Airbnb Business Analysis

Loading libraries

In [639]:

```
# Loading libraries for data analysis.
import pandas as pd
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import datetime as dt
from sklearn.preprocessing import normalize
```

Loading Files

In [640]:

```
# Set with web sessions log data for users
sessions=pd.read_csv('../JUPYTER_TMP/Data/Final/sessions.csv')
```

In [641]:

```
# Main Set with representative sample data of new users
train=pd.read_csv(
                    filepath_or_buffer='../JUPYTER_TMP/Data/Final/train_users_2.csv',
                    parse_dates=['date_account_created','timestamp_first_active','date_first_booking'])
```

In [642]:

```
## summary statistics of users' age group,gender, country of destination
age=pd.read_csv('../JUPYTER_TMP/Data/Final/age_gender_bkts.csv')
```

Data preview

In [643]:

```
# Preview sessions Table
sessions.head(2)
```

Out[643]:

	user_id	action	action_type	action_detail	device_type	secs_elapsed
0	d1mm9tcy42	lookup	NaN	NaN	Windows Desktop	319.0
1	d1mm9tcy42	search_results	click	view_search_results	Windows Desktop	67753.0

In [644]:

```
# Preview train Table
train.head(5)
```

Out[644]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	-unknown-	NaN	f
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	MALE	38.0	f
2	4ft3gnwmtx	2010-09-28	2009-06-09 23:12:47	2010-08-02	FEMALE	56.0	
3	bjjt8pjhuk	2011-12-05	2009-10-31 06:01:29	2012-09-08	FEMALE	42.0	f
4	87mebub9p4	2010-09-14	2009-12-08 06:11:05	2010-02-18	-unknown-	41.0	

In [645]:

```
# Preview age Table
age.head(2)
```

Out[645]:

	age_bucket	country_destination	gender	population_in_thousands	year
0	100+	AU	male	1.0	2015.0
1	95-99	AU	male	9.0	2015.0

Data Information

In [646]:

```
# Data type information of sessions Table
print(sessions.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10567737 entries, 0 to 10567736
Data columns (total 6 columns):
user_id          object
action           object
action_type      object
action_detail    object
device_type      object
secs_elapsed     float64
dtypes: float64(1), object(5)
memory usage: 483.8+ MB
None
```

In [647]:

```python
# Data type information of train Table
print(train.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 213451 entries, 0 to 213450
Data columns (total 16 columns):
id                         213451 non-null object
date_account_created       213451 non-null datetime64[ns]
timestamp_first_active     213451 non-null datetime64[ns]
date_first_booking         88908 non-null datetime64[ns]
gender                     213451 non-null object
age                        125461 non-null float64
signup_method              213451 non-null object
signup_flow                213451 non-null int64
language                   213451 non-null object
affiliate_channel          213451 non-null object
affiliate_provider         213451 non-null object
first_affiliate_tracked    207386 non-null object
signup_app                 213451 non-null object
first_device_type          213451 non-null object
first_browser              213451 non-null object
country_destination        213451 non-null object
dtypes: datetime64[ns](3), float64(1), int64(1), object(11)
memory usage: 26.1+ MB
None
```

In [648]:

```python
# Data type information of age Table
print(age.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 420 entries, 0 to 419
Data columns (total 5 columns):
age_bucket                 420 non-null object
country_destination        420 non-null object
gender                     420 non-null object
population_in_thousands    420 non-null float64
year                       420 non-null float64
dtypes: float64(2), object(3)
memory usage: 16.5+ KB
None
```

Analysis by age groups

In [649]:

```python
## Calculate % of never booking users
never_booking=(len(train)-train['date_first_booking'].count())/len(train)*100
print(f'The percent of users that never booking is {round(never_booking,2)}% from total new users')
```

```
The percent of users that never booking is 58.35% from total new users
```

Next step we check this rate according age group

In [650]:

```
# Creating groups by age group
train['age_group']=train['age'].apply(lambda x: '15-24' if 15<=x<25    # group age co
lumn creating
                                            else '25-34' if 25<=x<35
                                            else '35-44' if 35<=x<45
                                            else '45-54' if 45<=x<55
                                            else '55-64' if 55<=x<65
                                            else '65+'   if 65<=x<=85
                                            else 'n/a')
##Note: According to Airbnb practices, only an 18-year-old person can open an accoun
t.
    #In contrast, a company does not require age pre-registration and it is possible
 that 15 to 18 year olds
     #can also place an order on their own. Therefore, for research:
        #all customers who did not specify their age or age below 15 are defined as
 N/A.
        #all customers who did not specify their age or age more 85 are defined as N/
A.
```

In [651]:

```
i=len(train[train['age_group']=='n/a'])
print(f'The number new users without age is {i}') #number users without age setting
print(f'The percent new users without age is {round(i/len(train),3)*100}%') #percent
 users without age setting
```

```
The number new users without age is 90691
The percent new users without age is 42.5%
```

In [652]:

```
## Create users table with age group only
train_with_age=train[~(train['age_group']=='n/a')]
train_with_age.head(1)
```

Out[652]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_metl
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	MALE	38.0	faceb

In [653]:

```
# Grouping by age groups
count_booking_by_age=train_with_age.groupby('age_group')[['id','date_first_booking']]
.count()\
.rename(columns={'id':'total_users','date_first_booking':'number_booked_users'})
# Adding users rate from total users by each age group column
count_booking_by_age['users_rate_from_total_users']=round(count_booking_by_age['total
_users']/len(train_with_age),2)
# Adding percentege orders from total orders by each age group column
count_booking_by_age['booked_rate_from_total_users']=\
                          round(count_booking_by_age['number_booked_users']/train_wit
h_age['date_first_booking'].count(),2)
count_booking_by_age
```

Out[653]:

	total_users	number_booked_users	users_rate_from_total_users	booked_rate_from_total_users
age_group				
15-24	10778	5428	0.09	0.08
25-34	55694	32054	0.45	0.48
35-44	30759	16834	0.25	0.25
45-54	14521	7149	0.12	0.11
55-64	7599	3904	0.06	0.06
65+	3409	1743	0.03	0.03

In [654]:

```
# calculate booked rate by age groups
age_booking_rate=count_booking_by_age.assign(booked_rate_in_age_group=round(count_boo
king_by_age['number_booked_users']\
                                             /count_booking_by_age['total_users'],2
))
age_booking_rate=age_booking_rate[['users_rate_from_total_users','booked_rate_from_to
tal_users','booked_rate_in_age_group']]
age_booking_rate
#users_rate_from_total_users--> show the percent age group users from total users.
#booked_rate_from_total_users--> show how many orders booked  certain age group from
 the total orders.
#booked_rate--> show percentage who make a first booking within an age group.
```

Out[654]:

	users_rate_from_total_users	booked_rate_from_total_users	booked_rate_in_age_group
age_group			
15-24	0.09	0.08	0.50
25-34	0.45	0.48	0.58
35-44	0.25	0.25	0.55
45-54	0.12	0.11	0.49
55-64	0.06	0.06	0.51
65+	0.03	0.03	0.51

In [655]:

```
# Using "age" the table to get data on a total population in USA
 #will not take age groups under 15 age for research.
mask=(age['country_destination']=='US')&(~age['age_bucket'].isin(['0-4','5-9','10-14'
]))
age_usa=age[mask]
age_usa=age_usa.assign(age_group=age_usa['age_bucket']\
.apply(lambda x : '15-24' if x in (['15-19','20-24'])                  #distribution
 into age groups
             else '25-34' if x in (['25-29','30-34'])
             else '35-44' if x in (['35-39','40-44'])
             else '45-54' if x in (['45-49','50-54'])
             else '55-64' if x in (['55-59','60-64'])
             else '65+'))
age_usa.head()
```

Out[655]:

	age_bucket	country_destination	gender	population_in_thousands	year	age_group
378	90-94	US	female	1193.0	2015.0	65+
379	75-79	US	male	3641.0	2015.0	65+
380	70-74	US	male	5278.0	2015.0	65+
381	65-69	US	male	7561.0	2015.0	65+
382	60-64	US	male	9217.0	2015.0	55-64

In [656]:

```
# grouping by age group and calculating percentage of total study population
age_usa_group=age_usa.groupby('age_group')['population_in_thousands'].sum().to_frame
()
age_usa_group=age_usa_group.assign(rate_of_total_study_population=age_usa_group['popu
lation_in_thousands']\
                    .apply(lambda x:round(x/(age_usa_group['population_in_thousands']
.sum()),2)))
age_usa_group=age_usa_group['rate_of_total_study_population'].to_frame()
age_usa_group
```

Out[656]:

	rate_of_total_study_population
age_group	
15-24	0.17
25-34	0.17
35-44	0.16
45-54	0.17
55-64	0.16
65+	0.18

In [657]:

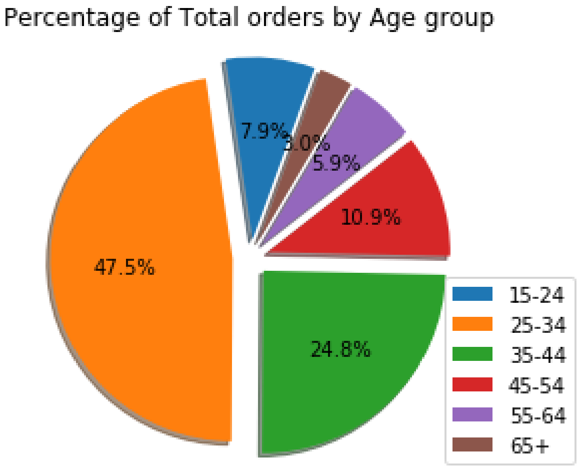
```
#join 'age_booking_rate' table with 'age_usa_group' table
age_summary_tbl=age_booking_rate.merge(age_usa_group,how='left',left_on='age_group',r
ight_on='age_group')
age_summary_tbl
#columns:
    #users_rate_from_total_users--> show the percent age group users from total user
s.
    #booked_rate_from_total_users--> show how many orders booked  certain age group f
rom the total orders.
    #booked_rate_in_age_group--> show percentage who make a first booking within an a
ge group.
    #rate_of_total_study_population--> percentage of total study population in USA.
```

Out[657]:

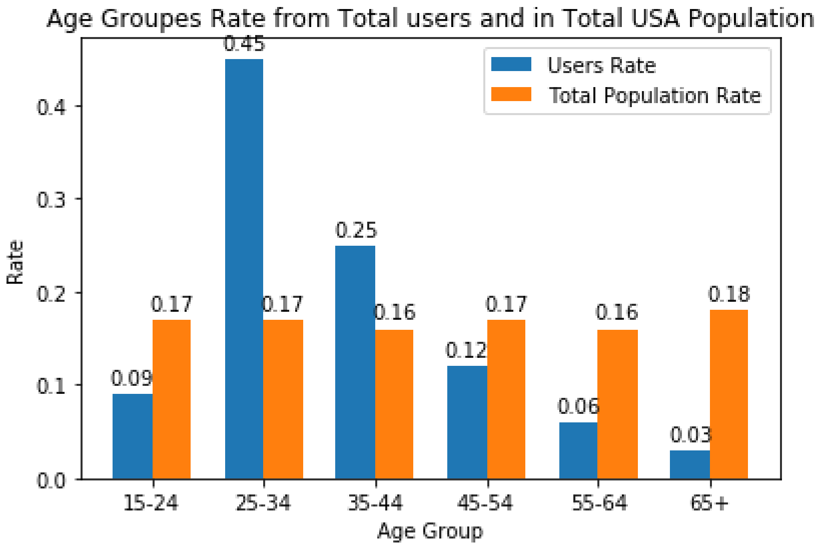
	users_rate_from_total_users	booked_rate_from_total_users	booked_rate_in_age_group	rate_of_
age_group				
15-24	0.09	0.08	0.50	
25-34	0.45	0.48	0.58	
35-44	0.25	0.25	0.55	
45-54	0.12	0.11	0.49	
55-64	0.06	0.06	0.51	
65+	0.03	0.03	0.51	

In [658]:

```
# Pie chart Percentage of Total orders by Age group
p_size = age_summary_tbl['booked_rate_from_total_users']
p_labels = age_summary_tbl.index

plt.pie(p_size, startangle=70, explode = (0.1, 0.1, 0.1,0.1,0.1,0.1),autopct='%1.1f%%
', shadow=True)
plt.title('Percentage of Total orders by Age group')
plt.axis('equal')
plt.legend(p_labels)
plt.show()
```

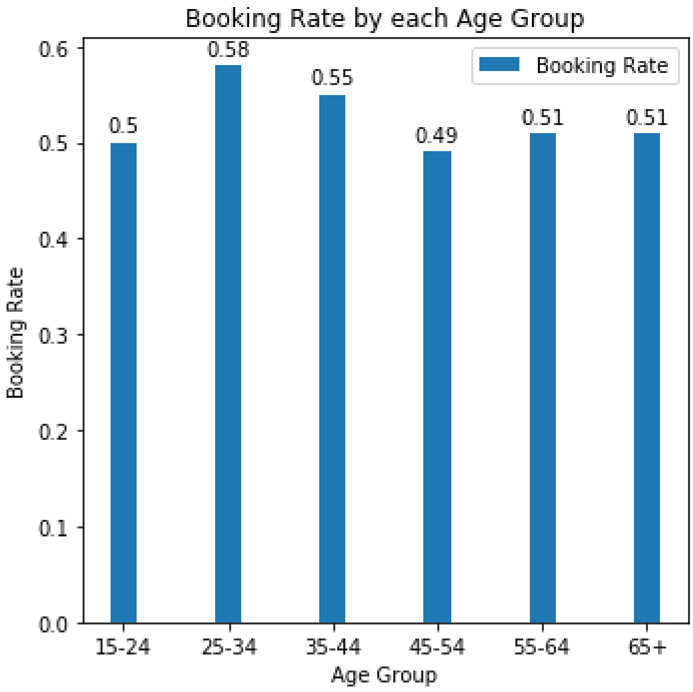


In [659]:
```
# Bar chart Age Groupes Rate from Total users and in Total USA Population
labels = age_summary_tbl.index
Users = age_summary_tbl['users_rate_from_total_users']
Population = age_summary_tbl['rate_of_total_study_population']

x = np.arange(len(labels))  # the label locations
width = 0.35  # the width of the bars

fig, ax = plt.subplots()
rects1 = ax.bar(x-width/2, Users, width, label='Users Rate')
rects2 = ax.bar(x+width/2, Population, width, label='Total Population Rate')

# Add some text for labels, title and custom x-axis tick labels, etc.
ax.set_ylabel('Rate')
ax.set_xlabel('Age Group')
ax.set_title('Age Groupes Rate from Total users and in Total USA Population')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend(loc=1)

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')

autolabel(rects1)
autolabel(rects2)
fig.tight_layout()
plt.show()
```



In [660]:

```
# Bar chart Booking Rate in each Age Group
labels = age_summary_tbl.index
Booking_rate=age_summary_tbl['booked_rate_in_age_group']

x = np.arange(len(labels))  # the label locations
width = 0.25  # the width of the bars

fig, ax = plt.subplots(figsize=(5,5))
rects1 = ax.bar(x , Booking_rate, width, label='Booking Rate')

# Add some text for labels, title and custom x-axis tick labels, etc.
ax.set_ylabel('Booking Rate')
ax.set_xlabel('Age Group')
ax.set_title('Booking Rate by each Age Group')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend(loc=1)

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



Country destination by age

In [661]:

```
# Creating table to analize booking destination of ech age group
mask=train_with_age['country_destination']=='NDF'
age_country=train_with_age[~mask][['age_group','country_destination','id']]
age_country.head(2)
```

Out[661]:

	age_group	country_destination	id
2	55-64	US	4ft3gnwmtx
3	35-44	other	bjjt8pjhuk

In [662]:

```
# Total orders by each age group
age_group_total_orders=age_country.groupby('age_group')['country_destination'].count
().to_frame()\
.rename(columns={'country_destination':'total_orders'})
age_group_total_orders
```

Out[662]:

	total_orders
age_group	
15-24	5428
25-34	32054
35-44	16834
45-54	7149
55-64	3904
65+	1743

In [663]:

```
# Making a pivot table number orders for each country by age groups.
age_country_pvt=age_country.pivot_table(index='age_group',columns='country_destinatio
n',
                                                  values='id',aggfunc='count')
age_country_pvt
```

Out[663]:

country_destination	AU	CA	DE	ES	FR	GB	IT	NL	PT	US	other
age_group											
15-24	25	73	82	238	364	173	238	77	16	3527	615
25-34	187	467	371	766	1503	678	829	256	78	23444	3475
35-44	124	292	207	384	932	427	475	147	32	11895	1919
45-54	54	133	86	162	474	229	233	51	13	4968	746
55-64	27	62	57	83	243	154	131	38	13	2657	439
65+	11	27	30	40	134	73	77	20	4	1123	204

In [664]:

```python
#Join tables total orders by age group and orders to each country by age group.
age_country_total_pvt=age_country_pvt.merge(age_group_total_orders,how='inner',left_on='age_group',right_on='age_group')
age_country_total_pvt
```

Out[664]:

	AU	CA	DE	ES	FR	GB	IT	NL	PT	US	other	total_orders
age_group												
15-24	25	73	82	238	364	173	238	77	16	3527	615	5428
25-34	187	467	371	766	1503	678	829	256	78	23444	3475	32054
35-44	124	292	207	384	932	427	475	147	32	11895	1919	16834
45-54	54	133	86	162	474	229	233	51	13	4968	746	7149
55-64	27	62	57	83	243	154	131	38	13	2657	439	3904
65+	11	27	30	40	134	73	77	20	4	1123	204	1743

In [665]:

```python
# Find percent orders to each country from total orders by each age group
age_country_total_pvt[['AU','CA','DE','ES','FR','GB','IT','NL','PT','US','other']]\
=normalize(age_country_total_pvt[['AU','CA','DE','ES','FR','GB','IT','NL','PT','US','other']], axis=1, norm="l1")
```

In [666]:

```python
# Preferences can now be clearly seen
age_country_rates=age_country_total_pvt[['AU','CA','DE','ES','FR','GB','IT','NL','PT','US','other']]
age_country_rates
```

Out[666]:

	AU	CA	DE	ES	FR	GB	IT	NL	PT	
age_group										
15-24	0.004606	0.013449	0.015107	0.043847	0.067060	0.031872	0.043847	0.014186	0.002948	0.
25-34	0.005834	0.014569	0.011574	0.023897	0.046890	0.021152	0.025863	0.007987	0.002433	0.
35-44	0.007366	0.017346	0.012297	0.022811	0.055364	0.025365	0.028217	0.008732	0.001901	0.
45-54	0.007554	0.018604	0.012030	0.022661	0.066303	0.032032	0.032592	0.007134	0.001818	0.
55-64	0.006916	0.015881	0.014600	0.021260	0.062244	0.039447	0.033555	0.009734	0.003330	0.
65+	0.006311	0.015491	0.017212	0.022949	0.076879	0.041882	0.044177	0.011474	0.002295	0.

In [667]:

```python
# Before rank results will make unpivot table
age_country_rates_upvt=age_country_rates.reset_index().melt(id_vars='age_group',
                                    value_vars=age_country_rates.columns,
                                    var_name='country',
                                    value_name='rate')
age_country_rates_upvt.head(2)
```

Out[667]:

	age_group	country	rate
0	15-24	AU	0.004606
1	25-34	AU	0.005834

In [668]:

```
# Rank by booking rate  to each country by each age group.
rnk=age_country_rates_upvt.groupby('age_group')['rate'].rank(method='min',ascending=F
alse)
age_country_rates_upvt_rnk=age_country_rates_upvt\
.assign(rate_rank=rnk)\
.sort_values(['age_group','rate'],ascending=[True,False])
age_country_rates_upvt_rnk.head(1)
```

Out[668]:

	age_group	country	rate	rate_rank
54	15-24	US	0.649779	1.0

In [669]:

```
# Round rate column.
age_country_rates_upvt_rnk['rate']=round(age_country_rates_upvt_rnk['rate'],2)
```

In [670]:

```
age_country_rates_upvt_rnk.head(1)
```

Out[670]:

	age_group	country	rate	rate_rank
54	15-24	US	0.65	1.0

In [671]:

```
# Top country destination by booking rate in each Age group.
top_countries=age_country_rates_upvt_rnk[age_country_rates_upvt_rnk['rate_rank']<=1]
[['age_group','country','rate']]\
.set_index('age_group')
top_countries
```

Out[671]:

	country	rate
age_group		
15-24	US	0.65
25-34	US	0.73
35-44	US	0.71
45-54	US	0.69
55-64	US	0.68
65+	US	0.64

In [672]:

```
# Because in each group the USA is more than 60% of total booking rate, will check ot
her destinations without US.
 # Top 2 country destination by booking rate in each Age group.
top_countries_2=age_country_rates_upvt_rnk[age_country_rates_upvt_rnk['rate_rank']==2
][['age_group','country','rate']]\
.set_index('age_group')
top_countries_2
```

Out[672]:

	country	rate
age_group		
15-24	other	0.11
25-34	other	0.11
35-44	other	0.11
45-54	other	0.10
55-64	other	0.11
65+	other	0.12

In [673]:

```
# Top 3 country destination by booking rate in each Age group.
top_countries_3=age_country_rates_upvt_rnk[age_country_rates_upvt_rnk['rate_rank']==3
][['age_group','country','rate']]\
.set_index('age_group')
top_countries_3
```

Out[673]:

	country	rate
age_group		
15-24	FR	0.07
25-34	FR	0.05
35-44	FR	0.06
45-54	FR	0.07
55-64	FR	0.06
65+	FR	0.08

Analysis by gender

In [674]:

```
# Calculate percentage of users without sex definition
mask=(train['gender']=='-unknown-')|(train['gender']=='OTHER')
i=train[mask]['gender'].count()/len(train)
print(f'Percentage of users without sex definition is {round((i),4)*100}%')
```

```
Percentage of users without sex definition is 44.96%
```

In [675]:

```
# Filtering to create users table with  gender settings only.
mask=(train['gender']=='-unknown-')|(train['gender']=='OTHER')
male_female_users=len(train[~mask])
train_male_female=train[~mask].groupby('gender')['id'].count().to_frame()\
.rename(columns={'id':'Number users'})
train_male_female
```

Out[675]:

	Number users
gender	
FEMALE	63041
MALE	54440

In [676]:

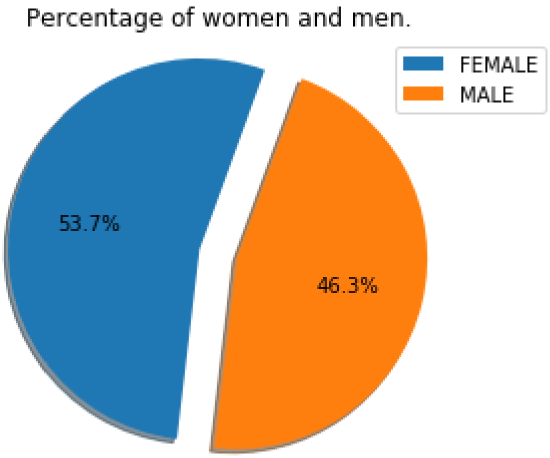
```
# Percentage of women and men.(only users with gender settings)
train_male_female_pct=(train_male_female['Number users']/male_female_users).to_frame
()
train_male_female_pct
```

Out[676]:

	Number users
gender	
FEMALE	0.536606
MALE	0.463394

In [677]:

```python
# Pie chart percentage of women and men.
p_size = train_male_female_pct['Number users']
p_labels = train_male_female_pct.index

plt.pie(p_size, startangle=70, explode = (0.1, 0.1),autopct='%1.1f%%', shadow=True)
plt.title('Percentage of women and men.')
plt.axis('equal')
plt.legend(p_labels)
plt.show()
```



In [678]:

```python
# create table with total users and ordered users by gender.
mask=(train['gender']=='-unknown-')|(train['gender']=='OTHER')
train_gender_only=train[~mask]
gender_orders=train_gender_only.groupby('gender')[['id','date_first_booking']].count
()\
.rename(columns={'id':'total','date_first_booking':'ordered'})
gender_orders
```

Out[678]:

	total	ordered
gender		
FEMALE	63041	31993
MALE	54440	27721

In [679]:

```python
# Calculate booking rate by gender.
gender_orders['pct_booking']=gender_orders['ordered']/gender_orders['total']
```

In [680]:

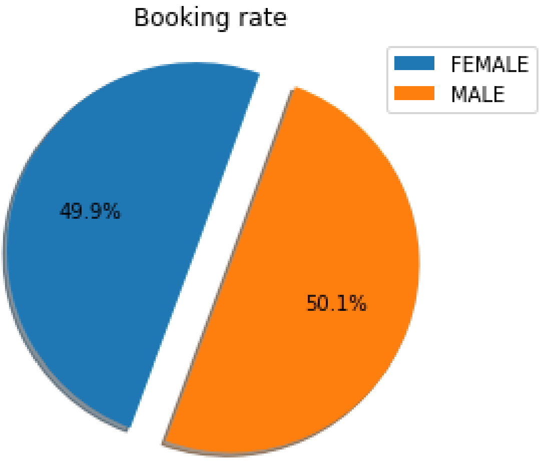
```python
gender_orders
```

Out[680]:

	total	ordered	pct_booking
gender			
FEMALE	63041	31993	0.507495
MALE	54440	27721	0.509203

In [681]:

```
# Pie chart booking rate by gender.
p_size = gender_orders['pct_booking']
p_labels = gender_orders.index

plt.pie(p_size, startangle=70, explode = (0.1, 0.1),autopct='%1.1f%%', shadow=True)
plt.title('Booking rate')
plt.axis('equal')
plt.legend(p_labels)
plt.show()
```



In [682]:

```
# Total orders by age and country destination.
train_gender_only=train_gender_only[~(train_gender_only['country_destination']=='NDF'
)]
train_gender_only_pvt=train_gender_only.pivot_table(index='gender',columns='country_d
estination',values='id',aggfunc='count')
train_gender_only_pvt
```

Out[682]:

country_destination	AU	CA	DE	ES	FR	GB	IT	NL	PT	US	other
gender											
FEMALE	207	455	358	853	1962	881	1091	254	78	22694	3160
MALE	188	477	416	677	1335	682	699	278	69	19457	3443

In [683]:

```
# Join to add 'total' column
train_gender_only_pvt=train_gender_only_pvt.merge(gender_orders['ordered'],how='inne
r',left_on='gender',right_on='gender')\
.rename(columns={'ordered':'total'}) # join to make table with 'total' column
train_gender_only_pvt
```

Out[683]:

	AU	CA	DE	ES	FR	GB	IT	NL	PT	US	other	total
gender												
FEMALE	207	455	358	853	1962	881	1091	254	78	22694	3160	31993
MALE	188	477	416	677	1335	682	699	278	69	19457	3443	27721

In [684]:

```
# Find percent orders to each country from total orders by each age group
train_gender_only_pvt[['AU','CA','DE','ES','FR','GB','IT','NL','PT','US','other']]\
=normalize(train_gender_only_pvt[['AU','CA','DE','ES','FR','GB','IT','NL','PT','US',
'other']], axis=1, norm="l1")
```

In [685]:

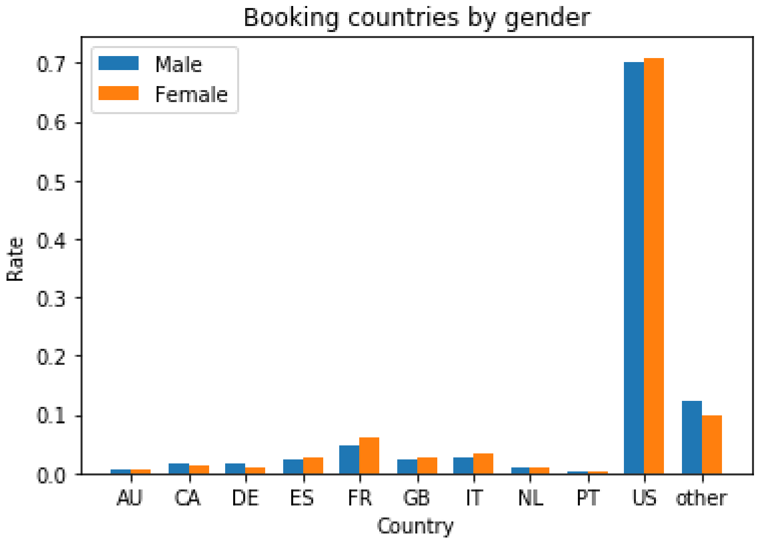
```python
# Table with booking rate to each country by gender.
gender_country_rates=train_gender_only_pvt[['AU','CA','DE','ES','FR','GB','IT','NL',
'PT','US','other']]
gender_country_rates=gender_country_rates.transpose()
gender_country_rates
```

Out[685]:

gender	FEMALE	MALE
AU	0.006470	0.006782
CA	0.014222	0.017207
DE	0.011190	0.015007
ES	0.026662	0.024422
FR	0.061326	0.048158
GB	0.027537	0.024602
IT	0.034101	0.025216
NL	0.007939	0.010028
PT	0.002438	0.002489
US	0.709343	0.701887
other	0.098772	0.124202

In [686]:

```python
# Bar chart booking rate to each country by gender.
fig, ax = plt.subplots()
bar_width = 0.35
x_axis_labels = gender_country_rates.index
x_axis_1 = np.arange(len(x_axis_labels))
y_axis_1 = gender_country_rates['MALE']
y_axis_2 = gender_country_rates['FEMALE']
ax.bar(x_axis_1, y_axis_1,bar_width,label='Male')
ax.bar(x_axis_1+bar_width, y_axis_2,bar_width,label='Female')
ax.set_xticks(np.arange(len(x_axis_labels))+bar_width/2)
ax.set_xticklabels(x_axis_labels)
ax.set_ylabel('Rate')
ax.set_xlabel('Country')
ax.set_title('Booking countries by gender')
ax.legend()
plt.show()
```



Gender and age drilldown

In [687]:

```
# Filtering to create users table with age and gender settings only.
mask1=~(train['age_group']=='n/a')
mask2=~((train['gender']=='-unknown-')|(train['gender']=='OTHER'))
train_age_gender=train[mask1&mask2]
train_age_gender.head(2)
```

Out[687]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_me
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	MALE	38.0	face
2	4ft3gnwmtx	2010-09-28	2009-06-09 23:12:47	2010-08-02	FEMALE	56.0	

In [688]:

```
 # Pivot table with number users with gender settings by age group
train_age_gender_pvt=train_age_gender.pivot_table(index='age_group',columns='gender',
values='id',aggfunc='count')
train_age_gender_pvt
```

Out[688]:

gender	FEMALE	MALE
age_group		
15-24	5622	3578
25-34	26300	22492
35-44	13073	13515
45-54	6306	6178
55-64	3742	2744
65+	1549	1337

In [689]:

```
# Add total column.
train_age_gender_pvt['Total']=train_age_gender_pvt['FEMALE']+train_age_gender_pvt['MA
LE']
```

In [690]:

```
# Calculate percent and round from total.
train_age_gender_pvt['FEMALE']=round((train_age_gender_pvt['FEMALE']/train_age_gender
_pvt['Total']),2)
train_age_gender_pvt['MALE']=round((train_age_gender_pvt['MALE']/train_age_gender_pvt
['Total']),2)
train_age_gender_pvt
```

Out[690]:

gender	FEMALE	MALE	Total
age_group			
15-24	0.61	0.39	9200
25-34	0.54	0.46	48792
35-44	0.49	0.51	26588
45-54	0.51	0.49	12484
55-64	0.58	0.42	6486
65+	0.54	0.46	2886

In [691]:

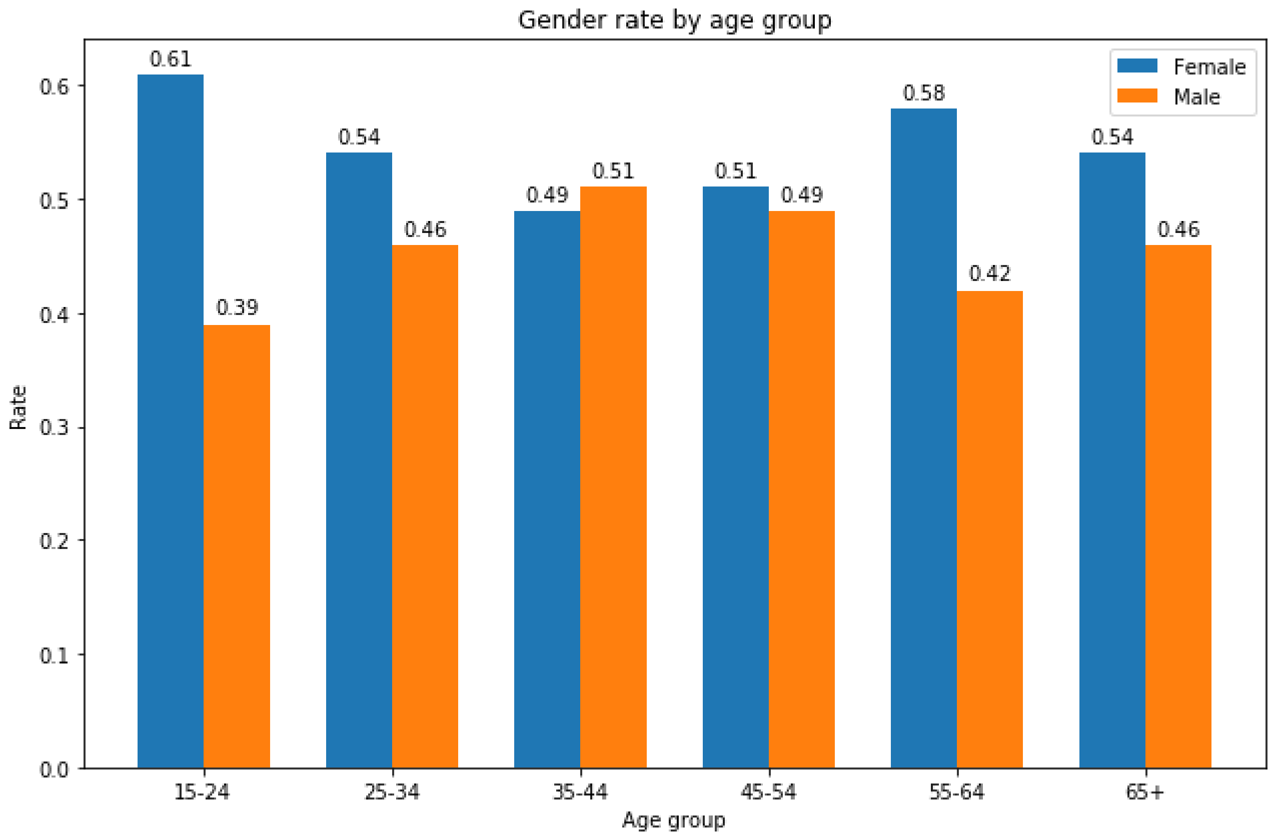
```
# Create table with gender rate by age group
train_age_gender_pvt=train_age_gender_pvt[['FEMALE','MALE']]
train_age_gender_pvt
```

Out[691]:

```
   gender  FEMALE  MALE
age_group
    15-24    0.61  0.39
    25-34    0.54  0.46
    35-44    0.49  0.51
    45-54    0.51  0.49
    55-64    0.58  0.42
      65+    0.54  0.46
```

In [692]:

```python
# Bar chart Users Rate in each Age Group by gender.
labels = train_age_gender_pvt.index
Female= train_age_gender_pvt['FEMALE']
Male = train_age_gender_pvt['MALE']

x = np.arange(len(labels))  # the label locations
width = 0.35  # the width of the bars
fig, ax = plt.subplots(figsize=(9,6))
rects1 = ax.bar(x - width/2, Female, width, label='Female')
rects2 = ax.bar(x + width/2, Male, width, label='Male')
ax.set_ylabel('Rate')
ax.set_xlabel('Age group')
ax.set_title('Gender rate by age group')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
autolabel(rects2)
fig.tight_layout()
plt.show()
```



In [693]:

```python
# Create pivot table with number users with first booking by gender in each age group.
train_age_gender_pvt_2=train_age_gender.pivot_table(index='age_group',columns='gender',values='date_first_booking',
                                                    aggfunc='count')\
.rename(columns={'FEMALE':'Female_orders','MALE':'Male_orders'})
train_age_gender_pvt_2
```

Out[693]:

gender	Female_orders	Male_orders
age_group		
15-24	2766	1655
25-34	14663	12240
35-44	6730	7082
45-54	2824	2949
55-64	1783	1346
65+	722	670

In [694]:

```python
# Create pivot table with total users by gender in each age group.
train_age_gender_pvt_1=train_age_gender.pivot_table(index='age_group',columns='gender',values='id',aggfunc='count')\
.rename(columns={'FEMALE':'Females_total','MALE':'Male_total'})
train_age_gender_pvt_1
```

Out[694]:

gender	Females_total	Male_total
age_group		
15-24	5622	3578
25-34	26300	22492
35-44	13073	13515
45-54	6306	6178
55-64	3742	2744
65+	1549	1337

In [695]:

```python
# Join tables with total users and users with booking by gender and age group.
train_age_gender_pvt_3=train_age_gender_pvt_2.merge(train_age_gender_pvt_1,how='inner',left_on='age_group',right_on='age_group')
train_age_gender_pvt_3
```

Out[695]:

gender	Female_orders	Male_orders	Females_total	Male_total
age_group				
15-24	2766	1655	5622	3578
25-34	14663	12240	26300	22492
35-44	6730	7082	13073	13515
45-54	2824	2949	6306	6178
55-64	1783	1346	3742	2744
65+	722	670	1549	1337

In [696]:

```
# Booking group by gender and age group.
train_age_gender_rate=train_age_gender_pvt_3\
.assign(Female_booking_rate=round(train_age_gender_pvt_3['Female_orders']/train_age_g
ender_pvt_3['Females_total'],2)\
       ,Male_booking_rate=round(train_age_gender_pvt_3['Male_orders']/train_age_gende
r_pvt_3['Male_total'],2))\
[['Female_booking_rate','Male_booking_rate']]
```

In [697]:

```
train_age_gender_rate
```

Out[697]:

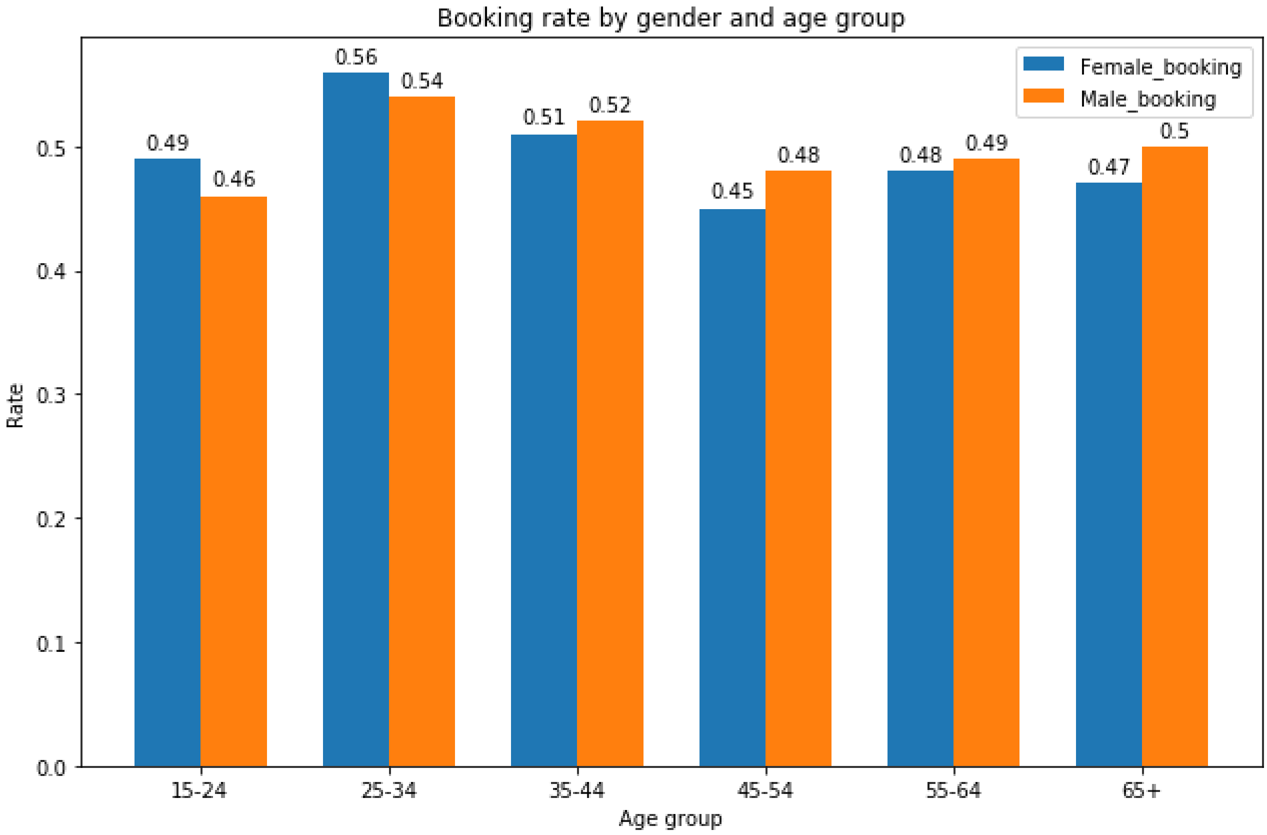
gender	**Female_booking_rate**	**Male_booking_rate**
age_group		
15-24	0.49	0.46
25-34	0.56	0.54
35-44	0.51	0.52
45-54	0.45	0.48
55-64	0.48	0.49
65+	0.47	0.50

In [698]:

```
#train_rates=train_age_gender_rate.merge(train_age_gender_pvt,how='inner',left_on='ag
e_group',right_on='age_group')\
#.rename(columns={'FEMALE':'Female_total_rate','MALE':'Male_total_rate'})
#train_rates # join two tables to get booking and total rates
```

In [699]:

```
# Bar chart Booking Rate in each Age Group by gender.
labels = train_age_gender_rate.index
Female_booking=train_age_gender_rate['Female_booking_rate']
Male_booking=train_age_gender_rate['Male_booking_rate']


x = np.arange(len(labels))  # the label locations
width = 0.35  # the width of the bars
fig, ax = plt.subplots(figsize=(9,6))

rects1 = ax.bar(x-width/2,Female_booking, width, label='Female_booking')
rects2 = ax.bar(x +width/2, Male_booking, width, label='Male_booking')
ax.set_ylabel('Rate')
ax.set_xlabel('Age group')
ax.set_title('Booking rate by gender and age group')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
autolabel(rects2)
fig.tight_layout()
plt.show()
```



In [700]:

```
# Users without age
train_no_age=train[train['age'].isnull()]
train_no_age.head(2)
```

Out[700]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_m
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	-unknown-	NaN	fa
5	osr2jwljor	2010-01-01	2010-01-01 21:56:19	2010-01-02	-unknown-	NaN	

In [701]:

```
# Bookings by users without age.
countries_no_age=train_no_age.groupby('country_destination')['id'].count().to_frame()
\
.rename(columns={'id':'number_users'})
countries_no_age
```

Out[701]:

	number_users
country_destination	
AU	103
CA	351
DE	210
ES	543
FR	1310
GB	550
IT	799
NDF	67614
NL	160
PT	59
US	13773
other	2518

In [702]:

```
# Percent from total users without age
countries_no_age['number_users_pct']=countries_no_age['number_users'].apply(lambda x:
round((x/len(train_no_age))*100,2 ))
countries_no_age.head(2)
```

Out[702]:

	number_users	number_users_pct
country_destination		
AU	103	0.12
CA	351	0.40

In [703]:

```
i=countries_no_age.loc['NDF']['number_users_pct']
print(f'{i}% of total users without age no makes any order.')
```

```
76.84% of total users without age no makes any order.
```

In [704]:
```
# Users without gender
mask=((train['gender']=='-unknown-')|(train['gender']=='OTHER'))
train_no_gender=train[mask]
train_no_gender.head(2)
```

Out[704]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	-unknown-	NaN	f
4	87mebub9p4	2010-09-14	2009-12-08 06:11:05	2010-02-18	-unknown-	41.0	

In [705]:
```
# Bookings by users without gender
countries_no_gender=train_no_gender.groupby('country_destination')['id'].count().to_f
rame()\
.rename(columns={'id':'number_users'})
countries_no_gender.head(2)
```

Out[705]:

	number_users
country_destination	
AU	144
CA	496

In [706]:
```
# Percent from total users without gender
countries_no_gender['number_users_pct']=countries_no_gender['number_users']\
.apply(lambda x: round((x/len(train_no_gender))*100,2 ))
countries_no_gender
```

Out[706]:

	number_users	number_users_pct
country_destination		
AU	144	0.15
CA	496	0.52
DE	287	0.30
ES	719	0.75
FR	1726	1.80
GB	761	0.79
IT	1045	1.09
NDF	66776	69.58
NL	230	0.24
PT	70	0.07
US	20225	21.07
other	3491	3.64

In [707]:
```
i=countries_no_gender.loc['NDF']['number_users_pct']
print(f'{i}% of total users without gender no makes any order.')
```

```
69.58% of total users without gender no makes any order.
```

User Environment Analysis

For analysis, users are divided into two groups: Those who placed a first order and those who ultimately did not make their first order.

In [708]:

```
# Adding auxiliary 'booked' column.
train['booked']=train['date_first_booking'].apply(lambda x: 'No' if pd.isnull(x) else
'Yes')
```

In [709]:

```
# Table users that place an order
train_booked=train[train['booked']=='Yes']
train_booked.head(1)
```

Out[709]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_me
2	4ft3gnwmtx	2010-09-28	2009-06-09 23:12:47	2010-08-02	FEMALE	56.0	

In [710]:

```
# Table users that not place an orde
train_non_booked=train[~(train['booked']=='Yes')]
train_non_booked.head(1)
```

Out[710]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_m
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	-unknown-	NaN	fa

Paid marketing

In [711]:

```
# Create table with number users by each affilate channel.
train_affiliate_total=train.groupby('affiliate_channel')['id'].count().to_frame().sor
t_values('id',ascending=False)\
.rename(columns={'id':'num_users'})
train_affiliate_total  # most popular affiliate chanels
```

Out[711]:

	num_users
affiliate_channel	
direct	137727
sem-brand	26045
sem-non-brand	18844
other	8961
seo	8663
api	8167
content	3948
remarketing	1096

In [712]:

```
# Table with most popular affiliate chanels by rate
train_affiliate_total=train_affiliate_total\
.assign(users_rate=round(train_affiliate_total['num_users']/len(train),2))['users_rat
e'].to_frame()
train_affiliate_total
```

Out[712]:

	users_rate
affiliate_channel	
direct	0.65
sem-brand	0.12
sem-non-brand	0.09
other	0.04
seo	0.04
api	0.04
content	0.02
remarketing	0.01

In [713]:

```
# Grouping by affiliate channel and booked
affiliate_chanel_users=train.groupby(['affiliate_channel','booked'])['id'].count().to
_frame()\
.rename(columns={'id':'num_users'})
affiliate_chanel_users
```

Out[713]:

		num_users
affiliate_channel	**booked**	
api	**No**	5382
	Yes	2785
content	**No**	3390
	Yes	558
direct	**No**	78329
	Yes	59398
other	**No**	5361
	Yes	3600
remarketing	**No**	728
	Yes	368
sem-brand	**No**	14951
	Yes	11094
sem-non-brand	**No**	11694
	Yes	7150
seo	**No**	4708
	Yes	3955

```
In [714]: # Creating  pivot table by affiliate channel and booked
          affiliate_chanel_users_pvt=affiliate_chanel_users.pivot_table(index='affiliate_channe
          l'
                                                                        ,columns='booked',value
          s='num_users',aggfunc='sum')
          affiliate_chanel_users_pvt
```

```
Out[714]:
                 booked     No    Yes
        affiliate_channel
                    api   5382   2785
                content   3390    558
                 direct  78329  59398
                  other   5361   3600
            remarketing    728    368
              sem-brand  14951  11094
          sem-non-brand  11694   7150
                    seo   4708   3955
```

```
In [715]: # Calculate rate from total
          affiliate_chanel_users_pvt[['Yes','No']]\
          =normalize(affiliate_chanel_users_pvt[['Yes','No']], axis=1, norm="l1")
```

```
In [716]: # Round result
          affiliate_chanel_users_pvt['Yes']=round(affiliate_chanel_users_pvt['Yes'],2)
```

```
In [717]: affiliate_chanel_users_pvt=affiliate_chanel_users_pvt['Yes'].to_frame()\
          .rename(columns={'Yes':'Booked_rate'}) # rename column
```

```
In [718]: # Channel efficiency by booking rate.
          affiliate_chanel_users_pvt
```

```
Out[718]:
                        Booked_rate
        affiliate_channel
                    api        0.34
                content        0.14
                 direct        0.43
                  other        0.40
            remarketing        0.34
              sem-brand        0.43
          sem-non-brand        0.38
                    seo        0.46
```

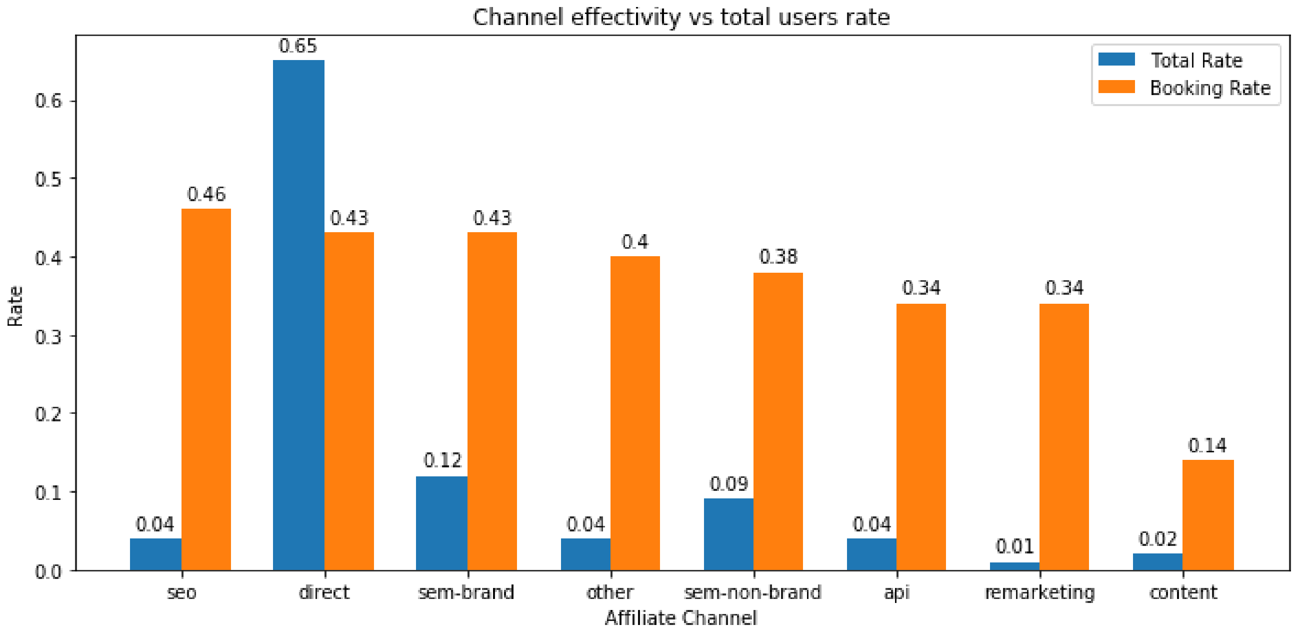
In [719]:

```
 # Join Tables with channel effectivity and total users rate
channel_effect=train_affiliate_total.merge(affiliate_chanel_users_pvt,how='inner'
                                          ,left_on='affiliate_channel',right_on='affiliate_channel')\
.sort_values('Booked_rate',ascending=False)
channel_effect
```

Out[719]:

	users_rate	Booked_rate
affiliate_channel		
seo	0.04	0.46
direct	0.65	0.43
sem-brand	0.12	0.43
other	0.04	0.40
sem-non-brand	0.09	0.38
api	0.04	0.34
remarketing	0.01	0.34
content	0.02	0.14

```
In [720]: # Bar chart Channel effectivity vs total users rate
labels = channel_effect.index
Total_users_rate=channel_effect['users_rate']
Booking_rate=channel_effect['Booked_rate']


x = np.arange(len(labels))  # the label locations
width = 0.35  # the width of the bars
fig, ax = plt.subplots(figsize=(10,5))

rects1 = ax.bar(x-width/2,Total_users_rate, width, label='Total Rate')
rects2 = ax.bar(x +width/2, Booking_rate, width, label='Booking Rate')
ax.set_ylabel('Rate')
ax.set_xlabel('Affiliate Channel')
ax.set_title('Channel effectivity vs total users rate')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
autolabel(rects2)
fig.tight_layout()
plt.show()
```



SEO and SEM driildown

In [721]:

```
# Users who came through SEO only.
mask=train['affiliate_channel']=='seo'
train_seo=train[mask]
train_seo.head(1)
```

Out[721]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_metl
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	MALE	38.0	faceb

In [722]:

```
# Grouping by SEO affiliate providers and booked.
train_seo_users=train_seo.groupby(['affiliate_provider','booked'])['id'].count().to_f
rame()\
.rename(columns={'id':'num_users'})
train_seo_users
```

Out[722]:

		num_users
affiliate_provider	**booked**	
baidu	**No**	4
bing	**No**	327
	Yes	162
facebook	**No**	953
	Yes	724
google	**No**	2952
	Yes	2739
other	**No**	150
	Yes	156
yahoo	**No**	322
	Yes	174

In [723]:

```
 # Pivot table number users by SEO affiliate providers and booked.
train_seo_users_pvt=train_seo_users.pivot_table(index='affiliate_provider',columns='b
ooked',values='num_users',aggfunc='sum')\
.fillna(0)
train_seo_users_pvt
```

Out[723]:

booked	**No**	**Yes**
affiliate_provider		
baidu	4.0	0.0
bing	327.0	162.0
facebook	953.0	724.0
google	2952.0	2739.0
other	150.0	156.0
yahoo	322.0	174.0

In [724]:

```
train_seo_users_pvt['Total']=train_seo_users_pvt['Yes']+train_seo_users_pvt['No'] # a
uxiliary 'Total' column
```

In [725]:

```
# In order to neutralize accidental providers,
 ##let's filter out that we will only review providers that have expressed at least 5% of users.
mask=train_seo_users_pvt['Total']>(train_seo_users_pvt['Total']).sum()*0.05
train_seo_users_pvt=train_seo_users_pvt[mask][['No','Yes']]
train_seo_users_pvt
```

Out[725]:

booked	No	Yes
affiliate_provider		
bing	327.0	162.0
facebook	953.0	724.0
google	2952.0	2739.0
yahoo	322.0	174.0

In [726]:

```
# Calculate rate from total
train_seo_users_pvt[['Yes','No']]\
=normalize(train_seo_users_pvt[['Yes','No']], axis=1, norm="l1")
```

In [727]:

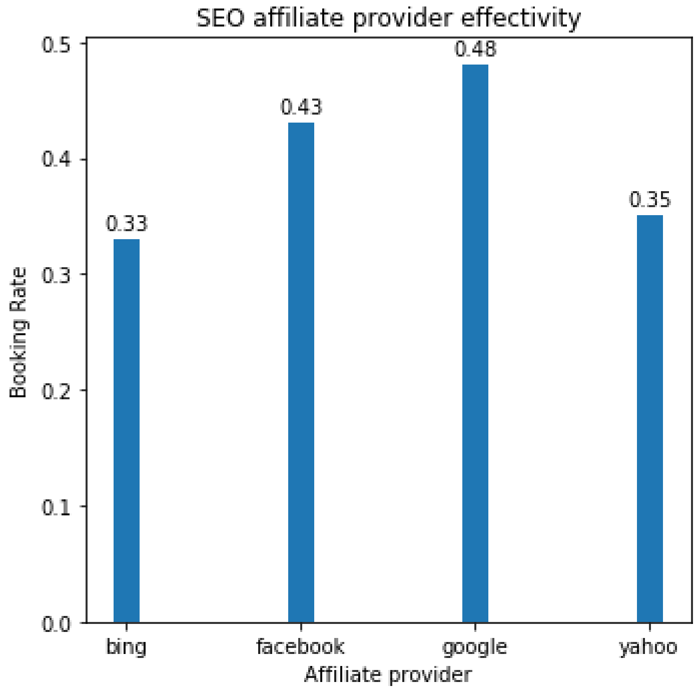
```
seo_providers=train_seo_users_pvt['Yes'].to_frame().rename(columns={'Yes':'Booked_rate'}) #rename column
seo_providers['Booked_rate']=round(seo_providers['Booked_rate'],2)
seo_providers
```

Out[727]:

	Booked_rate
affiliate_provider	
bing	0.33
facebook	0.43
google	0.48
yahoo	0.35

In [728]:

```python
# Bar Chart SEO affiliate provider effectivity
labels = seo_providers.index
Booked_rate=seo_providers['Booked_rate']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width, label='Booked Rate')

ax.set_ylabel('Booking Rate')
ax.set_xlabel('Affiliate provider')
ax.set_title('SEO affiliate provider effectivity')
ax.set_xticks(x)
ax.set_xticklabels(labels)
#ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



In [729]:

```python
# Table with users who came through SEM-brand only
mask=train['affiliate_channel']=='sem-brand'
train_sem_brand=train[mask]
train_sem_brand.head(1)
```

Out[729]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_
1025	dlg3a9x97v	2014-04-03	2010-07-12 21:29:24	NaT	MALE	47.0	

In [730]:

```
# Grouping by SEM-brand affiliate providers
train_sem_brand_users=train_sem_brand.groupby(['affiliate_provider','booked'])['id'].
count().to_frame()\
.rename(columns={'id':'num_users'})
train_sem_brand_users
```

Out[730]:

```
                            num_users
affiliate_provider  booked
             baidu      No          2
                       Yes          5
              bing      No        575
                       Yes        375
            google      No      14364
                       Yes      10705
             naver      No          4
                       Yes          3
             other      No          2
                       Yes          3
            yandex      No          4
                       Yes          3
```

In [731]:

```
 # Pivot table SEM-brand affiliate providers.
train_sem_brand_users_pvt=train_sem_brand_users\
.pivot_table(index='affiliate_provider',columns='booked',values='num_users',aggfunc=
'sum')\
.fillna(0)
train_sem_brand_users_pvt
```

Out[731]:

```
            booked     No    Yes
affiliate_provider
             baidu      2      5
              bing    575    375
            google  14364  10705
             naver      4      3
             other      2      3
            yandex      4      3
```

In [732]:

```
train_sem_brand_users_pvt['Total']=train_sem_brand_users_pvt['Yes']+train_sem_brand_u
sers_pvt['No'] # auxiliary 'Total' column
```

In [733]:

```
# In order to neutralize accidental providers,
 ##let's filter out that we will only review providers that have expressed at least
 5% of users.
mask=train_sem_brand_users_pvt['Total']>(train_sem_brand_users_pvt['Total']).sum()*0.
05
train_sem_brand_users_pvt=train_sem_brand_users_pvt[mask][['No','Yes']]
train_sem_brand_users_pvt
```

Out[733]:

booked	No	Yes
affiliate_provider		
google	14364	10705

In [734]:

```
# Calculate rate from total
train_sem_brand_users_pvt[['Yes','No']]\
=normalize(train_sem_brand_users_pvt[['Yes','No']], axis=1, norm="l1")
```

In [735]:

```
sem_brand_providers=train_sem_brand_users_pvt['Yes'].to_frame().rename(columns={'Yes'
:'Booked_rate'}) #rename column
sem_brand_providers['Booked_rate']=round(sem_brand_providers['Booked_rate'],2)
sem_brand_providers
```

Out[735]:

	Booked_rate
affiliate_provider	
google	0.43

In [736]:

```
# Table with users who came through SEM-non-brand only
mask=train['affiliate_channel']=='sem-non-brand'
train_sem__non_brand=train[mask]
train_sem__non_brand.head(1)
```

Out[736]:

	id	date_account_created	timestamp_first_active	date_first_booking	gender	age	signup_
35	ugy4obax11	2010-01-15	2010-01-15 08:27:11	NaT	-unknown-	49.0	

```
In [737]: # Grouping by SEM-non-brand affiliate providers
          train_sem_non_brand_users=train_sem__non_brand.groupby(['affiliate_provider','booked'
          ])['id'].count().to_frame()\
          .rename(columns={'id':'num_users'})
          train_sem_non_brand_users
```

```
Out[737]:
                                     num_users
          affiliate_provider  booked
                       baidu      No        13
                                 Yes         5
                        bing      No       593
                                 Yes       296
                        daum     Yes         1
                    facebook      No         5
                      google      No     10431
                                 Yes      6516
                       naver      No        30
                                 Yes        15
                       other      No        58
                                 Yes        45
                        vast      No       558
                                 Yes       271
                      yandex      No         6
                                 Yes         1
```

```
In [738]: # Pivot table SEM-non-brand affiliate providers
          train_sem_non_brand_users_pvt=train_sem_non_brand_users\
          .pivot_table(index='affiliate_provider',columns='booked',values='num_users',aggfunc=
          'sum')\
          .fillna(0)
          train_sem_non_brand_users_pvt
```

```
Out[738]:
                      booked       No     Yes
          affiliate_provider
                       baidu     13.0     5.0
                        bing    593.0   296.0
                        daum      0.0     1.0
                    facebook      5.0     0.0
                      google  10431.0  6516.0
                       naver     30.0    15.0
                       other     58.0    45.0
                        vast    558.0   271.0
                      yandex      6.0     1.0
```

```
In [739]: train_sem_non_brand_users_pvt['Total']\
          =train_sem_non_brand_users_pvt['Yes']+train_sem_non_brand_users_pvt['No'] # auxiliary
          'Total column
```

In [740]:

```
# In order to neutralize accidental providers,
 ##let's filter out that we will only review providers that have expressed at least
 5% of users.
mask=train_sem_non_brand_users_pvt['Total']>(train_sem_non_brand_users_pvt['Total']).
sum()*0.05
train_sem_non_brand_users_pvt=train_sem_non_brand_users_pvt[mask][['No','Yes']]
train_sem_non_brand_users_pvt
```

Out[740]:

```
            booked       No     Yes
 affiliate_provider
            google  10431.0  6516.0
```

In [741]:

```
# Calculate rate from total
train_sem_non_brand_users_pvt[['Yes','No']]\
=normalize(train_sem_non_brand_users_pvt[['Yes','No']], axis=1, norm="l1")
```

In [742]:

```
sem_non_brand_providers=train_sem_non_brand_users_pvt['Yes'].to_frame().rename(column
s={'Yes':'Booked_rate'}) #rename column
sem_non_brand_providers['Booked_rate']=round(sem_non_brand_providers['Booked_rate'],2
)
sem_non_brand_providers
```

Out[742]:

```
                    Booked_rate
 affiliate_provider
            google         0.38
```

In [743]:

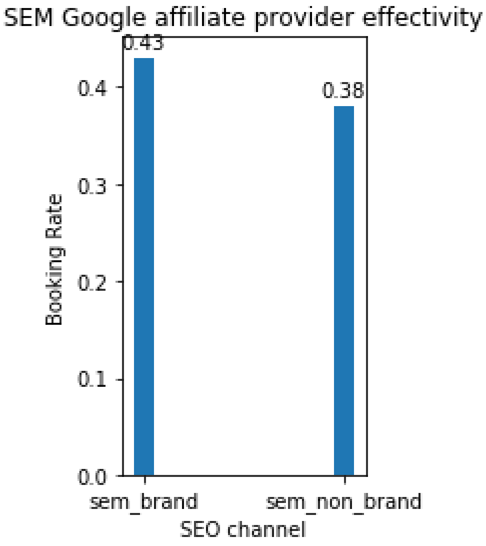
```
# Join to make table by affiliate provider rateof all SEM chanels.
sem_all=\
sem_brand_providers.merge(sem_non_brand_providers,how='inner',left_on='affiliate_prov
ider',right_on='affiliate_provider')\
.rename(columns={'Booked_rate_x':'sem_brand','Booked_rate_y':'sem_non_brand'})
sem_all
```

Out[743]:

```
                    sem_brand  sem_non_brand
 affiliate_provider
            google       0.43           0.38
```

In [744]:

```
# Bar chart SEM affiliate provider effectivity.
labels = sem_all.transpose().index
Booked_rate=sem_all.transpose()['google']

x = np.arange(len(labels))  # the label locations
width = 0.1  # the width of the bars
fig, ax = plt.subplots(figsize=(3,4))

rects1 = ax.bar(x,Booked_rate, width, label='Google provider Booked Rate')

ax.set_ylabel('Booking Rate')
ax.set_xlabel('SEO channel')
ax.set_title('SEM Google affiliate provider effectivity')
ax.set_xticks(x)
ax.set_xticklabels(labels)
#ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



User's Apps and Devices

In [745]:

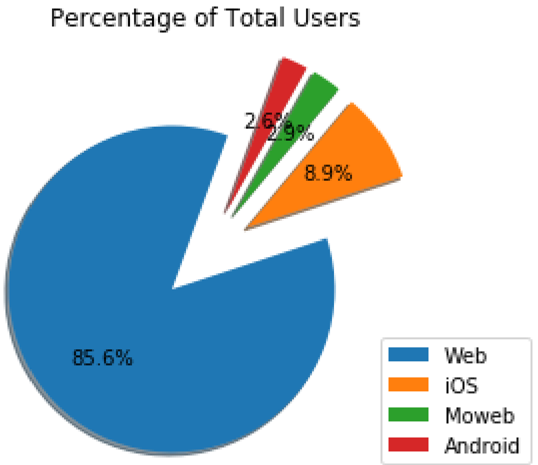
```python
# Grouping by Apps
train_app=train.groupby('signup_app')['id'].count().to_frame()\
.rename(columns={'id':'num_users'})\
.sort_values('num_users',ascending=False)
train_app
```

Out[745]:

	num_users
signup_app	
Web	182717
iOS	19019
Moweb	6261
Android	5454

In [746]:

```python
# Pie chart Percentage of Total Users by Apps
p_size = train_app['num_users']
p_labels = train_app.index
p_explode=[0.3 for i in range(len(train_app.index))]
plt.pie(p_size, startangle=70, explode = p_explode,autopct='%1.1f%%', shadow=True)
plt.title('Percentage of Total Users')
plt.axis('equal')
plt.legend(p_labels)
plt.show()
```



In [747]:

```python
# Grouping by First App and booked.
train_app_booked=train.groupby(['signup_app','booked'])['id'].count().to_frame()\
.rename(columns={'id':'num_users'})
train_app_booked
```

Out[747]:

		num_users
signup_app	**booked**	
Android	**No**	4221
	Yes	1233
Moweb	**No**	4118
	Yes	2143
Web	**No**	102696
	Yes	80021
iOS	**No**	13508
	Yes	5511

```
In [748]: # Create pivot table by App and booked.
          train_app_booked_pvt=train_app_booked.pivot_table(index='signup_app',columns='booked'
          ,values='num_users',aggfunc='sum')
          train_app_booked_pvt
```

```
Out[748]:
              booked      No    Yes
          signup_app
             Android    4221   1233
              Moweb     4118   2143
                Web   102696  80021
                iOS    13508   5511
```

```
In [749]: # Calculate rate from total.
          train_app_booked_pvt[['Yes','No']]\
          =normalize(train_app_booked_pvt[['Yes','No']], axis=1, norm="l1")
```

```
In [750]: train_app_booked_pvt
```

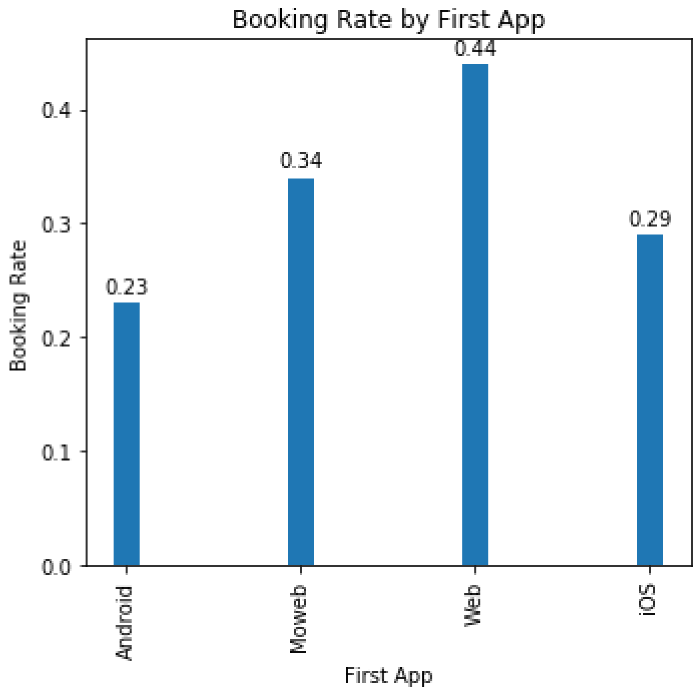
```
Out[750]:
              booked        No        Yes
          signup_app
             Android  0.773927   0.226073
              Moweb   0.657722   0.342278
                Web   0.562050   0.437950
                iOS   0.710237   0.289763
```

```
In [751]: # Round results.
          train_app_booked_pvt['Yes']=round(train_app_booked_pvt['Yes'],2)
          train_app_booked_pvt['No']=round(train_app_booked_pvt['No'],2)
```

```
In [752]: train_app_booked_pvt
```

```
Out[752]:
              booked    No   Yes
          signup_app
             Android  0.77  0.23
              Moweb   0.66  0.34
                Web   0.56  0.44
                iOS   0.71  0.29
```

```
In [753]: # Bar chart Percent of Total New Users by first devices.
labels = train_app_booked_pvt.index
Booked_rate=train_app_booked_pvt['Yes']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width)

ax.set_ylabel('Booking Rate')
ax.set_xlabel('First App')
ax.set_title('Booking Rate by First App')
ax.set_xticks(x)
ax.set_xticklabels(labels)
plt.xticks(rotation=90)
#ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



In [754]:

```python
# Ggrouping by devices
train_devices=train.groupby('first_device_type')['id'].count().to_frame()\
.rename(columns={'id':'num_users'})\
.sort_values('num_users',ascending=False)
train_devices
```

Out[754]:

	num_users
first_device_type	
Mac Desktop	89600
Windows Desktop	72716
iPhone	20759
iPad	14339
Other/Unknown	10667
Android Phone	2803
Android Tablet	1292
Desktop (Other)	1199
SmartPhone (Other)	76

In [755]:

```python
# Calculate pct of total users
train_devices['pct_users']=round(train_devices['num_users']/len(train),2)
```

In [756]:

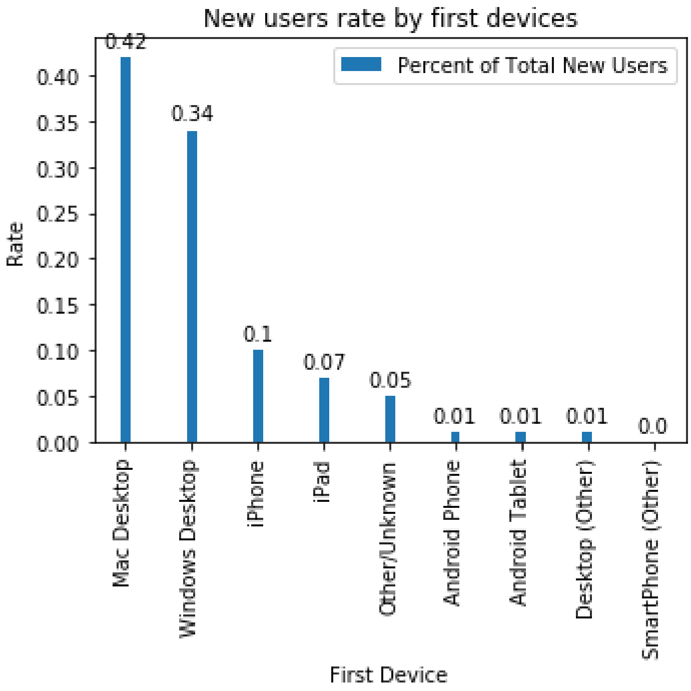
```python
train_devices
```

Out[756]:

	num_users	pct_users
first_device_type		
Mac Desktop	89600	0.42
Windows Desktop	72716	0.34
iPhone	20759	0.10
iPad	14339	0.07
Other/Unknown	10667	0.05
Android Phone	2803	0.01
Android Tablet	1292	0.01
Desktop (Other)	1199	0.01
SmartPhone (Other)	76	0.00

In [757]:

```
# Bar chart Percent of Total New Users by first devices.
labels = train_devices.index
Booked_rate=train_devices['pct_users']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width, label='Percent of Total New Users')

ax.set_ylabel('Rate')
ax.set_xlabel('First Device')
ax.set_title('New users rate by first devices')
ax.set_xticks(x)
ax.set_xticklabels(labels)
plt.xticks(rotation=90)
ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



Apps drilldown.

In [758]:

```
# Grouping by Singup App and first devices
train_app_device=train.groupby(['signup_app','first_device_type','booked'])['id'].count().to_frame()\
.rename(columns={'id':'num_users'})
train_app_device.head(2)
```

Out[758]:

```
                                          num_users
signup_app  first_device_type  booked
   Android      Android Phone      No           962
                                  Yes           271
```

In [759]:

```
# Create pivot table Singup App and first devices.
train_app_device_pvt=train_app_device\
.pivot_table(index=('signup_app','first_device_type'),columns='booked',values='num_users',aggfunc='sum').fillna(0)
train_app_device_pvt.head(2)
```

Out[759]:

```
                              booked     No    Yes
signup_app  first_device_type
   Android      Android Phone         962.0  271.0
               Android Tablet          75.0   29.0
```

In [760]:

```
train_app_device_pvt['Total']=train_app_device_pvt['Yes']+train_app_device_pvt['No']
# auxiliary 'Total' column
```

In [761]:

```
train_app_device_pvt.head()
```

Out[761]:

```
                              booked      No    Yes   Total
signup_app  first_device_type
   Android      Android Phone          962.0  271.0  1233.0
               Android Tablet           75.0   29.0   104.0
              Desktop (Other)            4.0    4.0     8.0
                 Mac Desktop            39.0   40.0    79.0
               Other/Unknown          3061.0  787.0  3848.0
```

In [762]:

```
#In order to neutralize accidental devices,
 ##let's filter out that we will only review devices that have expressed at least 5%
 of users
app_totals=train_app_device_pvt.reset_index().groupby('signup_app')['Total'].sum().to_frame()
app_totals['5%_app_Total']=app_totals['Total']*0.05
```

In [763]:

```
# Create chek table with minimum users to analysis
app_total_rate=app_totals['5%_app_Total'].to_frame()
```

In [764]:

```
app_total_rate
```

Out[764]:

	5%_app_Total
signup_app	
Android	272.70
Moweb	313.05
Web	9135.85
iOS	950.95

In [765]:

```
# Join App and Devices table with chek table
train_app_device_chek=\
train_app_device_pvt.reset_index().merge(app_total_rate,how='inner',left_on='signup_a
pp',right_on='signup_app')
train_app_device_chek.head(2)
```

Out[765]:

	signup_app	first_device_type	No	Yes	Total	5%_app_Total
0	Android	Android Phone	962.0	271.0	1233.0	272.7
1	Android	Android Tablet	75.0	29.0	104.0	272.7

In [766]:

```
# Filtering to 5% rate
mask=train_app_device_chek['Total']>train_app_device_chek['5%_app_Total']
train_app_device_filter_chek=train_app_device_chek[mask]
train_app_device_filter_chek.head(2)
```

Out[766]:

	signup_app	first_device_type	No	Yes	Total	5%_app_Total
0	Android	Android Phone	962.0	271.0	1233.0	272.7
4	Android	Other/Unknown	3061.0	787.0	3848.0	272.7

In [767]:

```
# Set two indexes
app_device_filter=train_app_device_filter_chek.set_index(['signup_app','first_device_
type'])[['No','Yes']]
app_device_filter.head(2)
```

Out[767]:

		No	Yes
signup_app	**first_device_type**		
Android	**Android Phone**	962.0	271.0
	Other/Unknown	3061.0	787.0

In [768]:

```
# Calculate rate from total
app_device_filter[['Yes','No']]\
=normalize(app_device_filter[['Yes','No']], axis=1, norm="l1")
```

In [769]:

```
app_device_filter['Yes']=round(app_device_filter['Yes'],2) #round result
```

In [770]:

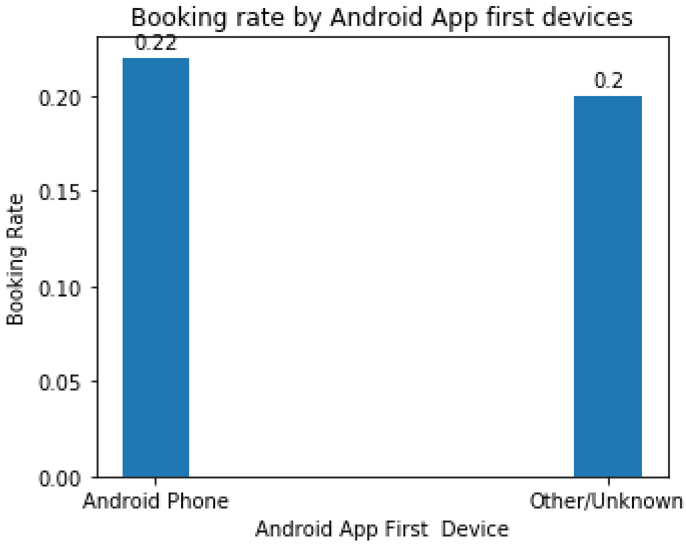
```
app_device_rates=app_device_filter['Yes'].to_frame().rename(columns={'Yes':'Booked_ra
te'})\
.sort_values(['signup_app','Booked_rate'],ascending=[True,False]) # rename column and
sorting values
```

```
In [771]: app_device_rates
```

```
Out[771]:
                                        Booked_rate
signup_app   first_device_type
   Android       Android Phone                 0.22
                 Other/Unknown                 0.20
     Moweb         Mac Desktop                 0.48
               Windows Desktop                 0.44
                        iPhone                 0.33
                 Android Phone                 0.27
                 Other/Unknown                 0.13
       Web         Mac Desktop                 0.47
               Windows Desktop                 0.41
                          iPad                 0.38
       iOS         Mac Desktop                 0.45
                          iPad                 0.36
                        iPhone                 0.28
                 Other/Unknown                 0.04
```

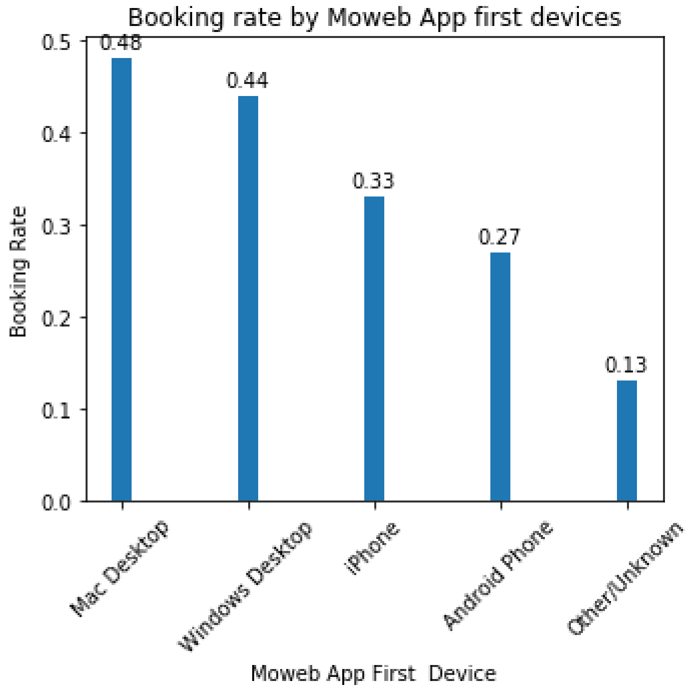
In [772]:

```
# Bar Chart Booking Rate by Android Devices.
labels = app_device_rates.loc['Android'].index
Booked_rate=app_device_rates.loc['Android']['Booked_rate']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,4))

rects1 = ax.bar(x,Booked_rate, width, label='Booking Rate')

ax.set_ylabel('Booking Rate')
ax.set_xlabel('Android App First  Device')
ax.set_title('Booking rate by Android App first devices')
ax.set_xticks(x)
ax.set_xticklabels(labels)
##plt.xticks(rotation=90)
##ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



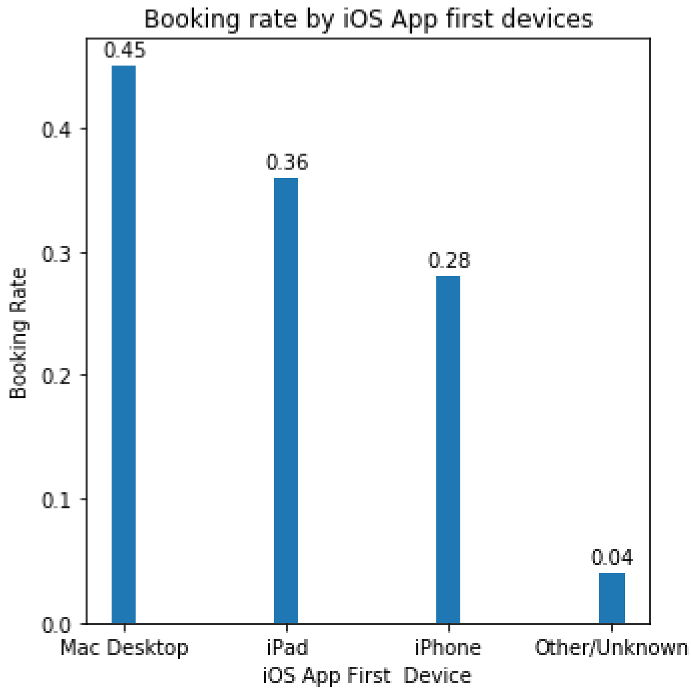
In [773]:

```
# Bar Chart Booking Rate by Moweb Devices.
labels = app_device_rates.loc['Moweb'].index
Booked_rate=app_device_rates.loc['Moweb']['Booked_rate']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width, label='Booking Rate')

ax.set_ylabel('Booking Rate')
ax.set_xlabel('Moweb App First  Device')
ax.set_title('Booking rate by Moweb App first devices')
ax.set_xticks(x)
ax.set_xticklabels(labels)
plt.xticks(rotation=45)
#ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



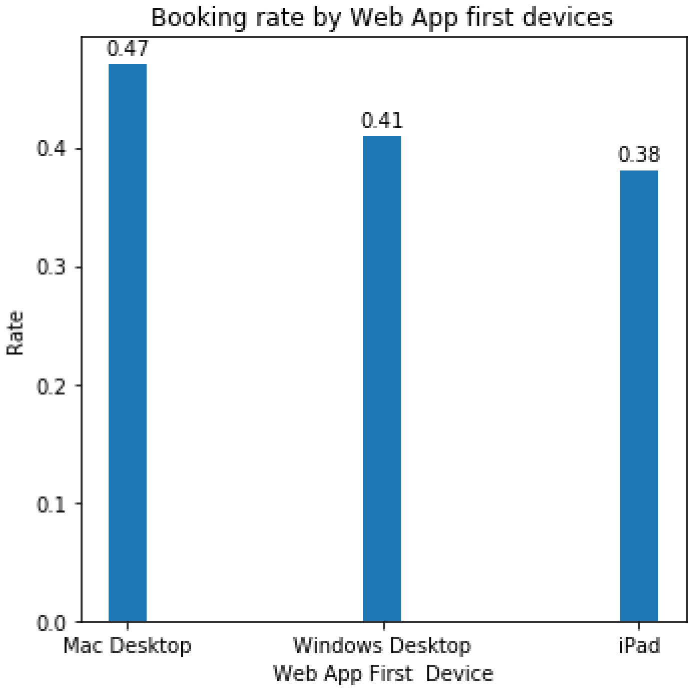
In [774]:

```
# Bar Chart Booking Rate by iOS Devices.
labels = app_device_rates.loc['iOS'].index
Booked_rate=app_device_rates.loc['iOS']['Booked_rate']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width, label='Booked Rate')

ax.set_ylabel('Booking Rate')
ax.set_xlabel('iOS App First  Device')
ax.set_title('Booking rate by iOS App first devices')
ax.set_xticks(x)
ax.set_xticklabels(labels)
##plt.xticks(rotation=90)
##ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



In [775]:

```
# Bar Chart Booking Rate by Web Devices.
labels = app_device_rates.loc['Web'].index
Booked_rate=app_device_rates.loc['Web']['Booked_rate']

x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x,Booked_rate, width, label='Booked Rate')

ax.set_ylabel('Rate')
ax.set_xlabel('Web App First  Device')
ax.set_title('Booking rate by Web App first devices')
ax.set_xticks(x)
ax.set_xticklabels(labels)
##plt.xticks(rotation=90)
#ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
fig.tight_layout()
plt.show()
```



Site Analysis

In [776]:

```
# Create table gruped by site language
train_language=train.groupby('language')['id'].count().to_frame()\
.rename(columns={'id':'num_users'}).sort_values('num_users',ascending=False)
train_language.head(2)
```

Out[776]:

	num_users
language	
en	206314
zh	1632

In [777]:

```
train_language=train_language.reset_index() ## reset index to get group by language
```

In [778]:

```
# Divided into two groups of English version users or another.
train_language['English_site']=train_language.reset_index()['language'].apply(lambda
x: 'Yes' if x=='en' else 'No')
```

In [779]:

```
# Grouping by english and non-english site version
train_site=train_language.groupby('English_site')['num_users'].sum().to_frame()
train_site
```

Out[779]:

	num_users
English_site	
No	7137
Yes	206314

In [780]:

```
 # Calculate rate of total
train_site['rate']=round(train_site['num_users']/len(train),2)
```

In [781]:

```
Y=train_site['rate']['Yes']*100
N=train_site['rate']['No']*100
print(f'The percent of users using english site version is {Y}%')
```

```
The percent of users using english site version is 97.0%
```

In [782]:

```
# Divided into two groups of English version users or another.
train['English_site']=train['language'].apply(lambda x: 'English' if x=='en' else 'Ot
her')
```

In [783]:

```
# Grouping by site version and booked
train_english_booked=train.groupby(['English_site','booked'])['id'].count().to_frame
()\
.rename(columns={'id':'num_users'})
train_english_booked
```

Out[783]:

		num_users
English_site	**booked**	
English	**No**	119650
	Yes	86664
Other	**No**	4893
	Yes	2244

In [784]:

```
 # Create pivot table by site version and booked
train_english_booked_pvt=\
train_english_booked.pivot_table(index='English_site',columns='booked',values='num_users',aggfunc='sum')
train_english_booked_pvt
```

Out[784]:

booked	No	Yes
English_site		
English	119650	86664
Other	4893	2244

In [785]:

```
# Calculate rate from total
train_english_booked_pvt[['Yes','No']]\
=normalize(train_english_booked_pvt[['Yes','No']], axis=1, norm="l1")
```

In [786]:

```
train_english_booked_pvt['No']=round(train_english_booked_pvt['No'],2)
train_english_booked_pvt['Yes']=round(train_english_booked_pvt['Yes'],2)
```

In [787]:

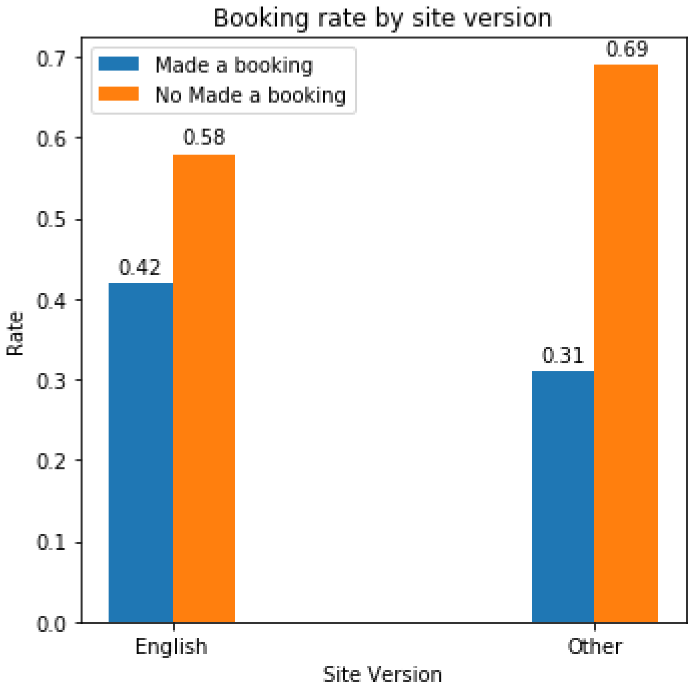
```
train_english_booked_pvt
```

Out[787]:

booked	No	Yes
English_site		
English	0.58	0.42
Other	0.69	0.31

In [788]:

```
# Bar chart Boking Rate by Site Version.
labels = train_english_booked_pvt.index
y_1=train_english_booked_pvt['Yes']
y_2=train_english_booked_pvt['No']


x = np.arange(len(labels))  # the label locations
width = 0.15  # the width of the bars
fig, ax = plt.subplots(figsize=(5,5))

rects1 = ax.bar(x-width/2,y_1, width, label='Made a booking')
rects2 = ax.bar(x +width/2, y_2, width, label='No Made a booking')
ax.set_ylabel('Rate')
ax.set_xlabel('Site Version')
ax.set_title('Booking rate by site version')
ax.set_xticks(x)
ax.set_xticklabels(labels)
ax.legend()

def autolabel(rects):
    """Attach a text label above each bar in *rects*, displaying its height."""
    for rect in rects:
        height = rect.get_height()
        ax.annotate('{}'.format(height),
                    xy=(rect.get_x() + rect.get_width() / 2, height),
                    xytext=(0, 3),  # 3 points vertical offset
                    textcoords="offset points",
                    ha='center', va='bottom')
autolabel(rects1)
autolabel(rects2)
fig.tight_layout()
plt.show()
```



Session

In [789]:

```python
# Create with specific columns
v_sessions=sessions[['user_id','device_type','secs_elapsed']]
v_sessions.head(2) # sample users sessions table
```

Out[789]:

	user_id	device_type	secs_elapsed
0	d1mm9tcy42	Windows Desktop	319.0
1	d1mm9tcy42	Windows Desktop	67753.0

In [790]:

```python
# Grouping by sum seconds by each user.
sessions_elapsed=v_sessions.groupby('user_id')['secs_elapsed'].sum().to_frame()
sessions_elapsed.head(2) # group by  seconds elapsed
```

Out[790]:

	secs_elapsed
user_id	
00023iyk9l	867896.0
0010k6l0om	586543.0

In [791]:

```python
# Create train table with specific columns.
v_train=train[['id','date_account_created','timestamp_first_active','date_first_booking','country_destination']]
v_train.head(2)
```

Out[791]:

	id	date_account_created	timestamp_first_active	date_first_booking	country_destination
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	NDF
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	NDF

In [792]:

```python
# Join train and sessions tables
times_tbl=v_train.merge(sessions_elapsed,how='inner',left_on='id',right_on='user_id')
times_tbl.head(2) # join train and sessions tables
```

Out[792]:

	id	date_account_created	timestamp_first_active	date_first_booking	country_destination	secs
0	d1mm9tcy42	2014-01-01	2014-01-01 00:09:36	2014-01-04	other	
1	yo8nz8bqcq	2014-01-01	2014-01-01 00:15:58	NaT	NDF	

In [793]:

```python
times_tbl['hours_elapsed']=round(times_tbl['secs_elapsed']/3600) #Adding hours spend column
```

In [794]:

```python
times_tbl.head(2)
```

Out[794]:

	id	date_account_created	timestamp_first_active	date_first_booking	country_destination	secs
0	d1mm9tcy42	2014-01-01	2014-01-01 00:09:36	2014-01-04	other	
1	yo8nz8bqcq	2014-01-01	2014-01-01 00:15:58	NaT	NDF	

In [795]:

```python
times_tbl_country=times_tbl.groupby('country_destination') # Grouping by countries
```

In [796]:

```python
# Aggrigation by number of users and average hours spend
times_tbl_country_agg=times_tbl_country.agg({'id':'count','hours_elapsed':'mean'})
```

In [797]:

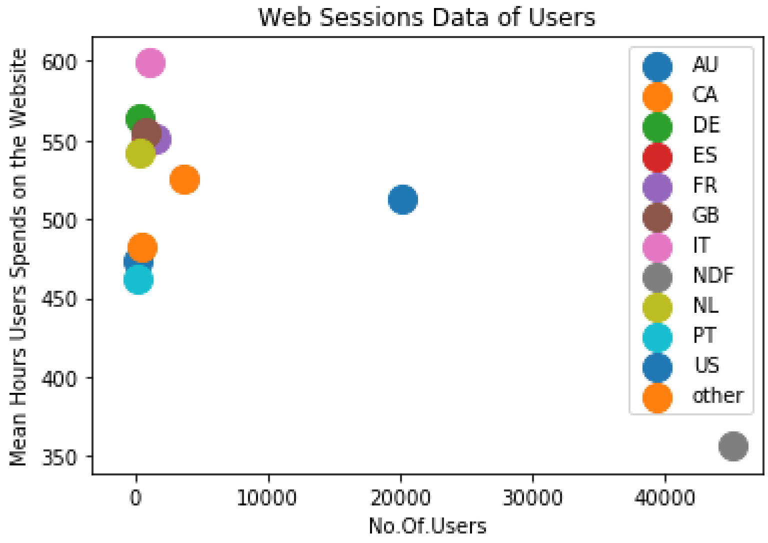
```
times_tbl_country_agg=times_tbl_country_agg.rename(columns={'id':'num_users','hours_e
lapsed':'avg_hours_spend'})
times_tbl_country_agg # rename columns
```

Out[797]:

country_destination	num_users	avg_hours_spend
AU	152	473.519737
CA	440	481.920455
DE	250	564.140000
ES	707	548.768034
FR	1435	550.543554
GB	731	554.900137
IT	979	599.502554
NDF	45041	356.541951
NL	247	542.222672
PT	83	461.590361
US	20095	512.557353
other	3655	525.592066

In [798]:

```
# Chart show Web Sessions Data of Users by country destination.
for i, row in times_tbl_country_agg.iterrows():
    plt.scatter(x=row.num_users, y=row.avg_hours_spend, label=i, s=200)

plt.title('Web Sessions Data of Users')
plt.xlabel('No.Of.Users')
plt.ylabel('Mean Hours Users Spends on the Website')
plt.legend()
plt.show()
```



The relationship between the likelihood of booking and time spent on the site.

In [799]:

```
 # Create train table with specific columns
v_train_2=train[['id','booked']]
v_train_2.head(2) # train table with specific columns
```

Out[799]:

	id	booked
0	gxn3p5htnn	No
1	820tgsjxq7	No

In [800]:

```
# Join sessions table to add secs_elapsed column
times_tbl_2=v_train_2.merge(sessions_elapsed,how='inner',left_on='id',right_on='user_
id')
```

In [801]:

```
times_tbl_2['hours_elapsed']=round(times_tbl_2['secs_elapsed']/3600) # Adding hours s
pend column
times_tbl_2.head(2)
```

Out[801]:

	id	booked	secs_elapsed	hours_elapsed
0	d1mm9tcy42	Yes	3427529.0	952.0
1	yo8nz8bqcq	No	207842.0	58.0

In [802]:

```
# Using 'ntile' method to divide to 10 groups by hours spend. We get 10 groups by ran
ges.
times_tbl_2['ntile']=pd.qcut(times_tbl_2['hours_elapsed'],10)
```

In [803]:

```
times_tbl_2.head(2)
```

Out[803]:

	id	booked	secs_elapsed	hours_elapsed	ntile
0	d1mm9tcy42	Yes	3427529.0	952.0	(679.0, 1048.0]
1	yo8nz8bqcq	No	207842.0	58.0	(47.0, 98.0]

In [804]:

```
# Extract midpoint of each group range.
times_tbl_2['mean_ntile'] = times_tbl_2['ntile'].apply(lambda x: x.mid)
```

In [805]:

```
times_tbl_2['mean_ntile']=round(times_tbl_2['mean_ntile']) # Round result
```

In [806]:

```
times_tbl_2 .head(2)
```

Out[806]:

	id	booked	secs_elapsed	hours_elapsed	ntile	mean_ntile
0	d1mm9tcy42	Yes	3427529.0	952.0	(679.0, 1048.0]	864.0
1	yo8nz8bqcq	No	207842.0	58.0	(47.0, 98.0]	72.0

In [807]:
```
# Grouping by mean hours spend and booked
times_tbl_2_group=times_tbl_2.groupby(['mean_ntile','booked'])['id'].count().to_frame
()\
.rename(columns={'id':'num_users'})
times_tbl_2_group
```

Out[807]:
```
                           num_users
mean_ntile   booked
       4.0       No             5572
                Yes             2022
      28.0       No             5430
                Yes             1781
      72.0       No             5163
                Yes             2308
     130.0       No             4587
                Yes             2672
     202.0       No             4459
                Yes             2917
     294.0       No             4300
                Yes             3115
     415.0       No             4307
                Yes             3083
     581.0       No             3999
                Yes             3346
     864.0       No             3854
                Yes             3528
    5832.0       No             3370
                Yes             4002
```

In [808]:

```
# Create pivot table by mean hours and booked
times_tbl_2_group_pvt=times_tbl_2_group.pivot_table(index='mean_ntile',columns='booke
d',values='num_users',aggfunc='sum')
times_tbl_2_group_pvt
```

Out[808]:

booked	**No**	**Yes**
mean_ntile		
4.0	5572	2022
28.0	5430	1781
72.0	5163	2308
130.0	4587	2672
202.0	4459	2917
294.0	4300	3115
415.0	4307	3083
581.0	3999	3346
864.0	3854	3528
5832.0	3370	4002

In [809]:

```
# Calculate rate from total
times_tbl_2_group_pvt[['Yes','No']]\
=normalize(times_tbl_2_group_pvt[['Yes','No']], axis=1, norm="l1")
```

In [810]:

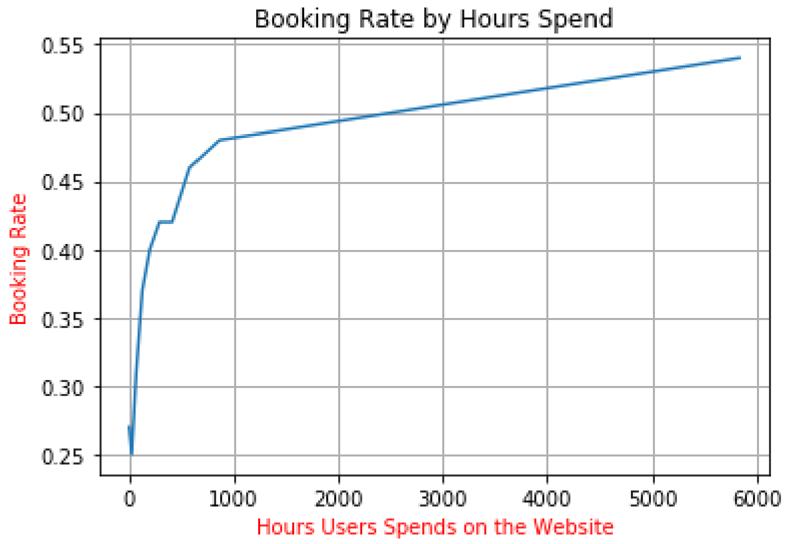
```
times_tbl_2_group_pvt['Yes']=round(times_tbl_2_group_pvt['Yes'],2)
times_tbl_2_group_pvt['No']=round(times_tbl_2_group_pvt['No'],2)      #round result
times_tbl_2_group_pvt
```

Out[810]:

booked	**No**	**Yes**
mean_ntile		
4.0	0.73	0.27
28.0	0.75	0.25
72.0	0.69	0.31
130.0	0.63	0.37
202.0	0.60	0.40
294.0	0.58	0.42
415.0	0.58	0.42
581.0	0.54	0.46
864.0	0.52	0.48
5832.0	0.46	0.54

In [811]:

```
# Line chart show relationship between the likelihood of booking and time spent on the site.
x_axis =times_tbl_2_group_pvt.index
y_axis = times_tbl_2_group_pvt["Yes"]
plt.plot(x_axis, y_axis)

plt.title('Booking Rate by Hours Spend')
plt.grid(True, linewidth=1)
plt.ylabel('Booking Rate', color='red')
plt.xlabel('Hours Users Spends on the Website' , color='red')
#for i,j in zip(x_axis,y_axis):
  #  plt.annotate(str(j),xy=(i,j))
plt.show()
```



Date and Time

To get reliable data and test trends it is necessary to check trends in common range from 01-01-2010 to 30-06-2014.

In [812]:

```
# Users train table with specific columns.
train_dates=train[['id','date_account_created','timestamp_first_active','date_first_booking','booked','age_group']]
train_dates.head(2)
```

Out[812]:

	id	date_account_created	timestamp_first_active	date_first_booking	booked	age_group
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	No	n/a
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	No	35-44

In [813]:

```
# Adding new colums: year, month and weekday
train_dates=train_dates.assign(year_account_created=train_dates['date_account_create
d'].dt.year,
                  month_account_created=train_dates['date_account_created'].dt.month,
                  weekday_account_created=train_dates['date_account_created'].dt.week
day_name,
                  year_first_active=train_dates['timestamp_first_active'].dt.year,
                  month_first_active=train_dates['timestamp_first_active'].dt.month,
                  weekday_first_active=train_dates['timestamp_first_active'].dt.weekd
ay_name,
                  year_first_booking=train_dates['date_first_booking'].dt.year,
                  month_first_booking=train_dates['date_first_booking'].dt.month,
                  weekday_first_booking=train_dates['date_first_booking'].dt.weekday_
name)
train_dates.head(2)
```

Out[813]:

	id	date_account_created	timestamp_first_active	date_first_booking	booked	age_group	year_
0	gxn3p5htnn	2010-06-28	2009-03-19 04:32:55	NaT	No	n/a	
1	820tgsjxq7	2011-05-25	2009-05-23 17:48:09	NaT	No	35-44	

Years

In [814]:

```
# Table  year and mont first booking
train_dates_first_booking=train_dates[['id','year_first_booking','month_first_bookin
g']]
train_dates_first_booking.head(2)
```

Out[814]:

	id	year_first_booking	month_first_booking
0	gxn3p5htnn	NaN	NaN
1	820tgsjxq7	NaN	NaN

In [815]:

```
# Grouping by year and month first booking
train_dates_first_booking_group=train_dates_first_booking\
.groupby(['year_first_booking','month_first_booking'])['id'].count().to_frame()
# Reset index before join
train_dates_first_booking_group=train_dates_first_booking_group.reset_index()
```

In [816]:

```
# Change type from float to str and create a common column with month and year combin
ation before join.
train_dates_first_booking_group['y_m_first_booking']=\
train_dates_first_booking_group['month_first_booking'].astype(int).astype(str)+\
'-'+train_dates_first_booking_group['year_first_booking'].astype(int).astype(str)
```

In [817]:

```
# Grouping by Year+month combination.
train_dates_first_booking_clear=train_dates_first_booking_group[['y_m_first_booking',
'id']]\
.rename(columns={'id':'booking_num_users','y_m_first_booking':'y_m'})
```

In [818]:

```
# Extract year
train_dates_first_booking_clear=\
train_dates_first_booking_clear.assign(Year=train_dates_first_booking_clear['y_m'].st
r.slice(-4))
```

In [819]:

```
train_dates_first_booking_clear.head(2)
# y_m --> common column for join
# booking_nub_users --> number users with booking
# Year --> booking year
```

Out[819]:

	y_m	booking_num_users	Year
0	1-2010	29	2010
1	2-2010	40	2010

In [820]:

```
# Filter dates to get common range from 01-01-2010 to 30-06-2014.
mask1=train_dates['timestamp_first_active'].between('2010-01-01','2014-06-30')
mask2=train_dates['date_account_created'].between('2010-01-01','2014-06-30')
train_dates_clear=train_dates[mask1&mask2][['id','year_account_created','month_account_created']]
train_dates_clear.head(2)
```

Out[820]:

	id	year_account_created	month_account_created
5	osr2jwljor	2010	1
6	lsw9q7uk0j	2010	1

In [821]:

```
# Grouping by year and month creared account
train_dates_account_group=train_dates_clear\
.groupby(['year_account_created','month_account_created'])['id'].count().to_frame()
train_dates_account_group=train_dates_account_group.reset_index()
```

In [822]:

```
train_dates_account_group.head(2)
```

Out[822]:

	year_account_created	month_account_created	id
0	2010	1	61
1	2010	2	102

In [823]:

```
# Adding common column befor join with change to str type
train_dates_account_group['y_m_account']=\
train_dates_account_group['month_account_created'].astype(str)+\
'-'+train_dates_account_group['year_account_created'].astype(str)
```

In [824]:

```
train_dates_account_group.head(2)
```

Out[824]:

	year_account_created	month_account_created	id	y_m_account
0	2010	1	61	1-2010
1	2010	2	102	2-2010

In [825]:

```
# Rename columns
train_dates_account_clear=train_dates_account_group.rename(columns={'id':'account_num_users','y_m_account':'y_m'})
```

In [826]:
```
train_dates_account_clear.head(2)
# y_m --> common column before join
# account_num_users --> nimber users with account
# year_account_created --> account year
# month_account_created --> account month
```

Out[826]:

	year_account_created	month_account_created	account_num_users	y_m
0	2010	1	61	1-2010
1	2010	2	102	2-2010

In [827]:
```
# Join with first booking and accounts created tables
account_booking_users=train_dates_account_clear.merge(train_dates_first_booking_clear
,how='left',left_on='y_m',right_on='y_m')
account_booking_users=account_booking_users.set_index('y_m')
```

In [828]:
```
account_booking_users.head(2)
```

Out[828]:

	year_account_created	month_account_created	account_num_users	booking_num_users	Year
y_m					
1-2010	2010	1	61	29	2010
2-2010	2010	2	102	40	2010

In [829]:
```
# Grouping by Year
account_booking_users_year=account_booking_users.groupby('Year')[['account_num_users'
,'booking_num_users']].sum()
account_booking_users_year
```

Out[829]:

	account_num_users	booking_num_users
Year		
2010	2785	1479
2011	11773	5738
2012	39462	16241
2013	82960	31259
2014	75876	27048

In [830]:
```
# Adding and round bookin rate column.
account_booking_users_year['booking_rate']=\
round(account_booking_users_year['booking_num_users']/account_booking_users_year['acc
ount_num_users'],2)
```

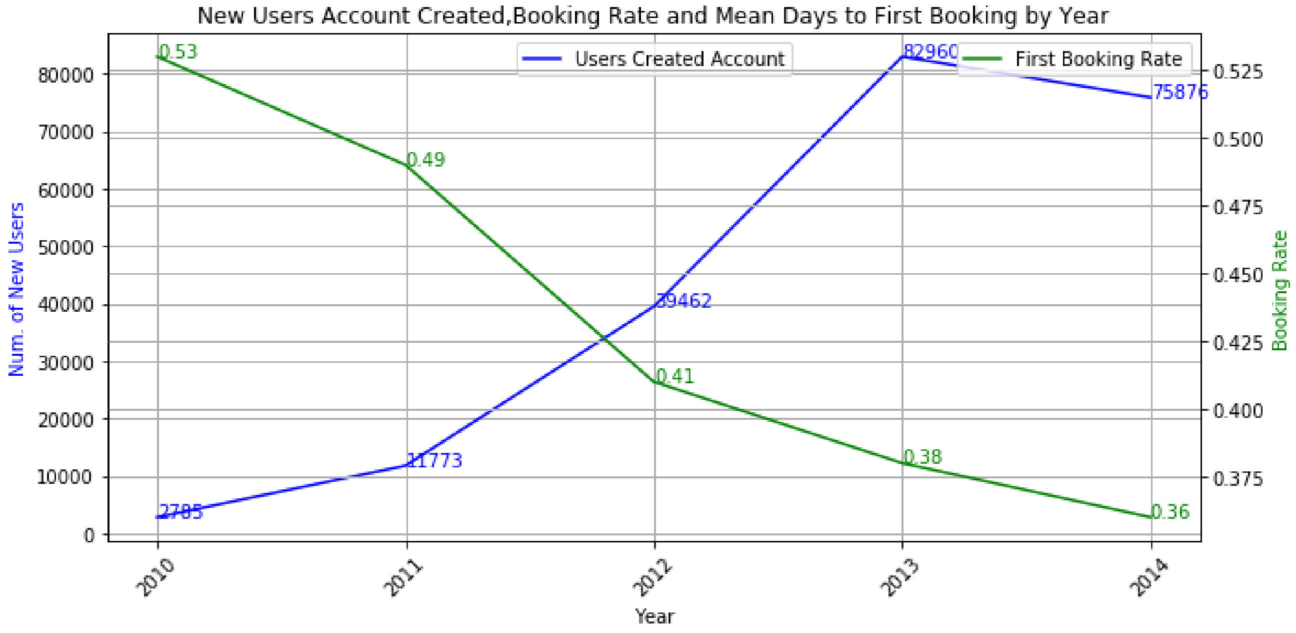
In [831]:
```
account_booking_users_year
```

Out[831]:

	account_num_users	booking_num_users	booking_rate
Year			
2010	2785	1479	0.53
2011	11773	5738	0.49
2012	39462	16241	0.41
2013	82960	31259	0.38
2014	75876	27048	0.36

In [832]:

```
# Line chart with total user with account and booking rate by Year.
x_axis =account_booking_users_year.index
y_axis_1 = account_booking_users_year["account_num_users"]
y_axis_2 = account_booking_users_year["booking_rate"]
#y_axis_3=time_to_booking['days_to_first_booking']


fig, ax1 = plt.subplots(figsize=(10, 5))

ax2 = ax1.twinx()
#ax3=ax1.twinx()
#ax3.spines['right'].set_position(('axes', 1.1))

ax1.plot(x_axis, y_axis_1,label='Users Created Account',color='b')
ax2.plot(x_axis, y_axis_2,label='First Booking Rate',color='g')
#ax3.plot(x_axis, y_axis_3,label='Days to First Booking',color='r')

ax1.set_xlabel('Year')
ax1.set_ylabel('Num. of New Users', color='blue')
ax2.set_ylabel('Booking Rate', color='green')
#ax3.set_ylabel('Mean Days to First Booking', color='red')

ax1.grid(True, linewidth=1)
ax2.grid(True, linewidth=1)
#ax3.grid(True, linewidth=1)
plt.title('New Users Account Created,Booking Rate and Mean Days to First Booking by Y
ear')

ax1.set_xticklabels( x_axis,rotation = 45)
plt.tight_layout()
ax1.legend(loc=9)
ax2.legend(loc=1)
#ax3.legend(loc=2)

for i,j,z in zip(x_axis,y_axis_1,y_axis_2):
    ax1.annotate(str(j),xy=(i,j),color='b')
    ax2.annotate(str(z),xy=(i,z),color='g')
    #ax3.annotate(str(f),xy=(i,f),color='r')
plt.show()
```



Days from first activity to booking

In [833]:

```python
# Filter dates to get common range from 01-01-2010 to 30-06-2014.
mask1=train_dates['timestamp_first_active'].between('2010-01-01','2014-06-30')
mask2=train_dates['date_account_created'].between('2010-01-01','2014-06-30')
mask3=train_dates['booked']=='Yes'
train_time_clear=train_dates[mask1&mask2&mask3][['id','timestamp_first_active','date_first_booking','year_first_active']]
train_time_clear.head(2)
```

Out[833]:

	id	timestamp_first_active	date_first_booking	year_first_active
5	osr2jwljor	2010-01-01 21:56:19	2010-01-02	2010
6	lsw9q7uk0j	2010-01-02 01:25:58	2010-01-05	2010

In [834]:

```python
# Calcule days different between first activity and first booking
train_times_diif=train_time_clear.assign(
    first_active_to_booking=np.ceil(((train_time_clear['date_first_booking']-train_time_clear['timestamp_first_active'])\
                                    /np.timedelta64(1,'D'))).astype(int))
```

In [835]:

```python
train_times_diif.head(2)
# first_active_to_booking --> How many days from user first activity and first booking
```

Out[835]:

	id	timestamp_first_active	date_first_booking	year_first_active	first_active_to_booking
5	osr2jwljor	2010-01-01 21:56:19	2010-01-02	2010	1
6	lsw9q7uk0j	2010-01-02 01:25:58	2010-01-05	2010	3

In [836]:

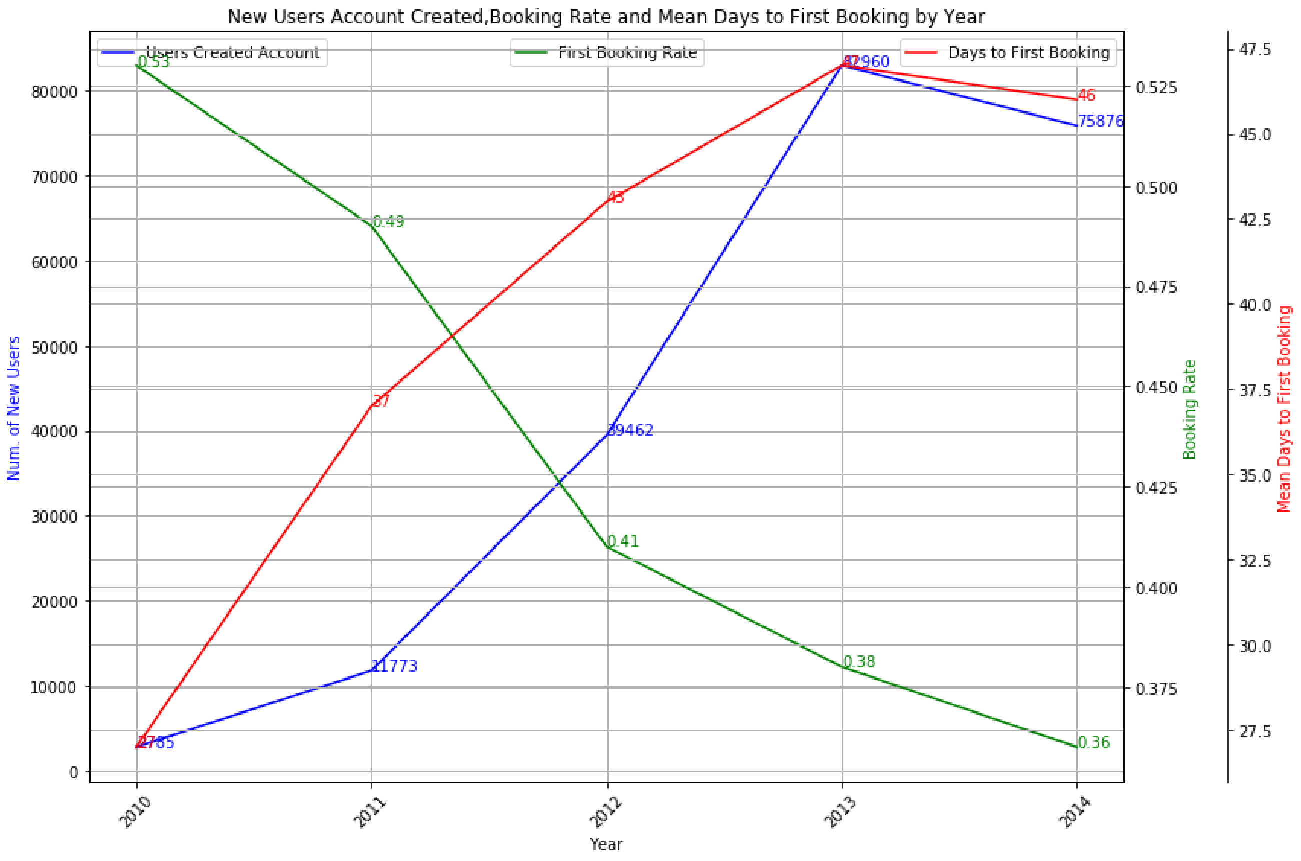
```python
# Group mean days by year
active_bookin_days=train_times_diif.groupby('year_first_active')['first_active_to_booking'].mean().to_frame()
# Round result
active_bookin_days['first_active_to_booking']=round(active_bookin_days['first_active_to_booking']).astype(int)
active_bookin_days
```

Out[836]:

	first_active_to_booking
year_first_active	
2010	27
2011	37
2012	43
2013	47
2014	46

In [837]:

```
# Line chart with total user with account and booking rate by Year.
x_axis =account_booking_users_year.index
y_axis_1 = account_booking_users_year["account_num_users"]
y_axis_2 = account_booking_users_year["booking_rate"]
y_axis_3 = active_bookin_days['first_active_to_booking']


fig, ax1 = plt.subplots(figsize=(12, 8))

ax2 = ax1.twinx()
ax3=ax1.twinx()
ax3.spines['right'].set_position(('axes', 1.1))

ax1.plot(x_axis, y_axis_1,label='Users Created Account',color='b')
ax2.plot(x_axis, y_axis_2,label='First Booking Rate',color='g')
ax3.plot(x_axis, y_axis_3,label='Days to First Booking',color='r')

ax1.set_xlabel('Year')
ax1.set_ylabel('Num. of New Users', color='blue')
ax2.set_ylabel('Booking Rate', color='green')
ax3.set_ylabel('Mean Days to First Booking', color='red')

ax1.grid(True, linewidth=1)
ax2.grid(True, linewidth=1)
ax3.grid(True, linewidth=1)
plt.title('New Users Account Created,Booking Rate and Mean Days to First Booking by Year')

ax1.set_xticklabels( x_axis,rotation = 45)
plt.tight_layout()
ax1.legend(loc=2)
ax2.legend(loc=9)
ax3.legend(loc=1)

for i,j,z,f in zip(x_axis,y_axis_1,y_axis_2,y_axis_3):
    ax1.annotate(str(j),xy=(i,j),color='b')
    ax2.annotate(str(z),xy=(i,z),color='g')
    ax3.annotate(str(f),xy=(i,f),color='r')
plt.show()
```



New User quality by Year

In [838]:

```
# Filter dates to get common range from 01-01-2010 to 30-06-2014.
mask=train_dates['date_account_created'].between('2010-01-01','2014-06-30')
age_dates_clear=train_dates[mask][['id','year_account_created','month_account_create
d','booked','age_group']]
age_dates_clear.head(2)
```

Out[838]:

	id	year_account_created	month_account_created	booked	age_group
0	gxn3p5htnn	2010	6	No	n/a
1	820tgsjxq7	2011	5	No	35-44

In [839]:

```
# Grouping by year,age group and booking
train_dates_age_year=age_dates_clear.groupby(['year_account_created','age_group','boo
ked'])['id'].count().to_frame()\
.rename(columns={'id':'num_users'})
train_dates_age_year.head(2)
```

Out[839]:

			num_users
year_account_created	**age_group**	**booked**	
2010	**15-24**	**No**	13
		Yes	38

In [840]:

```
# Create first pivot table year,age group and booking.
train_dates_age_year_pvt=train_dates_age_year.pivot_table(index=['year_account_created','age_group'],
                                                     columns='booked',
                                                     values='num_users',
                                                     aggfunc='sum')
train_dates_age_year_pvt.head(2)
```

Out[840]:

	booked	**No**	**Yes**
year_account_created	**age_group**		
2010	**15-24**	13	38
	25-34	245	400

In [841]:

```
# Calculate rate from total
train_dates_age_year_pvt[['Yes','No']]\
=normalize(train_dates_age_year_pvt[['Yes','No']], axis=1, norm="l1")
```

In [842]:

```
# Round column values
train_dates_age_year_pvt['Yes']=round(train_dates_age_year_pvt['Yes'],2)
```

In [843]:

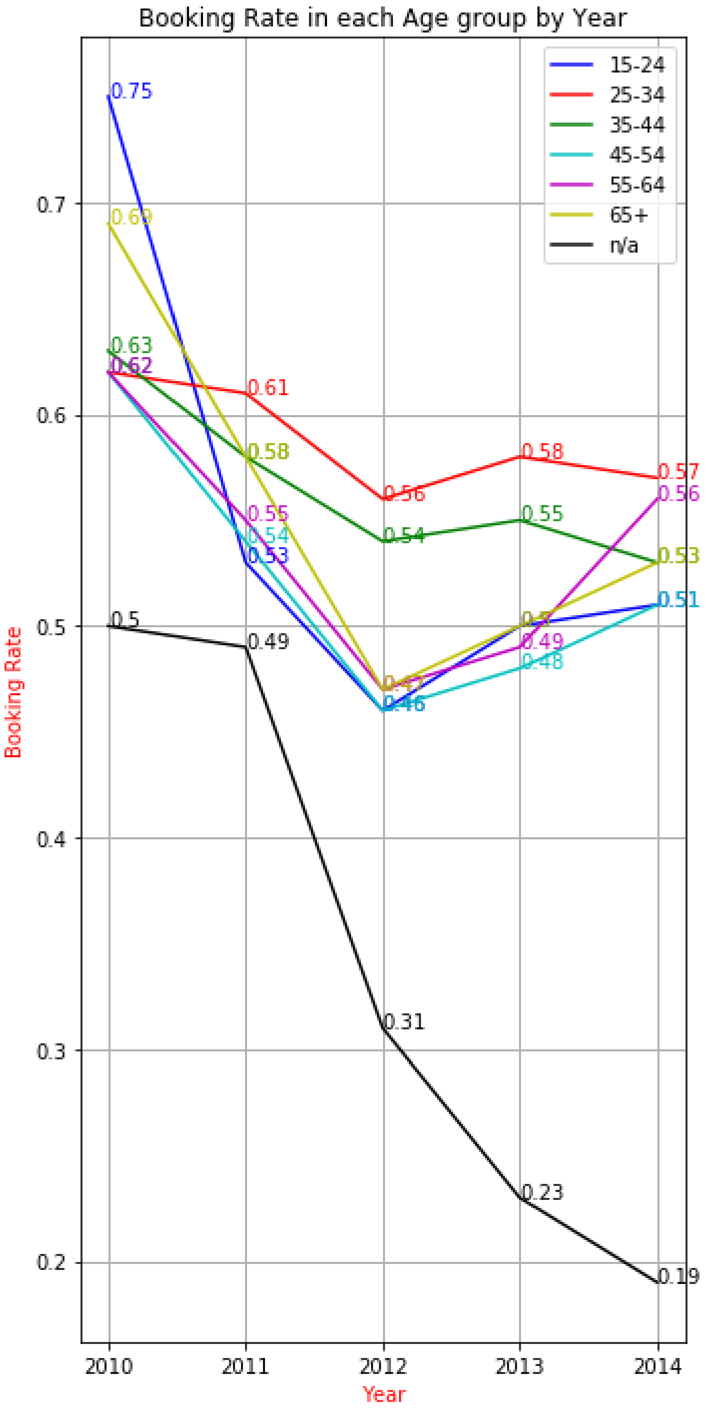
```
# Create second pivot table for make multi line chatrt
train_dates_age_year_pvt_2=\
train_dates_age_year_pvt\
.reset_index()\
.pivot_table(index=train_dates_age_year_pvt.reset_index()['year_account_created'],
             columns='age_group',
             values='Yes',
             aggfunc='sum')
train_dates_age_year_pvt_2
```

Out[843]:

age_group	**15-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65+**	**n/a**
year_account_created							
2010	0.75	0.62	0.63	0.62	0.62	0.69	0.50
2011	0.53	0.61	0.58	0.54	0.55	0.58	0.49
2012	0.46	0.56	0.54	0.46	0.47	0.47	0.31
2013	0.50	0.58	0.55	0.48	0.49	0.50	0.23
2014	0.51	0.57	0.53	0.51	0.56	0.53	0.19

In [844]:

```
# Chart booking rate by year in each age group
x_axis =['2010','2011','2012','2013','2014']
y_axis_1 = train_dates_age_year_pvt_2["15-24"]
y_axis_2 = train_dates_age_year_pvt_2["25-34"]
y_axis_3 = train_dates_age_year_pvt_2["35-44"]
y_axis_4 = train_dates_age_year_pvt_2["45-54"]
y_axis_5 = train_dates_age_year_pvt_2["55-64"]
y_axis_6 = train_dates_age_year_pvt_2["65+"]
y_axis_7 = train_dates_age_year_pvt_2["n/a"]

fig, ax1 = plt.subplots(figsize=(5, 10))

ax1.plot(x_axis, y_axis_1,label='15-24',color='b')
ax1.plot(x_axis, y_axis_2,label='25-34',color='r')
ax1.plot(x_axis, y_axis_3,label='35-44',color='g')
ax1.plot(x_axis, y_axis_4,label='45-54',color='c')
ax1.plot(x_axis, y_axis_5,label='55-64',color='m')
ax1.plot(x_axis, y_axis_6,label='65+',color='y')
ax1.plot(x_axis, y_axis_7,label='n/a',color='k')


ax1.set_xlabel('Year' , color='red')
ax1.set_ylabel('Booking Rate', color='red')
ax1.grid(True, linewidth=1)
plt.title('Booking Rate in each Age group by Year')

plt.tight_layout()
ax1.legend()

for i,a,b,c,d,f,g,e in zip(x_axis,y_axis_1,y_axis_2,y_axis_3,y_axis_4,y_axis_5,y_axis
_6,y_axis_7):
    ax1.annotate(str(a),xy=(i,a),color='b')
    ax1.annotate(str(b),xy=(i,b),color='r')
    ax1.annotate(str(c),xy=(i,c),color='g')
    ax1.annotate(str(d),xy=(i,d),color='c')
    ax1.annotate(str(f),xy=(i,f),color='m')
    ax1.annotate(str(g),xy=(i,g),color='y')
    ax1.annotate(str(e),xy=(i,e),color='k')
plt.show()
```



In [845]:

```
# Grouping by year and age group
train_dates_age_year_total=age_dates_clear.groupby(['year_account_created','age_group'])['id'].count().to_frame()\
.rename(columns={'id':'num_users'})
train_dates_age_year_total.head(2)
```

Out[845]:

		num_users
year_account_created	**age_group**	
2010	**15-24**	51
	25-34	645

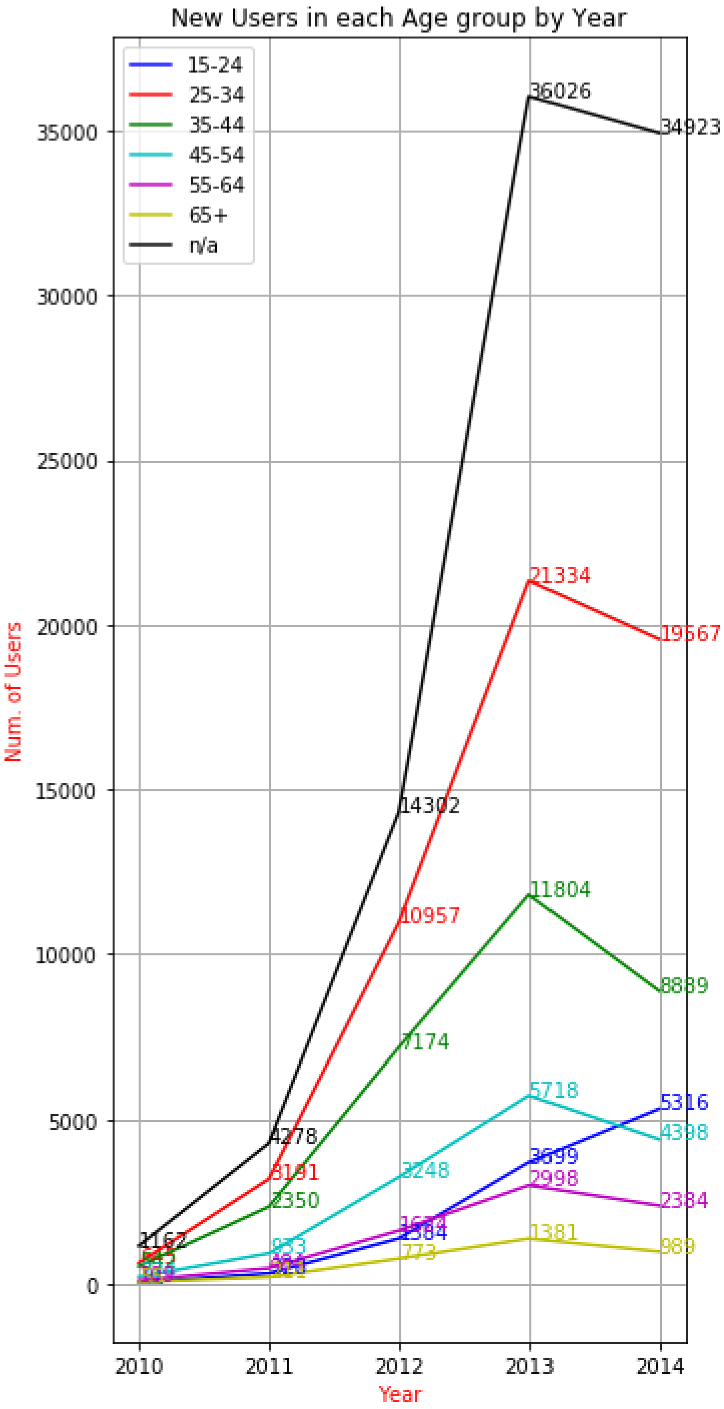
```
In [846]: # Create pivot table : number users by year and age group
          train_dates_age_year_total_pvt=train_dates_age_year_total.pivot_table(index='year_acc
          ount_created',
                                                                                      columns='age_gr
          oup',
                                                                                      values='num_use
          rs',
                                                                                        aggfunc='sum'
          )
          train_dates_age_year_total_pvt
```

Out[846]:

age_group	15-24	25-34	35-44	45-54	55-64	65+	n/a
year_account_created							
2010	51	645	542	224	109	55	1162
2011	328	3191	2350	933	484	211	4278
2012	1384	10957	7174	3248	1624	773	14302
2013	3699	21334	11804	5718	2998	1381	36026
2014	5316	19567	8889	4398	2384	989	34923

In [847]:

```
# Chart number of new users by year in each age group
x_axis =['2010','2011','2012','2013','2014']
y_axis_1 = train_dates_age_year_total_pvt["15-24"]
y_axis_2 = train_dates_age_year_total_pvt["25-34"]
y_axis_3 = train_dates_age_year_total_pvt["35-44"]
y_axis_4 = train_dates_age_year_total_pvt["45-54"]
y_axis_5 = train_dates_age_year_total_pvt["55-64"]
y_axis_6 = train_dates_age_year_total_pvt["65+"]
y_axis_7 = train_dates_age_year_total_pvt["n/a"]

fig, ax1 = plt.subplots(figsize=(5, 10))

ax1.plot(x_axis, y_axis_1,label='15-24',color='b')
ax1.plot(x_axis, y_axis_2,label='25-34',color='r')
ax1.plot(x_axis, y_axis_3,label='35-44',color='g')
ax1.plot(x_axis, y_axis_4,label='45-54',color='c')
ax1.plot(x_axis, y_axis_5,label='55-64',color='m')
ax1.plot(x_axis, y_axis_6,label='65+'  ,color='y')
ax1.plot(x_axis, y_axis_7,label='n/a'  ,color='k')


ax1.set_xlabel('Year' , color='red')
ax1.set_ylabel('Num. of Users', color='red')
ax1.grid(True, linewidth=1)
plt.title('New Users in each Age group by Year')

plt.tight_layout()
ax1.legend()

for i,a,b,c,d,f,g,e in zip(x_axis,y_axis_1,y_axis_2,y_axis_3,y_axis_4,y_axis_5,y_axis
_6,y_axis_7):
    ax1.annotate(str(a),xy=(i,a),color='b')
    ax1.annotate(str(b),xy=(i,b),color='r')
    ax1.annotate(str(c),xy=(i,c),color='g')
    ax1.annotate(str(d),xy=(i,d),color='c')
    ax1.annotate(str(f),xy=(i,f),color='m')
    ax1.annotate(str(g),xy=(i,g),color='y')
    ax1.annotate(str(e),xy=(i,e),color='k')
plt.show()
```



Month

In [848]:
```
account_booking_users.head(2)
```

Out[848]:

	year_account_created	month_account_created	account_num_users	booking_num_users	Year
y_m					
1-2010	2010	1	61	29	2010
2-2010	2010	2	102	40	2010

In [849]:

```
account_booking_users_month=\
account_booking_users.groupby('month_account_created')[['account_num_users','booking_num_users']].sum()
account_booking_users_month
```

Out[849]:

```
                        account_num_users  booking_num_users
month_account_created
                    1               17495               5997
                    2               16582               6408
                    3               20325               8024
                    4               21867               8534
                    5               25911              10287
                    6               26831              10450
                    7               13832               5485
                    8               14611               5952
                    9               15393               5760
                   10               13476               5478
                   11               13129               4737
                   12               13404               4653
```

In [850]:

```
account_booking_users_month['booking_rate']=\
round(account_booking_users_month['booking_num_users']/account_booking_users_month['account_num_users'],2)
```

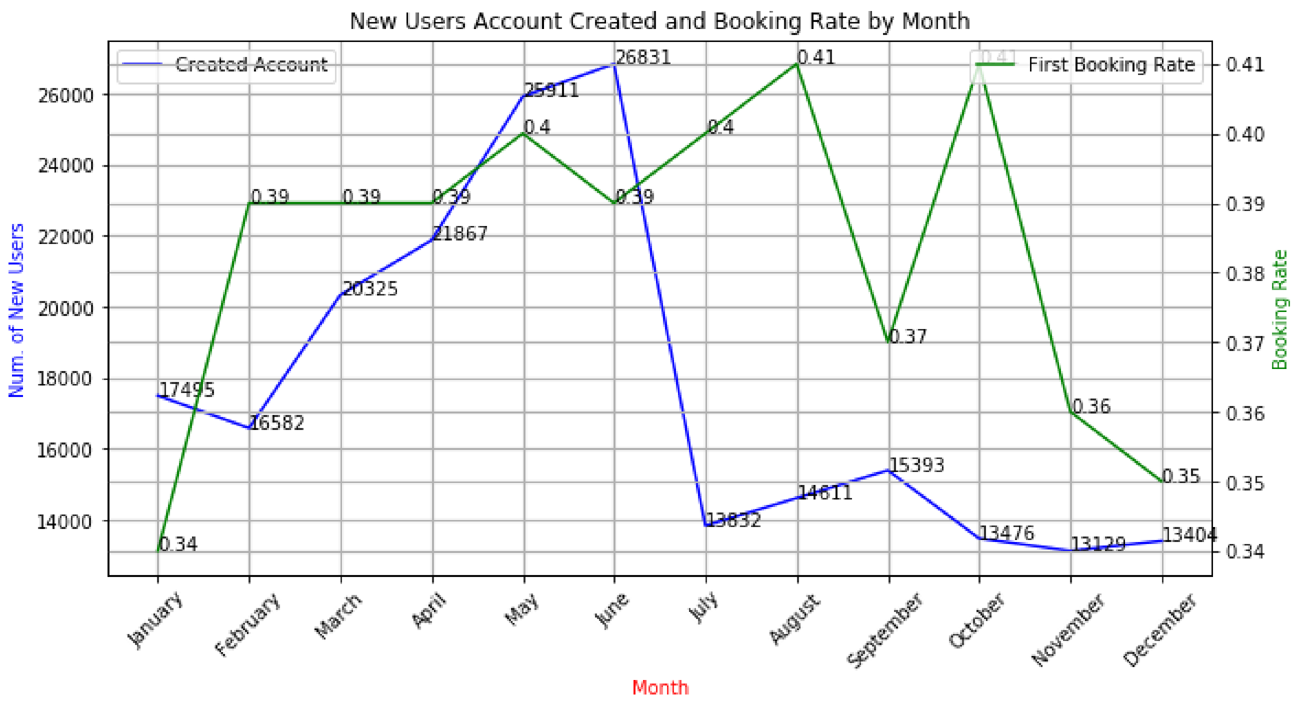
In [851]:

```
account_booking_users_month
```

Out[851]:

```
                        account_num_users  booking_num_users  booking_rate
month_account_created
                    1               17495               5997          0.34
                    2               16582               6408          0.39
                    3               20325               8024          0.39
                    4               21867               8534          0.39
                    5               25911              10287          0.40
                    6               26831              10450          0.39
                    7               13832               5485          0.40
                    8               14611               5952          0.41
                    9               15393               5760          0.37
                   10               13476               5478          0.41
                   11               13129               4737          0.36
                   12               13404               4653          0.35
```

```
In [852]: # Line chart Trend new accounts created and booking rate by months
          names = ['January', 'February', 'March',
                   'April', 'May', 'June', 'July',
                   'August', 'September', 'October',
                   'November', 'December']
          x_axis =names
          y_axis_1 = account_booking_users_month["account_num_users"]
          y_axis_2 = account_booking_users_month["booking_rate"]

          fig, ax1 = plt.subplots(figsize=(10, 5))

          ax2 = ax1.twinx()
          ax1.plot(x_axis, y_axis_1,label='Created Account',color='b')
          ax2.plot(x_axis, y_axis_2,label='First Booking Rate',color='g')

          ax1.set_xlabel('Month' , color='red')
          ax1.set_ylabel('Num. of New Users', color='blue')
          ax2.set_ylabel('Booking Rate', color='green')
          ax1.grid(True, linewidth=1.25)
          ax2.grid(True, linewidth=1.25)
          plt.title('New Users Account Created and Booking Rate by Month')


          plt.tight_layout()
          ax1.legend(loc=2)
          ax2.legend(loc=1)
          ax1.set_xticklabels( names,rotation = 45)


          for i,j,z in zip(x_axis,y_axis_1,y_axis_2):
              ax1.annotate(str(j),xy=(i,j))
              ax2.annotate(str(z),xy=(i,z))
          plt.show()
```



Age groups by month

In [853]:

```
# Grouping by month and age group
train_dates_age_month=age_dates_clear.groupby(['month_account_created','age_group','booked'])['id'].count().to_frame()\
.rename(columns={'id':'num_users'})
train_dates_age_month.head(2)
```

Out[853]:

```
                                                num_users
month_account_created  age_group  booked
                    1      15-24      No              437
                                     Yes              435
```

In [854]:

```
# Create first pivot table month,age group and booking
train_dates_age_month_pvt=train_dates_age_month.pivot_table(index=['month_account_created','age_group'],
                                                             columns='booked',
                                                             values='num_users',
                                                             aggfunc='sum')
train_dates_age_month_pvt.head(2)
```

Out[854]:

```
                                  booked    No   Yes
month_account_created  age_group
                    1      15-24           437   435
                           25-34          2029  2675
```

In [855]:

```
# Calculate rate from total
train_dates_age_month_pvt[['Yes','No']]\
=normalize(train_dates_age_month_pvt[['Yes','No']], axis=1, norm="l1")
```

In [856]:

```
# Round column values
train_dates_age_month_pvt['Yes']=round(train_dates_age_month_pvt['Yes'],2)
```

In [857]:

```
train_dates_age_month_pvt.head(2)
```

Out[857]:

```
                                  booked          No   Yes
month_account_created  age_group
                    1      15-24           0.501147  0.50
                           25-34           0.431335  0.57
```

In [858]:

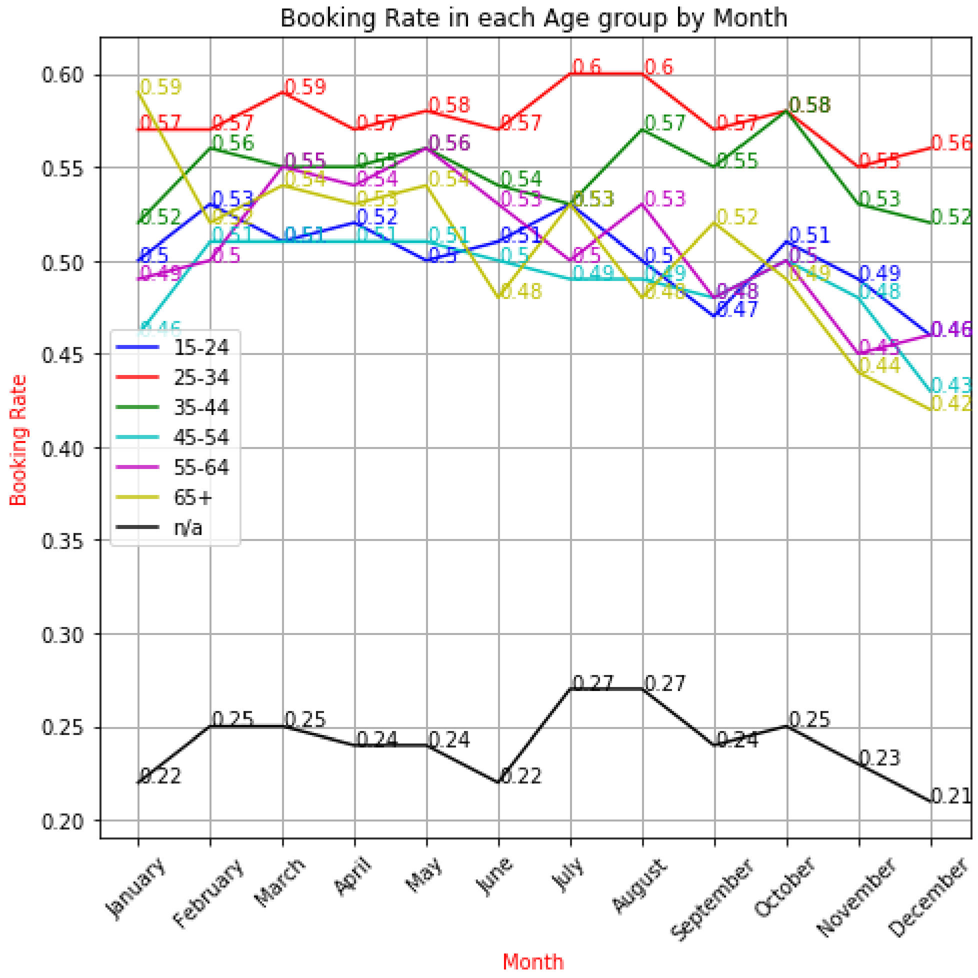
```
# Create second pivot table month,age group and booking
train_dates_age_month_pvt_2=\
train_dates_age_month_pvt\
.reset_index()\
.pivot_table(index=train_dates_age_month_pvt.reset_index()['month_account_created'],
             columns='age_group',
             values='Yes',
             aggfunc='sum')
train_dates_age_month_pvt_2
```

Out[858]:

age_group	15-24	25-34	35-44	45-54	55-64	65+	n/a
month_account_created							
1	0.50	0.57	0.52	0.46	0.49	0.59	0.22
2	0.53	0.57	0.56	0.51	0.50	0.52	0.25
3	0.51	0.59	0.55	0.51	0.55	0.54	0.25
4	0.52	0.57	0.55	0.51	0.54	0.53	0.24
5	0.50	0.58	0.56	0.51	0.56	0.54	0.24
6	0.51	0.57	0.54	0.50	0.53	0.48	0.22
7	0.53	0.60	0.53	0.49	0.50	0.53	0.27
8	0.50	0.60	0.57	0.49	0.53	0.48	0.27
9	0.47	0.57	0.55	0.48	0.48	0.52	0.24
10	0.51	0.58	0.58	0.50	0.50	0.49	0.25
11	0.49	0.55	0.53	0.48	0.45	0.44	0.23
12	0.46	0.56	0.52	0.43	0.46	0.42	0.21

In [859]:

```
# Chart booking rate by month in each age group
names = ['January', 'February', 'March',
         'April', 'May', 'June', 'July',
         'August', 'September', 'October',
         'November', 'December']
x_axis =names
y_axis_1 = train_dates_age_month_pvt_2["15-24"]
y_axis_2 = train_dates_age_month_pvt_2["25-34"]
y_axis_3 = train_dates_age_month_pvt_2["35-44"]
y_axis_4 = train_dates_age_month_pvt_2["45-54"]
y_axis_5 = train_dates_age_month_pvt_2["55-64"]
y_axis_6 = train_dates_age_month_pvt_2["65+"]
y_axis_7 = train_dates_age_month_pvt_2["n/a"]


fig, ax1 = plt.subplots(figsize=(7, 7))

ax1.plot(x_axis, y_axis_1,label='15-24',color='b')
ax1.plot(x_axis, y_axis_2,label='25-34',color='r')
ax1.plot(x_axis, y_axis_3,label='35-44',color='g')
ax1.plot(x_axis, y_axis_4,label='45-54',color='c')
ax1.plot(x_axis, y_axis_5,label='55-64',color='m')
ax1.plot(x_axis, y_axis_6,label='65+',color='y')
ax1.plot(x_axis, y_axis_7,label='n/a',color='k')



ax1.set_xlabel('Month' , color='red')
ax1.set_ylabel('Booking Rate', color='red')
ax1.grid(True, linewidth=1)
plt.title('Booking Rate in each Age group by Month')

ax1.set_xticklabels( names,rotation = 45)
plt.tight_layout()
ax1.legend(loc=6)

for i,a,b,c,d,f,g,e in zip(x_axis,y_axis_1,y_axis_2,y_axis_3,y_axis_4,y_axis_5,y_axis
_6,y_axis_7):
    ax1.annotate(str(a),xy=(i,a),color='b')
    ax1.annotate(str(b),xy=(i,b),color='r')
    ax1.annotate(str(c),xy=(i,c),color='g')
    ax1.annotate(str(d),xy=(i,d),color='c')
    ax1.annotate(str(f),xy=(i,f),color='m')
    ax1.annotate(str(g),xy=(i,g),color='y')
    ax1.annotate(str(e),xy=(i,e),color='k')
plt.show()
```



Weekday

In [860]:

```
# Filter dates to get common range from 01-01-2010 to 30-06-2014.
mask1=train_dates['timestamp_first_active'].between('2010-01-01','2014-06-30')
mask2=train_dates['date_account_created'].between('2010-01-01','2014-06-30')
train_dates_clear_weekday_account=train_dates[mask1&mask2]
train_dates_clear_weekday_account.head(2)
```

Out[860]:

	id	date_account_created	timestamp_first_active	date_first_booking	booked	age_group	year_
5	osr2jwljor	2010-01-01	2010-01-01 21:56:19	2010-01-02	Yes	n/a	
6	lsw9q7uk0j	2010-01-02	2010-01-02 01:25:58	2010-01-05	Yes	45-54	

In [861]:

```
# Create table by weekday account created
weekday_account=train_dates_clear_weekday_account[['id','weekday_account_created']]
weekday_account.head(2)
```

Out[861]:

	id	weekday_account_created
5	osr2jwljor	Friday
6	lsw9q7uk0j	Saturday

In [862]:

```
#  Grouping by weekday
weekday_account_group=weekday_account.groupby('weekday_account_created')['id'].count
().to_frame()\
.rename(columns={'id':'account_num_users'})
# Reset index before join
weekday_account_group=weekday_account_group.reset_index().rename(columns={'weekday_ac
count_created':'weekday'})
weekday_account_group
```

Out[862]:

	weekday	account_num_users
0	Friday	29741
1	Monday	32270
2	Saturday	24538
3	Sunday	24568
4	Thursday	32570
5	Tuesday	35083
6	Wednesday	34086

In [863]:

```
# Create table by weekday booking
weekday_booking=train_dates[['id','weekday_first_booking','age_group']]
weekday_booking.head(2)
```

Out[863]:

	id	weekday_first_booking	age_group
0	gxn3p5htnn	NaN	n/a
1	820tgsjxq7	NaN	35-44

In [864]:

```
# Grouping by weekday booking
weekday_booking_group=weekday_booking.groupby('weekday_first_booking')['id'].count().
to_frame()\
.rename(columns={'id':'booking_num_users'})
weekday_booking_group=weekday_booking_group.reset_index().rename(columns={'weekday_fi
rst_booking':'weekday'})
weekday_booking_group
```

Out[864]:

	weekday	booking_num_users
0	Friday	13299
1	Monday	12734
2	Saturday	10420
3	Sunday	9845
4	Thursday	13939
5	Tuesday	14297
6	Wednesday	14374

In [865]:

```
#  Join tables total users and booking users
weekday_account_booking=weekday_account_group.merge(weekday_booking_group,how='inner'
,left_on='weekday',right_on='weekday')
weekday_account_booking
```

Out[865]:

	weekday	account_num_users	booking_num_users
0	Friday	29741	13299
1	Monday	32270	12734
2	Saturday	24538	10420
3	Sunday	24568	9845
4	Thursday	32570	13939
5	Tuesday	35083	14297
6	Wednesday	34086	14374

In [866]:

```
# Adding booking rate column
weekday_account_booking['booking_rate']=\
round(weekday_account_booking['booking_num_users']/weekday_account_booking['account_n
um_users'],2)
weekday_account_booking
```

Out[866]:

	weekday	account_num_users	booking_num_users	booking_rate
0	Friday	29741	13299	0.45
1	Monday	32270	12734	0.39
2	Saturday	24538	10420	0.42
3	Sunday	24568	9845	0.40
4	Thursday	32570	13939	0.43
5	Tuesday	35083	14297	0.41
6	Wednesday	34086	14374	0.42

In [867]:

```
# Sort weekday names by weekday numbers
names = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday'
]
weekday_account_booking['weekday'] =\
pd.Categorical(weekday_account_booking['weekday'], categories=names, ordered=True)
weekday_account_booking = weekday_account_booking.sort_values('weekday')
weekday_account_booking.set_index('weekday',inplace=True)
```

In [868]:

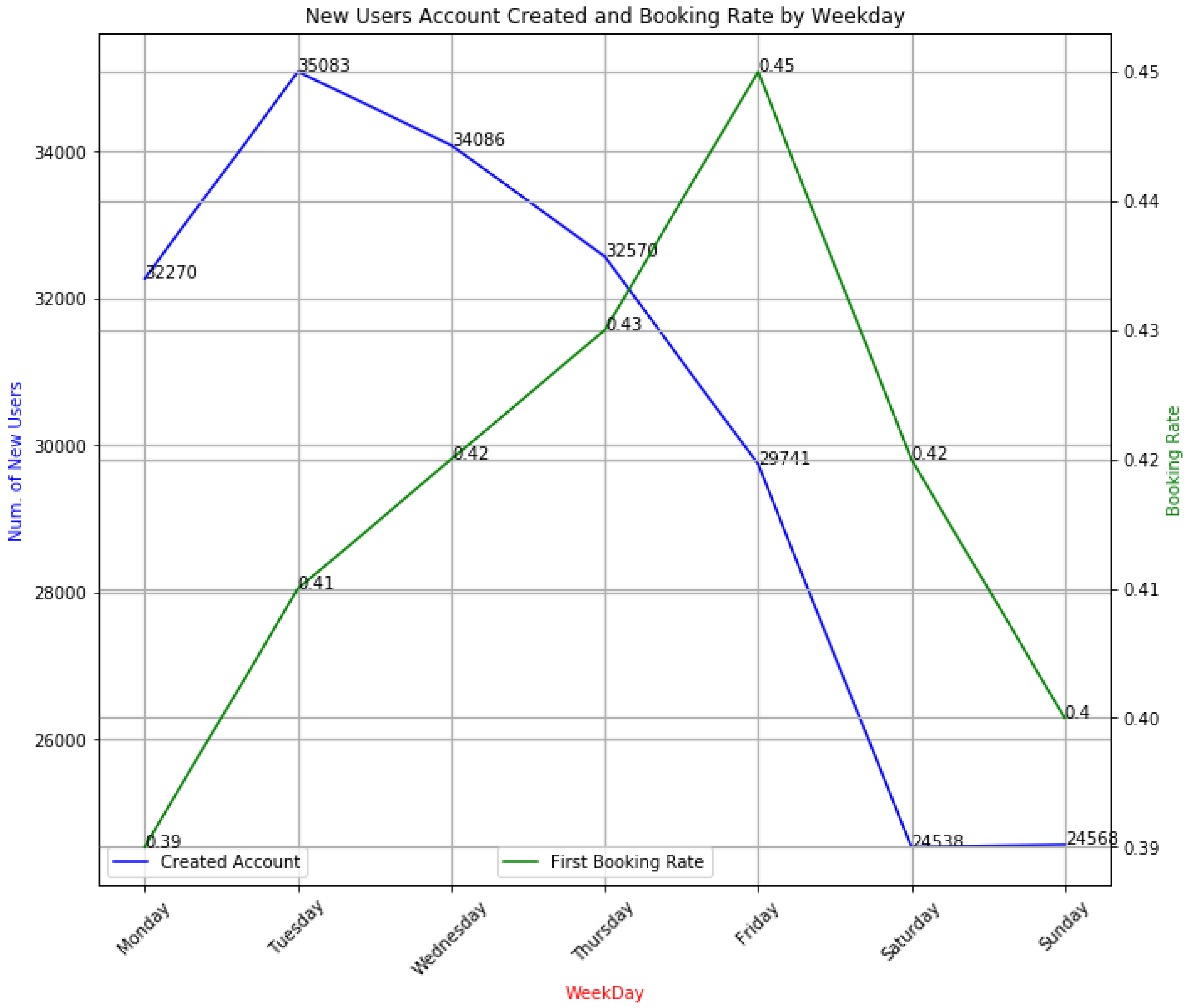
```
weekday_account_booking
```

Out[868]:

	account_num_users	booking_num_users	booking_rate
weekday			
Monday	32270	12734	0.39
Tuesday	35083	14297	0.41
Wednesday	34086	14374	0.42
Thursday	32570	13939	0.43
Friday	29741	13299	0.45
Saturday	24538	10420	0.42
Sunday	24568	9845	0.40

In [869]:

```
# Line chart Trend new accounts created and booking rate by weekdays
x_axis =weekday_account_booking.index
y_axis_1 = weekday_account_booking["account_num_users"]
y_axis_2 = weekday_account_booking["booking_rate"]

fig, ax1 = plt.subplots(figsize=(10,8))

ax2 = ax1.twinx()
ax1.plot(x_axis, y_axis_1,label='Created Account',color='b')
ax2.plot(x_axis, y_axis_2,label='First Booking Rate',color='g')

ax1.set_xlabel('WeekDay' , color='red')
ax1.set_ylabel('Num. of New Users', color='blue')
ax2.set_ylabel('Booking Rate', color='green')
ax1.grid(True, linewidth=1.25)
ax2.grid(True, linewidth=1.25)
plt.title('New Users Account Created and Booking Rate by Weekday')

plt.tight_layout()
ax1.legend(loc=3)
ax2.legend(loc=8)
ax1.set_xticklabels( names,rotation = 45)


for i,j,z in zip(x_axis,y_axis_1,y_axis_2):
    ax1.annotate(str(j),xy=(i,j))
    ax2.annotate(str(z),xy=(i,z))
plt.show()
```



End