Objective

The goal of this data analysis project usingsql would be to identify opportunities to increase the occupancy rate on low-performancing flights, which can ultimately lead to increased profitablity for the airline.

Importing Libraries

```
import sqlite3
import pandas as pd
import matplotlib.pyplot as plt
import warnings
import seaborn as sns
warnings.filterwarnings('ignore')
```

Database Connection

```
connection = sqlite3.connect('/content/travel.sqlite')
cursor = connection.cursor()
```

```
cursor.execute("""select name from sqlite_master where type = 'table';""")
print('List of tables present in the database')
table_list = [table[0] for table in cursor.fetchall()]
table_list
```

```
List of tables present in the database
['aircrafts_data',
 'airports_data',
 'boarding_passes',
 'bookings',
 'flights',
 'seats',
 'ticket_flights',
 'tickets']
```

Data Exploration

```
aircrafts_data = pd.read_sql_query("select * from aircrafts_data",connection)
aircrafts_data.head()
```

	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

Next steps: Generate code with aircrafts_data View recommended plots New interactive sheet

```
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
5	319	{"en": "Airbus A319-100", "ru": "Аэробус A319-...	6700
6	733	{"en": "Boeing 737-300", "ru": "Боинг 737-300"}	4200
7	CN1	{"en": "Cessna 208 Caravan", "ru": "Сессна 208...	1200
8	CR2	{"en": "Bombardier CRJ-200", "ru": "Бомбардье ...	2700

Next steps: Generate code with `aircrafts_data` View recommended plots New interactive sheet

Airports data

```
airports_data = pd.read_sql_query("select * from airports_data", connection)
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
...	...	...	...	...	...
99	MMK	{"en": "Murmansk Airport", "ru": "Мурманск"}	{"en": "Murmansk", "ru": "Мурманск"}	(32.7508010864257812,68.7817001342773438)	Europe/Moscow
100	ABA	{"en": "Abakan Airport", "ru": "Абакан"}	{"en": "Abakan", "ru": "Абакан"}	(91.3850021362304688,53.7400016784667969)	Asia/Krasnoyarsk
101	BAX	{"en": "Barnaul Airport", "ru": "Барнаул"}	{"en": "Barnaul", "ru": "Барнаул"}	(83.5384979248046875,53.363800048828125)	Asia/Krasnoyarsk
102	AAQ	{"en": "Anapa Vityazevo Airport", "ru":	{"en": "Anapa", "ru": "Анапа"}	(37.3473014831539984,45.002101898192997)	Europe/Moscow

Next steps: Generate code with `airports_data` View recommended plots New interactive sheet

#

Boarding Passes

```
boarding_passes = pd.read_sql_query("select * from boarding_passes", connection)
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
...	...	...	...	...
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 × 4 columns

Bookings

```
bookings = pd.read_sql_query("select * from bookings", connection)
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
...	...	...	...
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 × 3 columns

Flights

```
flights = pd.read_sql_query("select * from flights", connection)
flights
```

	flight_id	flight_no	scheduled_departure	scheduled_arrival	departure_airport	arrival_airport	status
0	1185	PG0134	2017-09-10 09:50:00+03	2017-09-10 14:55:00+03	DME	BTK	Scheduled
1	3979	PG0052	2017-08-25 14:50:00+03	2017-08-25 17:35:00+03	VKO	HMA	Scheduled
2	4739	PG0561	2017-09-05 12:30:00+03	2017-09-05 14:15:00+03	VKO	AER	Scheduled
3	5502	PG0529	2017-09-12 09:50:00+03	2017-09-12 11:20:00+03	SVO	UFA	Scheduled
4	6938	PG0461	2017-09-04 12:25:00+03	2017-09-04 13:20:00+03	SVO	ULV	Scheduled
...	...	...	...	...	...	...	...
33116	33117	PG0063	2017-08-02 19:25:00+03	2017-08-02 20:10:00+03	SKX	SVO	Arrived
33117	33118	PG0063	2017-07-28 19:25:00+03	2017-07-28 20:10:00+03	SKX	SVO	Arrived
33118	33119	PG0063	2017-09-08 19:25:00+03	2017-09-08 20:10:00+03	SKX	SVO	Scheduled
33119	33120	PG0063	2017-08-01 19:25:00+03	2017-08-01 20:10:00+03	SKX	SVO	Arrived
33120	33121	PG0063	2017-08-26 19:25:00+03	2017-08-26 20:10:00+03	SKX	SVO	Scheduled

33121 rows × 10 columns

Next steps: Generate code with `flights` View recommended plots New interactive sheet

Seats

```
seats = pd.read_sql_query("select * from seats", connection)
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
...	...	...	...
1334	773	48H	Economy
1335	773	48K	Economy
1336	773	49A	Economy
1337	773	49C	Economy
1338	773	49D	Economy

1339 rows × 3 columns

Next steps: Generate code with `seats` View recommended plots New interactive sheet

Tickets_flights

```
ticket_flights = pd.read_sql_query("select * from ticket_flights", connection)
ticket_flights = pd.read_sql_query("select * from ticket_flights", connection)
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
...	...	...	...	...
1045721	0005435097522	32094	Economy	5200
1045722	0005435097521	32094	Economy	5200
1045723	0005435104384	32094	Economy	5200
1045724	0005435104352	32094	Economy	5200
1045725	0005435104389	32094	Economy	5200

1045726 rows × 4 columns

Tickets

```
tickets = pd.read_sql_query("select * from tickets", connection)
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
...	...	...	...
366728	0005435999869	D730BA	0474 690760
366729	0005435999870	D730BA	6535 751108
366730	0005435999871	A1AD46	1596 156448
366731	0005435999872	7B6A53	9374 822707
366732	0005435999873	7B6A53	7380 075822

366733 rows × 3 columns

Data types of all the columns

```
for table in table_list:
    print('\ntable:', table)
    column_info = connection.execute("PRAGMA table_info({})".format(table))
    for column in column_info.fetchall():
        print(column)
```

```

table: aircrafts_data
(0, 'aircraft_code', 'character(3)', 1, None, 0)
(1, 'model', 'jsonb', 1, None, 0)
(2, 'range', 'INTEGER', 1, None, 0)

table: airports_data
(0, 'airport_code', 'character(3)', 1, None, 0)
```

```
(1, 'airport_name', 'jsonb', 1, None, 0)
(2, 'city', 'jsonb', 1, None, 0)
(3, 'coordinates', 'point', 1, None, 0)
(4, 'timezone', 'TEXT', 1, None, 0)

table: boarding_passes
(0, 'ticket_no', 'character(13)', 1, None, 0)
(1, 'flight_id', 'INTEGER', 1, None, 0)
(2, 'boarding_no', 'INTEGER', 1, None, 0)
(3, 'seat_no', 'character varying(4)', 1, None, 0)

table: bookings
(0, 'book_ref', 'character(6)', 1, None, 0)
(1, 'book_date', 'timestamp with time zone', 1, None, 0)
(2, 'total_amount', 'numeric(10,2)', 1, None, 0)

table: flights
(0, 'flight_id', 'INTEGER', 1, None, 0)
(1, 'flight_no', 'character(6)', 1, None, 0)
(2, 'scheduled_departure', 'timestamp with time zone', 1, None, 0)
(3, 'scheduled_arrival', 'timestamp with time zone', 1, None, 0)
(4, 'departure_airport', 'character(3)', 1, None, 0)
(5, 'arrival_airport', 'character(3)', 1, None, 0)
(6, 'status', 'character varying(20)', 1, None, 0)
(7, 'aircraft_code', 'character(3)', 1, None, 0)
(8, 'actual_departure', 'timestamp with time zone', 0, None, 0)
(9, 'actual_arrival', 'timestamp with time zone', 0, None, 0)

table: seats
(0, 'aircraft_code', 'character(3)', 1, None, 0)
(1, 'seat_no', 'character varying(4)', 1, None, 0)
(2, 'fare_conditions', 'character varying(10)', 1, None, 0)

table: ticket_flights
(0, 'ticket_no', 'character(13)', 1, None, 0)
(1, 'flight_id', 'INTEGER', 1, None, 0)
(2, 'fare_conditions', 'character varying(10)', 1, None, 0)
(3, 'amount', 'numeric(10,2)', 1, None, 0)

table: tickets
(0, 'ticket_no', 'character(13)', 1, None, 0)
(1, 'book_ref', 'character(6)', 1, None, 0)
(2, 'passenger_id', 'character varying(20)', 1, None, 0)
```

Checking the missing values

```
for table in table_list:
    print('\ntable: ',table)
    df_table = pd.read_sql_query(f"select * from {table}", connection)
    print(df_table.isnull().sum())
```

```
table:  aircrafts_data
aircraft_code    0
model            0
range            0
dtype: int64

table:  airports_data
airport_code    0
airport_name    0
city            0
coordinates     0
timezone        0
dtype: int64

table:  boarding_passes
ticket_no      0
flight_id      0
boarding_no    0
seat_no        0
dtype: int64

table:  bookings
book_ref        0
book_date       0
```

```
total_amount    0
dtype: int64

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

table:  seats
aircraft_code      0
seat_no            0
fare_conditions    0
dtype: int64

table:  ticket_flights
ticket_no          0
flight_id          0
fare_conditions    0
amount             0
dtype: int64

table:  tickets
ticket_no       0
book_ref        0
passenger_id    0
```

Basic Analysis

How many planes have more than 100 seats?

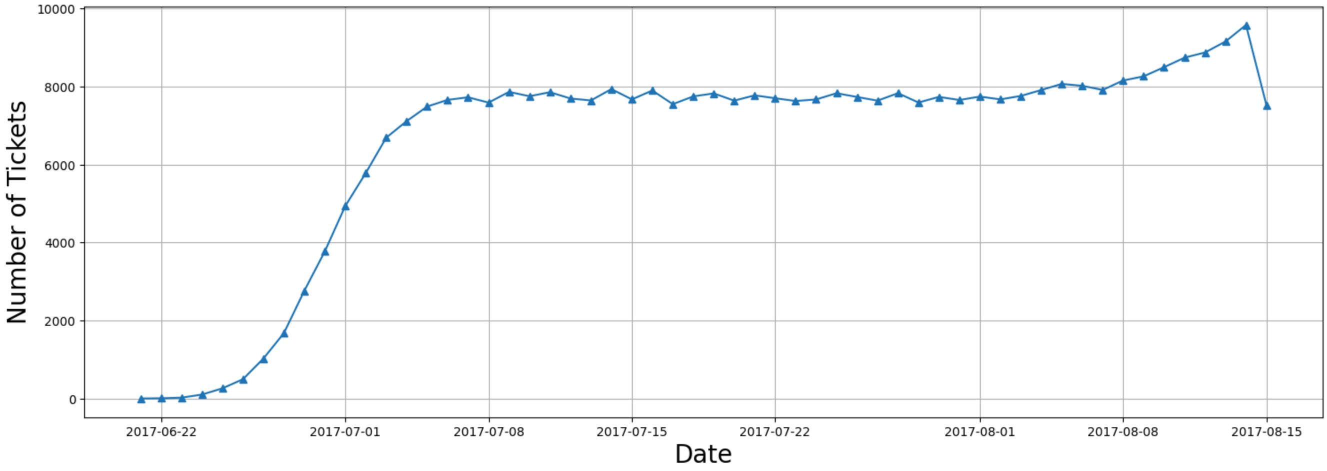
```
pd.read_sql_query("""select aircraft_code, count(*) as num_seats from seats group by aircraft_code having num_seats >
```

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

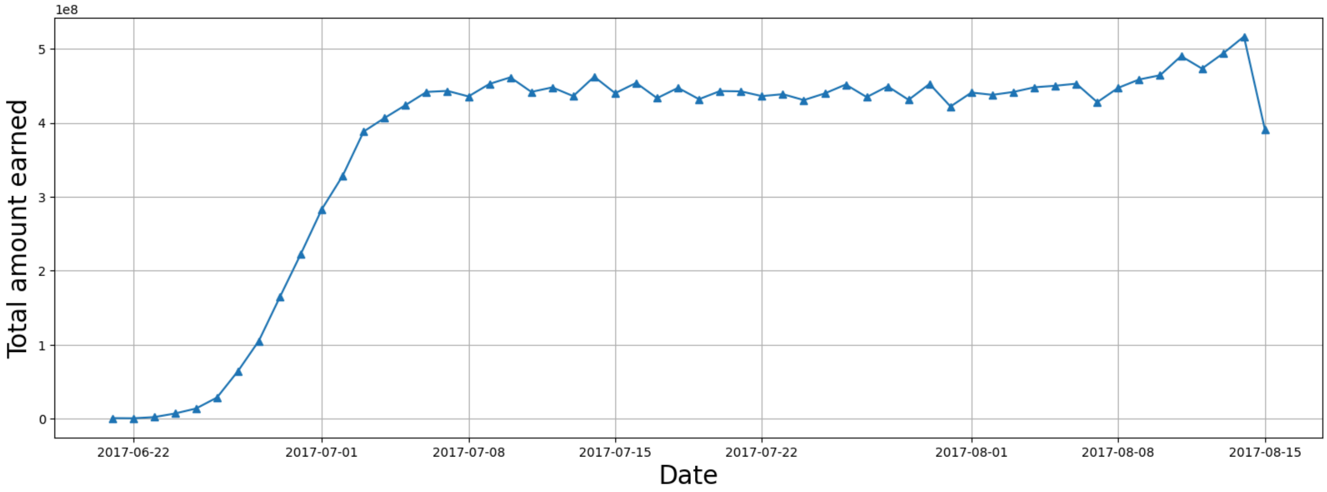
How the number of tickets booked and total amount earned changed with the time

```
tickets = pd.read_sql_query("""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')[['date']].count()
plt.figure(figsize = (18,6))
plt.plot(x.index, x['date'], marker = '^')
plt.xlabel('Date', fontsize = 20)
plt.ylabel('Number of Tickets', fontsize = 20)
plt.grid('b')
plt.show()
```



```
bookings = pd.read_sql_query("select * from bookings", connection)
bookings['book_date'] = pd.to_datetime(tickets['book_date'])
bookings['date'] = bookings['book_date'].dt.date
x = bookings.groupby('date')[['total_amount']].sum()
plt.figure(figsize = (18,6))
plt.plot(x.index, x['total_amount'], marker = '^')
plt.xlabel('Date', fontsize = 20)
plt.ylabel('Total amount earned', fontsize = 20)
plt.grid('b')
plt.show()
```

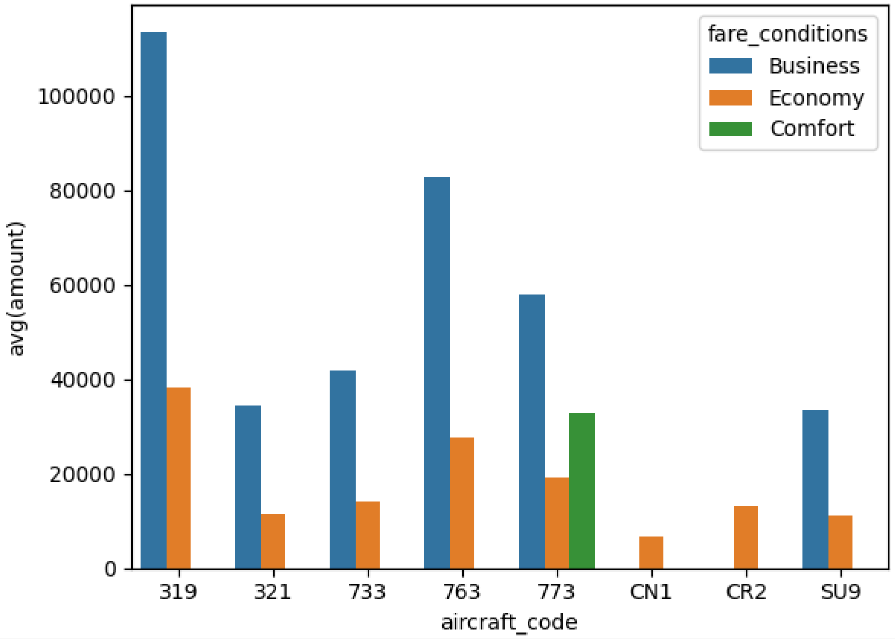


Calculate the average charges for each aircraft with different fare conditions.

```
df = pd.read_sql_query("""select fare_conditions, aircraft_code, avg(amount)
                        from ticket_flights join flights on ticket_flights.flight_id = flights.flight_id
                        group by aircraft_code, fare_conditions""", connection)
```

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

```
<Axes: xlabel='aircraft_code', ylabel='avg(amount)'>
```



Analyzing occupancy rate

For each aircraft, calculate the total revenue per year and the average revenue per ticket.

```
pd.read_sql_query("""select aircraft_code, ticket_count, total_revenue, total_revenue/ticket_count as avg_revenue_per_
(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)""", connectio
```

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

Calculate the average occupancy per aircraft.

```
occupancy_rate = pd.read_sql_query("""select a.aircraft_code, avg(a.seats_count) as booked_seats, b.num_seats, avg(a.s
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
```

	aircraft_code	booked_seats	num_seats	occupancy_rate
0	319	53.583181	116	0.461924
1	321	88.809231	170	0.522407
2	733	80.255462	130	0.617350
3	763	113.937294	222	0.513231
4	773	264.925806	402	0.659019
5	CN1	6.004431	12	0.500369
6	CR2	21.482847	50	0.429657
7	SU9	56.812113	97	0.585692

Next steps: Generate code with occupancy_rate View recommended plots New interactive sheet

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

```
occupancy_rate['Inc occupancy rate'] = occupancy_rate['occupancy_rate']+occupancy_rate['occupancy_rate']*0.1
occupancy_rate
```

	aircraft_code	booked_seats	num_seats	occupancy_rate	Inc occupancy rate
0	319	53.583181	116	0.461924	0.508116
1	321	88.809231	170	0.522407	0.574648
2	733	80.255462	130	0.617350	0.679085
3	763	113.937294	222	0.513231	0.564554
4	773	264.925806	402	0.659019	0.724921
5	CN1	6.004431	12	0.500369	0.550406
6	CR2	21.482847	50	0.429657	0.472623
7	SU9	56.812113	97	0.585692	0.644261

Next steps: Generate code with occupancy_rate View recommended plots New interactive sheet

check total revinue

```
pd.set_option("display.float_format",str)
```

```
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'])*occupan

occupancy_rate
```

	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