561	2017-09-05 12:30:00+03	2017-09-05 14:15:00+03	VKO	AER	Scheduled	763	\N	\N
3	5502	PG0529	2017-09-12 09:50:00+03	2017-09-12 11:20:00+03	SVO	UFA	Scheduled	763	\N	\N
4	6938	PG0461	2017-09-04 12:25:00+03	2017-09-04 13:20:00+03	SVO	ULV	Scheduled	SU9	\N	\N

-- seats --

	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

-- ticket_flights --

	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

-- tickets --

	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

In [32]:
```python
for table in table_list['name']:
    df = pd.read_sql_query(f"SELECT * FROM {table}", connection)
    print(f"Table: {table} - Shape: {df.shape}")
```

```
Table: aircrafts_data - Shape: (9, 3)
Table: airports_data - Shape: (104, 5)
Table: boarding_passes - Shape: (579686, 4)
Table: bookings - Shape: (262788, 3)
Table: flights - Shape: (33121, 10)
Table: seats - Shape: (1339, 3)
Table: ticket_flights - Shape: (1045726, 4)
Table: tickets - Shape: (366733, 3)
```

Checking for missing values in each column for every table.

In [33]:
```python
for table in table_list['name']:
    print(f'\nMissing Values in table {table}:')
    df_table = pd.read_sql_query(f"SELECT * FROM {table}", connection)
    print(df_table.isnull().sum())
```

```
Missing Values in table aircrafts_data:
aircraft_code    0
model            0
range            0
dtype: int64

Missing Values in table airports_data:
airport_code    0
airport_name    0
city            0
coordinates     0
timezone        0
dtype: int64

Missing Values in table boarding_passes:
ticket_no      0
flight_id      0
boarding_no    0
seat_no        0
dtype: int64

Missing Values in table bookings:
book_ref        0
book_date       0
total_amount    0
dtype: int64

Missing Values in table flights:
flight_id              0
flight_no              0
scheduled_departure    0
scheduled_arrival      0
departure_airport      0
arrival_airport        0
status                 0
aircraft_code          0
actual_departure       0
actual_arrival         0
dtype: int64

Missing Values in table seats:
aircraft_code      0
seat_no            0
fare_conditions    0
dtype: int64

Missing Values in table ticket_flights:
ticket_no          0
flight_id          0
fare_conditions    0
amount             0
dtype: int64

Missing Values in table tickets:
ticket_no       0
book_ref        0
passenger_id    0
dtype: int64
```

Basic Analysis

Aircraft having more than 100 seats

In [34]:
```python
seats = pd.read_sql_query(f"SELECT * FROM seats", connection)
seats.head()
```

Out[34]:

	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

In [35]:
```python
pd.read_sql_query(f"""SELECT aircraft_code, COUNT(*) as num_seats FROM seats
                        GROUP BY aircraft_code
                        HAVING num_seats > 100
                        ORDER BY num_seats DESC""", connection)
```

Out[35]:

	aircraft_code	num_seats
0	773	402
1	763	222
2	321	170
3	320	140
4	733	130
5	319	116

Number of tickets booked and total amount earned changing with the time?

In [36]:
```python
tickets = pd.read_sql_query(f"SELECT * FROM tickets", connection)
tickets.head()
```

Out[36]:

	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

In [37]:
```python
bookings = pd.read_sql_query(f"SELECT * FROM bookings", connection)
bookings.head()
```

Out[37]:

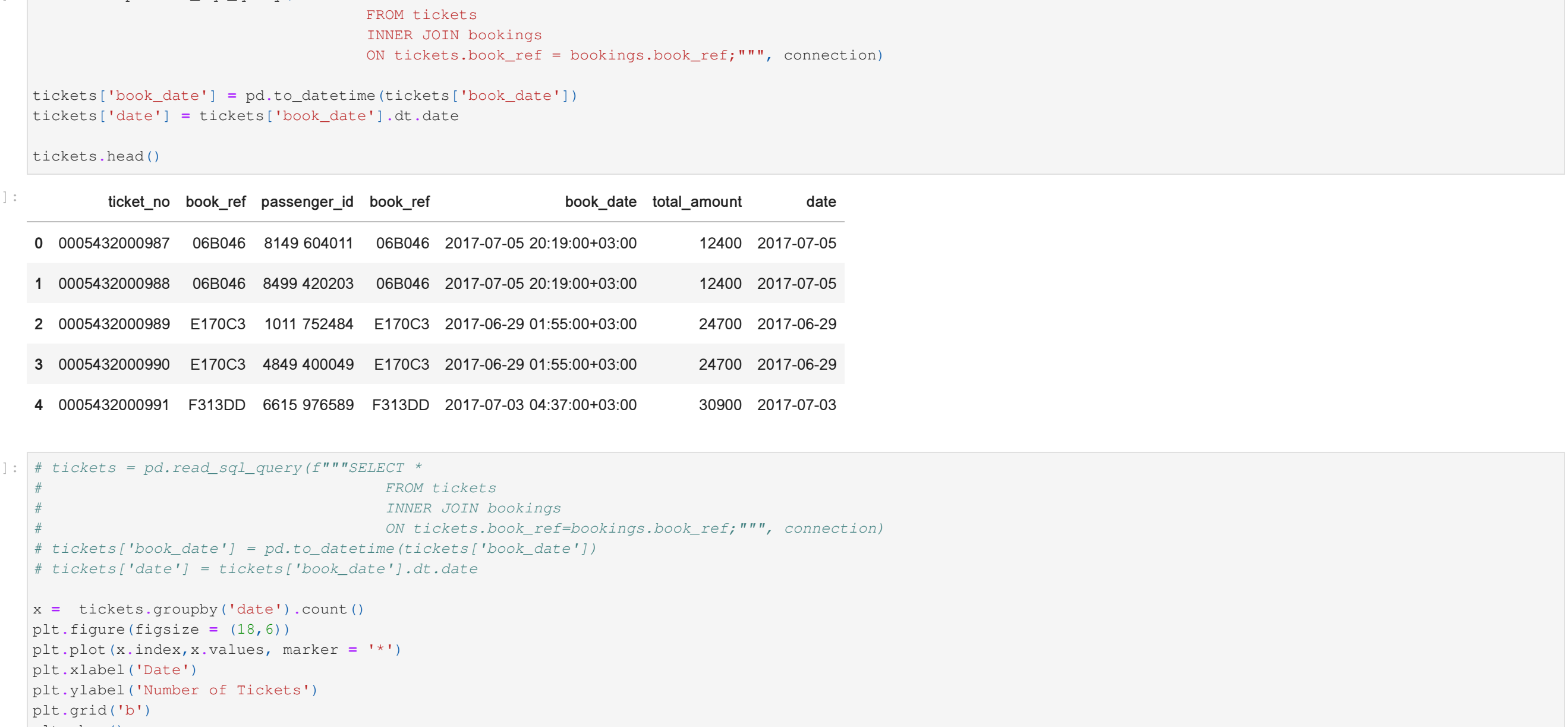
	book_ref	book_date	total_amount
0	00000F	2017-07-05 03:12:00+03	265700
1	000012	2017-07-14 09:02:00+03	37900
2	000068	2017-08-15 14:27:00+03	18100
3	000181	2017-08-10 13:28:00+03	131800
4	0002D8	2017-08-07 21:40:00+03	23600

In [38]:
```python
tickets = pd.read_sql_query(f"""SELECT *
                                    FROM tickets
                                    INNER JOIN bookings
                                    ON tickets.book_ref = bookings.book_ref;""", connection)

tickets['book_date'] = pd.to_datetime(tickets['book_date'])
tickets['date'] = tickets['book_date'].dt.date

tickets.head()
```

Out[38]:

	ticket_no	book_ref	passenger_id	book_ref	book_date	total_amount	date
0	0005432000987	06B046	8149 604011	06B046	2017-07-05 20:19:00+03:00	12400	2017-07-05
1	0005432000988	06B046	8499 420203	06B046	2017-07-05 20:19:00+03:00	12400	2017-07-05
2	0005432000989	E170C3	1011 752484	E170C3	2017-06-29 01:55:00+03:00	24700	2017-06-29
3	0005432000990	E170C3	4849 400049	E170C3	2017-06-29 01:55:00+03:00	24700	2017-06-29
4	0005432000991	F313DD	6615 976589	F313DD	2017-07-03 04:37:00+03:00	30900	2017-07-03

In [39]:
```python
# tickets = pd.read_sql_query(f"""SELECT *
#                                     FROM tickets
#                                     INNER JOIN bookings
#                                     ON tickets.book_ref=bookings.book_ref;""", connection)
# tickets['book_date'] = pd.to_datetime(tickets['book_date'])
# tickets['date'] = tickets['book_date'].dt.date

x =  tickets.groupby('date').count()
plt.figure(figsize = (18,6))
plt.plot(x.index,x.values, marker = '*')
plt.xlabel('Date')
plt.ylabel('Number of Tickets')
plt.grid('b')
plt.show()
```

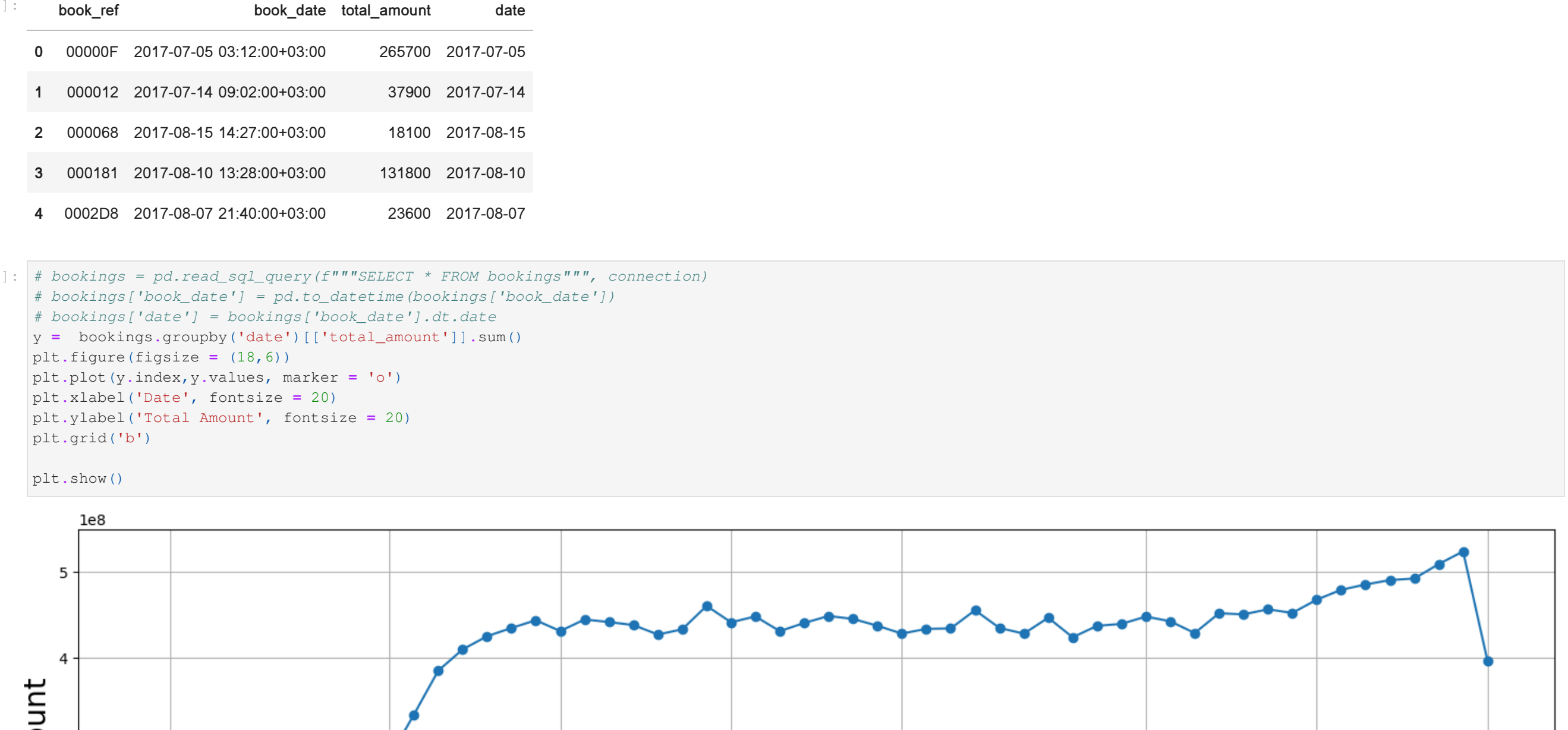


In [40]:
```python
bookings = pd.read_sql_query(f"""SELECT * FROM bookings""", connection)
bookings['book_date'] = pd.to_datetime(bookings['book_date'])
bookings['date'] = bookings['book_date'].dt.date
bookings.head()
```

Out[40]:

	book_ref	book_date	total_amount	date
0	00000F	2017-07-05 03:12:00+03:00	265700	2017-07-05
1	000012	2017-07-14 09:02:00+03:00	37900	2017-07-14
2	000068	2017-08-15 14:27:00+03:00	18100	2017-08-15
3	000181	2017-08-10 13:28:00+03:00	131800	2017-08-10
4	0002D8	2017-08-07 21:40:00+03:00	23600	2017-08-07

In [41]:
```python
# bookings = pd.read_sql_query(f"""SELECT * FROM bookings""", connection)
# bookings['book_date'] = pd.to_datetime(bookings['book_date'])
# bookings['date'] = bookings['book_date'].dt.date
y =  bookings.groupby('date')[['total_amount']].sum()
plt.figure(figsize = (18,6))
plt.plot(y.index,y.values, marker = 'o')
plt.xlabel('Date', fontsize = 20)
plt.ylabel('Total Amount', fontsize = 20)
plt.grid('b')

plt.show()
```



Average charges for each aircraft with different fare conditions.

In [42]:
```python
ticket_flights = pd.read_sql_query(f"SELECT * FROM ticket_flights", connection)
ticket_flights.head()
```

Out[42]:

	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

In [43]:
```python
flights = pd.read_sql_query(f"SELECT * FROM flights", connection)
flights.head()
```

Out[43]:

	flight_id	flight_no	scheduled_departure	scheduled_arrival	departure_airport	arrival_airport	status	aircraft_code	actual_departure	actual_arrival
0	1185	PG0134	2017-09-10 09:50:00+03	2017-09-10 14:55:00+03	DME	BTK	Scheduled	319	\N	\N
1	3979	PG0052	2017-08-25 14:50:00+03	2017-08-25 17:35:00+03	VKO	HMA	Scheduled	CR2	\N	\N
2	4739	PG0561	2017-09-05 12:30:00+03	2017-09-05 14:15:00+03	VKO	AER	Scheduled	763	\N	\N
3	5502	PG0529	2017-09-12 09:50:00+03	2017-09-12 11:20:00+03	SVO	UFA	Scheduled	763	\N	\N
4	6938	PG0461	2017-09-04 12:25:00+03	2017-09-04 13:20:00+03	SVO	ULV	Scheduled	SU9	\N	\N

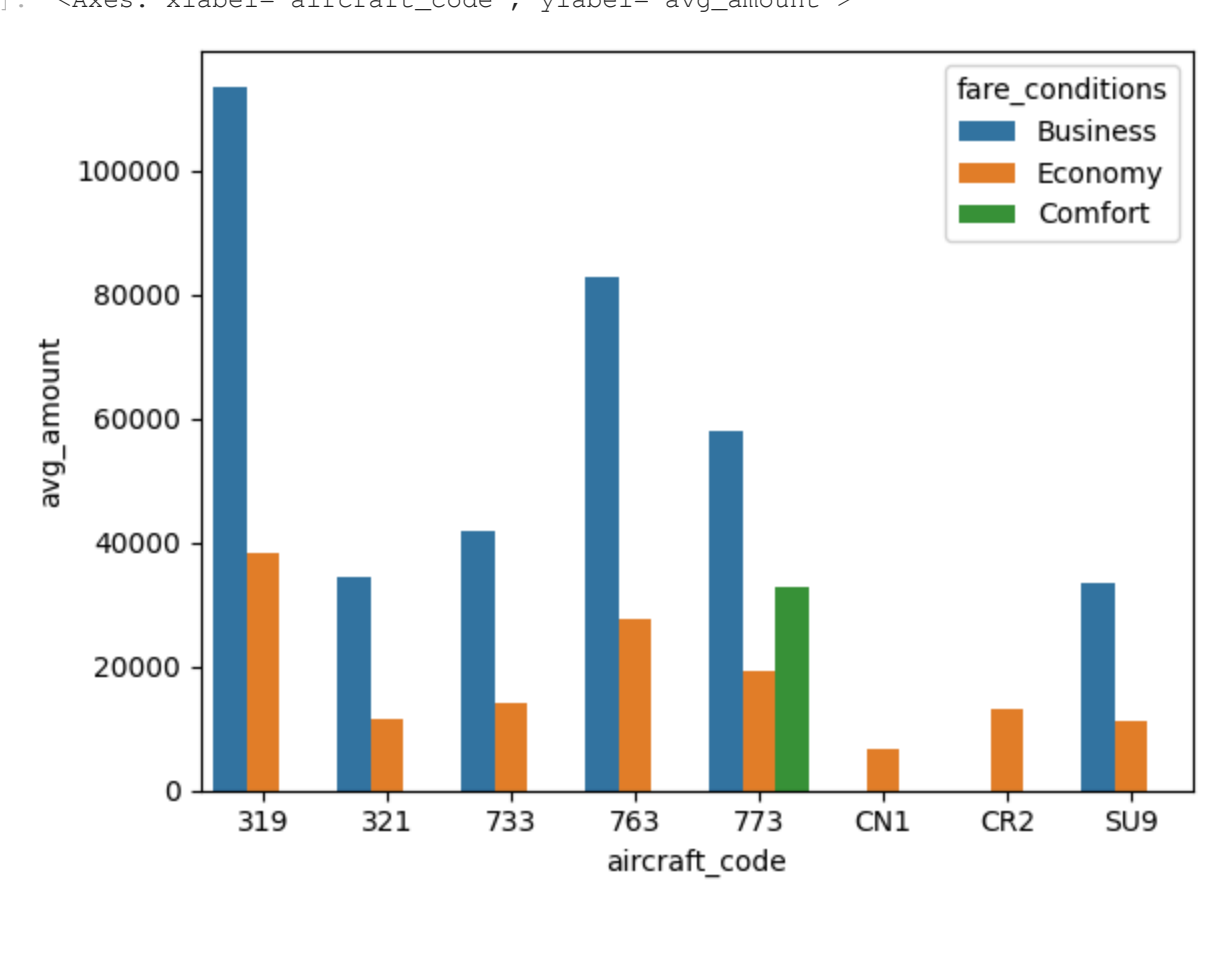
In [44]:
```python
df = pd.read_sql_query(f"""SELECT
                            fare_conditions, aircraft_code, AVG(amount) as avg_amount FROM ticket_flights as tf
                             JOIN flights as f
                             ON tf.flight_id=f.flight_id
                             GROUP BY aircraft_code, fare_conditions""", connection)
df
```

Out[44]:

	fare_conditions	aircraft_code	avg_amount
0	Business	319	113550.55770292656
1	Economy	319	38311.40234713914
2	Business	321	34435.66266431457
3	Economy	321	11534.97476439323
4	Business	733	41865.626175253856
5	Economy	733	13985.152
6	Business	763	82839.84286649604
7	Economy	763	27594.7218286053
8	Business	773	57779.90943535718
9	Comfort	773	32740.552888786075
10	Economy	773	19265.225693249846
11	Economy	CN1	6568.552344601963
12	Economy	CR2	13207.66110230346
13	Business	SU9	33487.84982935154
14	Economy	SU9	11220.183400305355

In [45]:
```python
# df = pd.read_sql_query(f"""SELECT
#                             fare_conditions, aircraft_code, AVG(amount) as avg_amount FROM ticket_flights as tf
#                              JOIN flights as f
#                              ON tf.flight_id=f.flight_id
#                              GROUP BY aircraft_code, fare_conditions""", connection)

sns.barplot( x = 'aircraft_code', y ='avg_amount', data = df, hue = 'fare_conditions')
```

Out[45]: `<Axes: xlabel='aircraft_code', ylabel='avg_amount'>`



Analyzing occupancy rate

Calculating the total revenue per year and the average revenue per ticket for each aircraft.

In [46]:
```python
pd.set_option('display.float_format', str)
```

In [47]:
```python
pd.read_sql_query(f"""SELECT aircraft_code, total_revenue, ticket_count, total_revenue/ticket_count as avg_revenue_per_ticket
                        FROM
                        (SELECT aircraft_code, COUNT(*) as ticket_count, SUM(amount) as total_revenue  FROM ticket_flights
                        JOIN flights
                        ON ticket_flights.flight_id=flights.flight_id
                        GROUP BY aircraft_code)""", connection)
```

Out[47]:

	aircraft_code	total_revenue	ticket_count	avg_revenue_per_ticket
0	319	2706163100	52853	51201
1	321	1638164100	107129	15291
2	733	1426552100	86102	16568
3	763	4371277100	124774	35033
4	773	3431205500	144376	23765
5	CN1	96373800	14672	6568
6	CR2	1982760500	150122	13207
7	SU9	5114484700	365698	13985

Calculating the average occupancy per aircraft.

In [48]:
```python
occupancy_rate = pd.read_sql_query(f"""SELECT a.aircraft_code, AVG(a.seats_count) as booked_seats, b.num_seats,
AVG(a.seats_count)/b.num_seats as occupancy_rate
                            FROM (
                                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
                                ) as a INNER JOIN
                                (
                                SELECT aircraft_code, COUNT(*) as num_seats FROM seats
                                GROUP BY aircraft_code
                                ) as b
                                ON a.aircraft_code = b.aircraft_code
                            GROUP BY a.aircraft_code""", connection)
occupancy_rate
```

Out[48]:

	aircraft_code	booked_seats	num_seats	occupancy_rate
0	319	53.58318098720292	116	0.46192397402761143
1	321	88.80923076923077	170	0.5224072398190045
2	733	80.25546218487395	130	0.617349709114415
3	763	113.93729372937294	222	0.5132310528350132
4	773	264.9258064516129	402	0.659019419033863
5	CN1	6.004431314623338	12	0.5003692762186115
6	CR2	21.48284690220174	50	0.42965693804403476
7	SU9	56.81211267605634	97	0.5856918832583128

Calculate by how much the total annual turnover could increase by giving all aircraft a 10% higher occupancy rate.

In [49]:
```python
occupancy_rate['Inc occupancy rate'] = occupancy_rate['occupancy_rate'] + occupancy_rate['occupancy_rate']*0.1
occupancy_rate
```

Out[49]:

	aircraft_code	booked_seats	num_seats	occupancy_rate	Inc occupancy rate
0	319	53.58318098720292	116	0.46192397402761143	0.5081163714303726
1	321	88.80923076923077	170	0.5224072398190045	0.574647963800905
2	733	80.25546218487395	130	0.617349709114415	0.6790846800258565
3	763	113.93729372937294	222	0.5132310528350132	0.5645541581185146
4	773	264.9258064516129	402	0.659019419033863	0.7249213609372492
5	CN1	6.004431314623338	12	0.5003692762186115	0.5504062038404727
6	CR2	21.48284690220174	50	0.42965693804403476	0.4726226318484382
7	SU9	56.81211267605634	97	0.5856918832583128	0.644261071584144

In [50]:
```python
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""", connection)

occupancy_rate['Inc Total Annual Turnover'] = (total_revenue['total_revenue']/occupancy_rate['occupancy_rate'])*occupancy_rate['Inc occupancy rate']
occupancy_rate
```

Out[50]:

	aircraft_code	booked_seats	num_seats	occupancy_rate	Inc occupancy rate	Inc Total Annual Turnover
0	319	53.58318098720292	116	0.46192397402761143	0.5081163714303726	2976779410.0
1	321	88.80923076923077	170	0.5224072398190045	0.574647963800905	1801980510.0
2	733	80.25546218487395	130	0.617349709114415	0.6790846800258565	1569207310.0000002
3	763	113.93729372937294	222	0.5132310528350132	0.5645541581185146	4808404810.0
4	773	264.9258064516129	402	0.659019419033863	0.7249213609372492	3774326050.0
5	CN1	6.004431314623338	12	0.5003692762186115	0.5504062038404727	106011180.00000001
6	CR2	21.48284690220174	50	0.42965693804403476	0.4726226318484382	2181036550.0
7	SU9	56.81211267605634	97	0.5856918832583128	0.644261071584144	5625933169.999999

In [51]:
```python
connection.close()
```

In [ ]: