Business Problem

In recent years, City Hotel and Resort Hotel have seen high cancellation rates. Each hotel is now dealing with a number of issues as a result, including fewer revenues and less than ideal hotel room use. Consequently, lowering cancellation rates is both hotels' primary goal in order to increase their efficiency in generating revenue and for us to offer thorough business advice to address this problem.

Research Question

1. What are the variables that affect hotel reservation cancellations?

2. How can we make hotel reservations cancellations better?

3. How will hotels be assisted in making pricing and promotional decisions?

Importing Libraries

In [40]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
```

Loading the Dataset

In [29]:
```
df = pd.read_csv('C:/Users/DAVINA/Downloads/hotel.csv')
```

Exploratory Data Analysis and Data Cleaning

In [13]:
```
df.head()
```

Out[13]:

	hotel	is_canceled	lead_time	arrival_date_year	arrival_date_month	arrival_date_week_number	arrival_date_day_of_month	stays_in_weekend_nights	stays_in_week_nights	adults	...	deposit_type
0	Resort Hotel	0	342	2015	July	27	1	0	0	2	...	No Deposit
1	Resort Hotel	0	737	2015	July	27	1	0	0	2	...	No Deposit
2	Resort Hotel	0	7	2015	July	27	1	0	1	1	...	No Deposit
3	Resort Hotel	0	13	2015	July	27	1	0	1	1	...	No Deposit
4	Resort Hotel	0	14	2015	July	27	1	0	2	2	...	No Deposit

5 rows × 32 columns

In [14]:
```
df.tail()
```

Out[14]:

	hotel	is_canceled	lead_time	arrival_date_year	arrival_date_month	arrival_date_week_number	arrival_date_day_of_month	stays_in_weekend_nights	stays_in_week_nights	adults	...	deposit_typ
119385	City Hotel	0	23	2017	August	35	30	2	5	2	...	No Depos
119386	City Hotel	0	102	2017	August	35	31	2	5	3	...	No Depos
119387	City Hotel	0	34	2017	August	35	31	2	5	2	...	No Depos
119388	City Hotel	0	109	2017	August	35	31	2	5	2	...	No Depos
119389	City Hotel	0	205	2017	August	35	29	2	7	2	...	No Depos

5 rows × 32 columns

In [15]:
```
df.shape
```

Out[15]:
```
(119390, 32)
```

In [16]:
```
df.columns
```

Out[16]:
```
Index(['hotel', 'is_canceled', 'lead_time', 'arrival_date_year',
       'arrival_date_month', 'arrival_date_week_number',
       'arrival_date_day_of_month', 'stays_in_weekend_nights',
       'stays_in_week_nights', 'adults', 'children', 'babies', 'meal',
       'country', 'market_segment', 'distribution_channel',
       'is_repeated_guest', 'previous_cancellations',
       'previous_bookings_not_canceled', 'reserved_room_type',
       'assigned_room_type', 'booking_changes', 'deposit_type', 'agent',
       'company', 'days_in_waiting_list', 'customer_type', 'adr',
       'required_car_parking_spaces', 'total_of_special_requests',
       'reservation_status', 'reservation_status_date'],
      dtype='object')
```

In [18]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 119390 entries, 0 to 119389
Data columns (total 32 columns):
 #   Column                          Non-Null Count   Dtype  
---  ------                          --------------   -----  
 0   hotel                           119390 non-null  object 
 1   is_canceled                     119390 non-null  int64  
 2   lead_time                       119390 non-null  int64  
 3   arrival_date_year               119390 non-null  int64  
 4   arrival_date_month              119390 non-null  object 
 5   arrival_date_week_number        119390 non-null  int64  
 6   arrival_date_day_of_month       119390 non-null  int64  
 7   stays_in_weekend_nights         119390 non-null  int64  
 8   stays_in_week_nights            119390 non-null  int64  
 9   adults                          119390 non-null  int64  
 10  children                        119386 non-null  float64
 11  babies                          119390 non-null  int64  
 12  meal                            119390 non-null  object 
 13  country                         118902 non-null  object 
 14  market_segment                  119390 non-null  object 
 15  distribution_channel            119390 non-null  object 
 16  is_repeated_guest               119390 non-null  int64  
 17  previous_cancellations          119390 non-null  int64  
 18  previous_bookings_not_canceled  119390 non-null  int64  
 19  reserved_room_type              119390 non-null  object 
 20  assigned_room_type              119390 non-null  object 
 21  booking_changes                 119390 non-null  int64  
 22  deposit_type                    119390 non-null  object 
 23  agent                           103050 non-null  float64
 24  company                         6797 non-null    float64
 25  days_in_waiting_list            119390 non-null  int64  
 26  customer_type                   119390 non-null  object 
 27  adr                             119390 non-null  float64
 28  required_car_parking_spaces     119390 non-null  int64  
 29  total_of_special_requests       119390 non-null  int64  
 30  reservation_status              119390 non-null  object 
 31  reservation_status_date         119390 non-null  object 
dtypes: float64(4), int64(16), object(12)
memory usage: 29.1+ MB
```

In [105…
```
df['reservation_status_date'] = pd.to_datetime(df['reservation_status_date'])
```

In [22]:
```
df.describe(include = 'object')
```

Out[22]:

	hotel	arrival_date_month	meal	country	market_segment	distribution_channel	reserved_room_type	assigned_room_type	deposit_type	customer_type	reservation_status
count	119390	119390	119390	118902	119390	119390	119390	119390	119390	119390	119390
unique	2	12	5	177	8	5	10	12	3	4	3
top	City Hotel	August	BB	PRT	Online TA	TA/TO	A	A	No Deposit	Transient	Check-Out
freq	79330	13877	92310	48590	56477	97870	85994	74053	104641	89613	75166

In [25]:
```
for col in df.describe(include = 'object').columns:
    print(col)
    print(df[col].unique())
    print('-'*50)
```

```
hotel
['Resort Hotel' 'City Hotel']
--------------------------------------------------
arrival_date_month
['July' 'August' 'September' 'October' 'November' 'December' 'January'
 'February' 'March' 'April' 'May' 'June']
--------------------------------------------------
meal
['BB' 'FB' 'HB' 'SC' 'Undefined']
--------------------------------------------------
country
['PRT' 'GBR' 'USA' 'ESP' 'IRL' 'FRA' nan 'ROU' 'NOR' 'OMN' 'ARG' 'POL'
 'DEU' 'BEL' 'CHE' 'CN' 'GRC' 'ITA' 'NLD' 'DNK' 'RUS' 'SWE' 'AUS' 'EST'
 'CZE' 'BRA' 'FIN' 'MOZ' 'BWA' 'LUX' 'SVN' 'ALB' 'IND' 'CHN' 'MEX' 'MAR'
 'UKR' 'SMR' 'LVA' 'PRI' 'SRB' 'CHL' 'AUT' 'BLR' 'LTU' 'TUR' 'ZAF' 'AGO'
 'ISR' 'CYM' 'ZMB' 'CPV' 'ZWE' 'DZA' 'KOR' 'CRI' 'HUN' 'ARE' 'TUN' 'JAM'
 'HRV' 'HKG' 'IRN' 'GEO' 'AND' 'GIB' 'URY' 'JEY' 'CAF' 'CYP' 'COL' 'GGY'
 'KWT' 'NGA' 'MDV' 'VEN' 'SVK' 'FJI' 'KAZ' 'PAK' 'IDN' 'LBN' 'PHL' 'SEN'
 'SYC' 'AZE' 'BHR' 'NZL' 'THA' 'DOM' 'MKD' 'MYS' 'ARM' 'JPN' 'LKA' 'CUB'
 'CMR' 'BIH' 'MUS' 'COM' 'SUR' 'UGA' 'BGR' 'CIV' 'JOR' 'SYR' 'SGP' 'BDI'
 'SAU' 'VNM' 'PLW' 'QAT' 'EGY' 'PER' 'MLT' 'MWI' 'ECU' 'MDG' 'ISL' 'UZB'
 'NPL' 'BHS' 'MAC' 'TGO' 'TWN' 'DJI' 'STP' 'KNA' 'ETH' 'IRQ' 'HND' 'RWA'
 'KHM' 'MCO' 'BGD' 'IMN' 'TJK' 'NIC' 'BEN' 'VGB' 'TZA' 'GAB' 'GHA' 'TMP'
 'GLP' 'KEN' 'LIE' 'GNB' 'MNE' 'UMI' 'MYT' 'FRO' 'MMR' 'PAN' 'BFA' 'LBY'
 'MLI' 'NAM' 'BOL' 'PRY' 'BRB' 'ABW' 'AIA' 'SLV' 'DMA' 'PYF' 'GUY' 'LCA'
 'ATA' 'GTM' 'ASM' 'MRT' 'NCL' 'KIR' 'SDN' 'ATF' 'SLE' 'LAO']
--------------------------------------------------
market_segment
['Direct' 'Corporate' 'Online TA' 'Offline TA/TO' 'Complementary' 'Groups'
 'Undefined' 'Aviation']
--------------------------------------------------
distribution_channel
['Direct' 'Corporate' 'TA/TO' 'Undefined' 'GDS']
--------------------------------------------------
reserved_room_type
['C' 'A' 'D' 'E' 'G' 'F' 'H' 'L' 'P' 'B']
--------------------------------------------------
assigned_room_type
['C' 'A' 'D' 'E' 'G' 'F' 'I' 'B' 'H' 'P' 'L' 'K']
--------------------------------------------------
deposit_type
['No Deposit' 'Refundable' 'Non Refund']
--------------------------------------------------
customer_type
['Transient' 'Contract' 'Transient-Party' 'Group']
--------------------------------------------------
reservation_status
['Check-Out' 'Canceled' 'No-Show']
--------------------------------------------------
```

In [30]:
```
df.isnull().sum()
```

Out[30]:
```
hotel                                  0
is_canceled                            0
lead_time                              0
arrival_date_year                      0
arrival_date_month                     0
arrival_date_week_number               0
arrival_date_day_of_month              0
stays_in_weekend_nights                0
stays_in_week_nights                   0
adults                                 0
children                               4
babies                                 0
meal                                   0
country                              488
market_segment                         0
distribution_channel                   0
is_repeated_guest                      0
previous_cancellations                 0
previous_bookings_not_canceled         0
reserved_room_type                     0
assigned_room_type                     0
booking_changes                        0
deposit_type                           0
agent                              16340
company                           112593
days_in_waiting_list                   0
customer_type                          0
adr                                    0
required_car_parking_spaces            0
total_of_special_requests              0
reservation_status                     0
reservation_status_date                0
dtype: int64
```

In [31]:
```
df.drop(['company','agent'],axis = 1 , inplace = True)
df.dropna(inplace = True)
```

In [32]:
```
df.isnull().sum()
```

Out[32]:
```
hotel                             0
is_canceled                       0
lead_time                         0
arrival_date_year                 0
arrival_date_month                0
arrival_date_week_number          0
arrival_date_day_of_month         0
stays_in_weekend_nights           0
stays_in_week_nights              0
adults                            0
children                          0
babies                            0
meal                              0
country                           0
market_segment                    0
distribution_channel              0
is_repeated_guest                 0
previous_cancellations            0
previous_bookings_not_canceled    0
reserved_room_type                0
assigned_room_type                0
booking_changes                   0
deposit_type                      0
days_in_waiting_list              0
customer_type                     0
adr                               0
required_car_parking_spaces       0
total_of_special_requests         0
reservation_status                0
reservation_status_date           0
dtype: int64
```

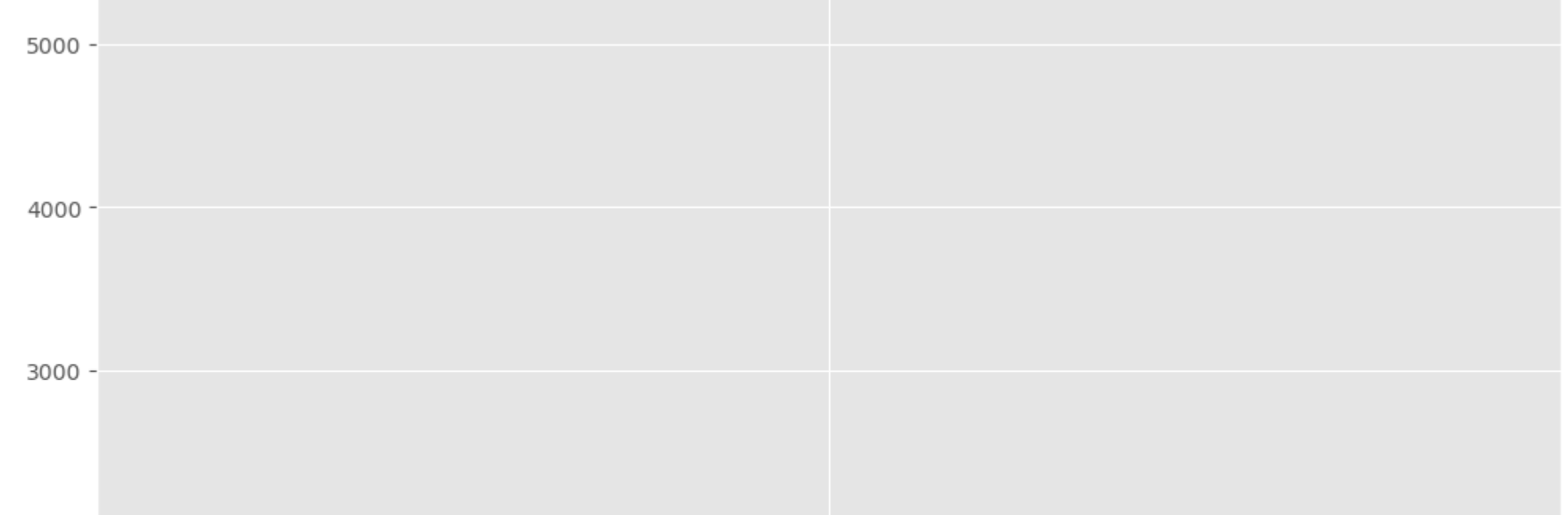
In [33]:
```
df.describe()
```

Out[33]:

	is_canceled	lead_time	arrival_date_year	arrival_date_week_number	arrival_date_day_of_month	stays_in_weekend_nights	stays_in_week_nights	adults	children	babi
count	118898.000000	118898.000000	118898.000000	118898.000000	118898.000000	118898.000000	118898.000000	118898.000000	118898.000000	118898.0000
mean	0.371352	104.311435	2016.157656	27.166555	15.800880	0.928897	2.502145	1.858391	0.104207	0.0079
std	0.483168	106.903309	0.707459	13.589971	8.780324	0.996216	1.900168	0.578576	0.399172	0.0973
min	0.000000	0.000000	2015.000000	1.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.0000
25%	0.000000	18.000000	2016.000000	16.000000	8.000000	0.000000	1.000000	2.000000	0.000000	0.0000
50%	0.000000	69.000000	2016.000000	28.000000	16.000000	1.000000	2.000000	2.000000	0.000000	0.0000
75%	1.000000	161.000000	2017.000000	38.000000	23.000000	2.000000	3.000000	2.000000	0.000000	0.0000
max	1.000000	737.000000	2017.000000	53.000000	31.000000	16.000000	41.000000	55.000000	10.000000	10.0000

In [41]:
```
df['adr'].plot(kind = 'box')
```

Out[41]:
```
<Axes: >
```



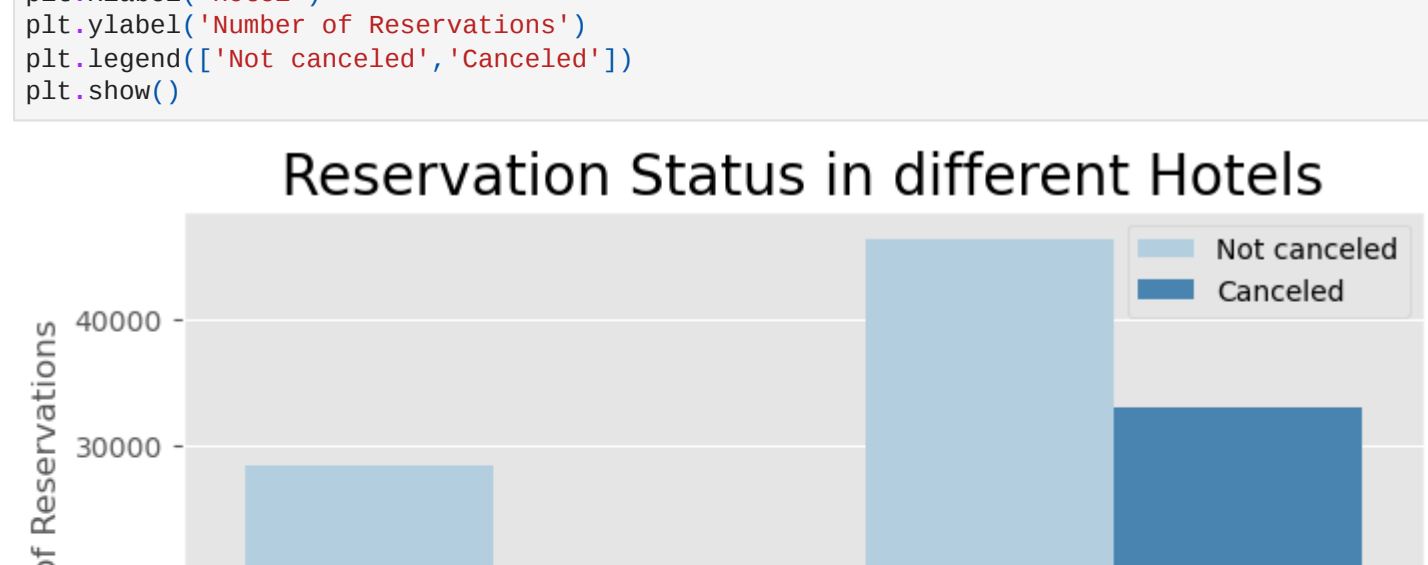
In [42]:
```
df = df[df['adr']< 5000]
```

Data Analysis and Visualizations

In [52]:
```
cancelled_perc = df['is_canceled'].value_counts(normalize = True)
print(cancelled_perc)
plt.figure(figsize = (5,4))
plt.title('Reservation Status count')
plt.bar(['Not canceled','Canceled'],df['is_canceled'].value_counts(),edgecolor = 'k',width = 0.7)
plt.show()
```

```
0    0.628653
1    0.371347
Name: is_canceled, dtype: float64
```

In [83]:
```
plt.figure(figsize = (8,4))
ax1 = sns.countplot(x = 'hotel',hue = 'is_canceled',data = df,palette ='Blues')
legend_labels,_ = ax1.get_legend_handles_labels()
ax1.legend(bbox_to_anchor=(1,1))
plt.title('Reservation Status in different Hotels', size = 20)
plt.xlabel('Hotel')
plt.ylabel('Number of Reservations')
plt.legend(['Not canceled','Canceled'])
plt.show()
```



From the bar graph , it shows the percentage of reservations that are canceled and those that are not. It is obvious that there are still a significant number of reservations that have not been cancelled. There are still 37% of clients who cancelled their reservation,which has a significant impact on the hotel's earnings.

In comparison to resort hotels,city hotels have more bookings. It's possible that resort hotels are more expensive than those in cities.

In [71]:
```
resort_hotel = df[df['hotel']=='Resort Hotel']
resort_hotel['is_canceled'].value_counts(normalze= True)
```

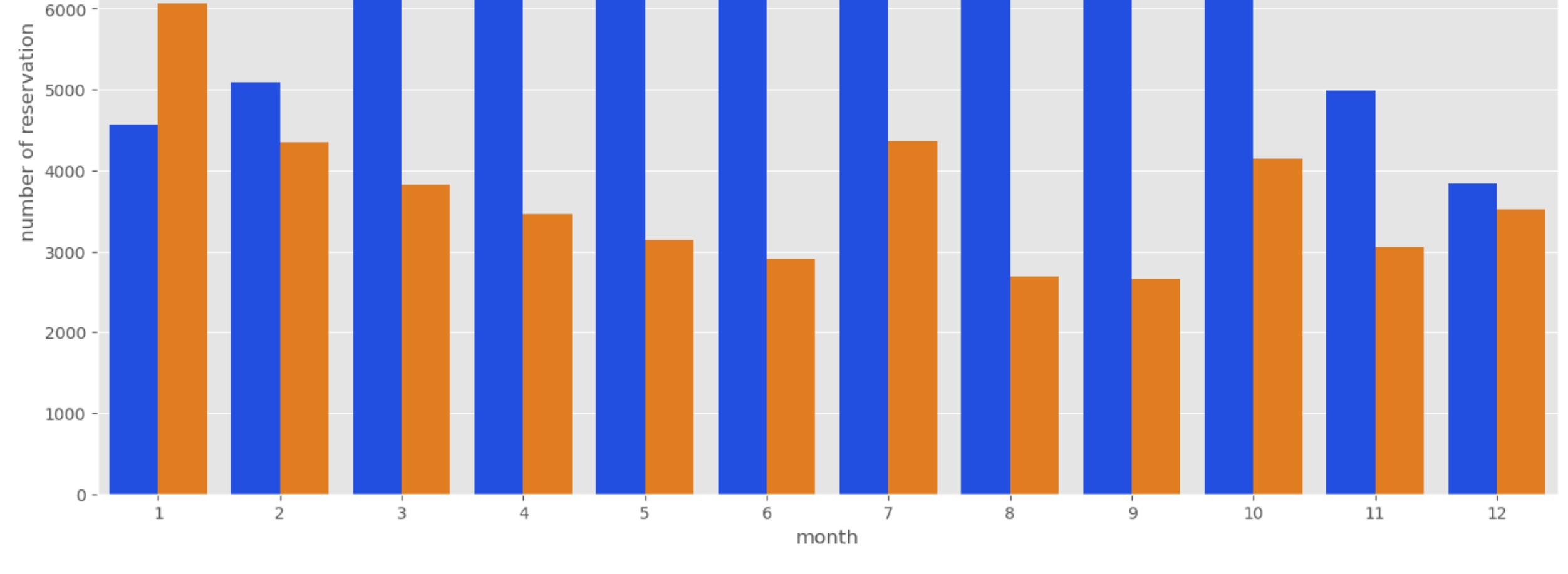
Out[71]:
```
0    0.72025
1    0.27975
Name: is_canceled, dtype: float64
```

In [72]:
```
city_hotel = df[df['hotel']=='City Hotel']
city_hotel['is_canceled'].value_counts(normalize = True)
```

Out[72]:
```
0    0.582918
1    0.417082
Name: is_canceled, dtype: float64
```

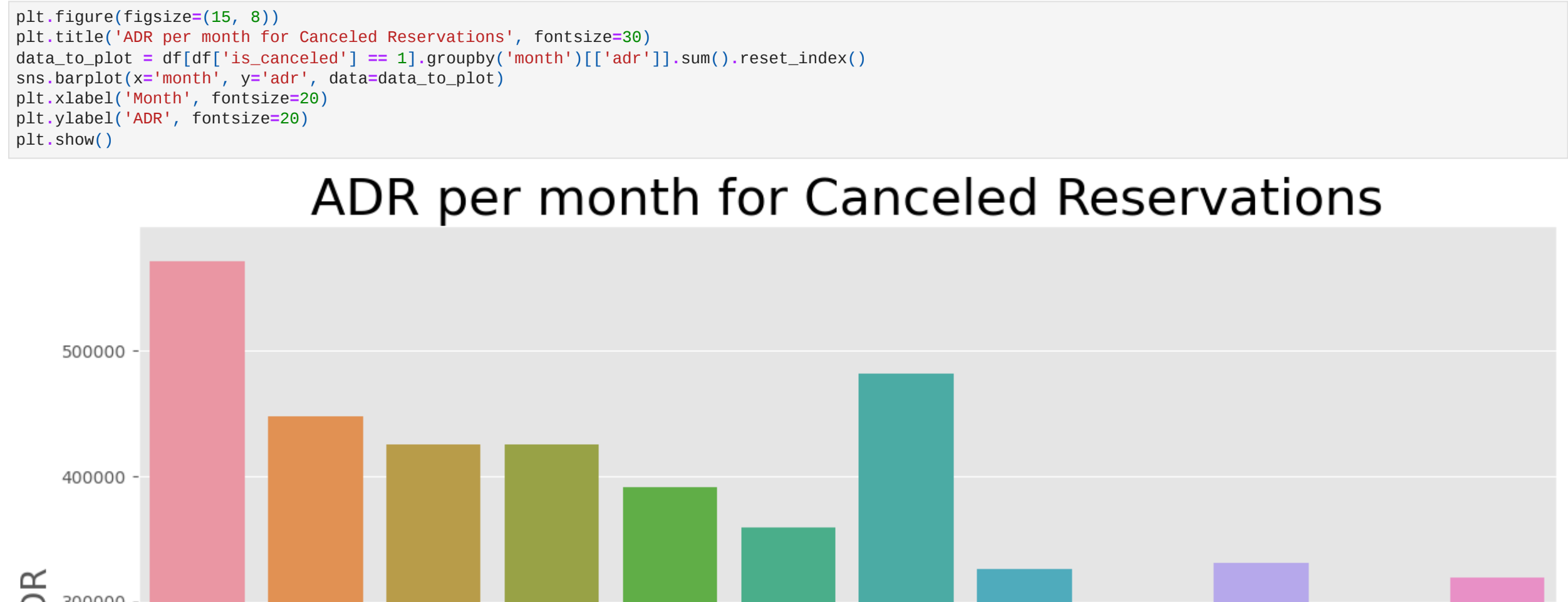
In [79]:
```
resort_hotel = resort_hotel.groupby('reservation_status_date')[['adr']].mean()
city_hotel = city_hotel.groupby('reservation_status_date')[['adr']].mean()
```

In [106…
```
df['month'] = df['reservation_status_date'].dt.month
plt.figure(figsize = (16,8))
ax1 = sns.countplot(x = 'month',hue = 'is_canceled',data = df, palette = 'bright')
legend_labels,_ = ax1. get_legend_handles_labels()
ax1.legend(bbox_to_anchor = (1,1))
plt.title('Rerservation Status per Month', size = 20)
plt.xlabel('month')
plt.ylabel('number of reservation')
plt.legend(['not canceled','canceled'])
plt.show()
```



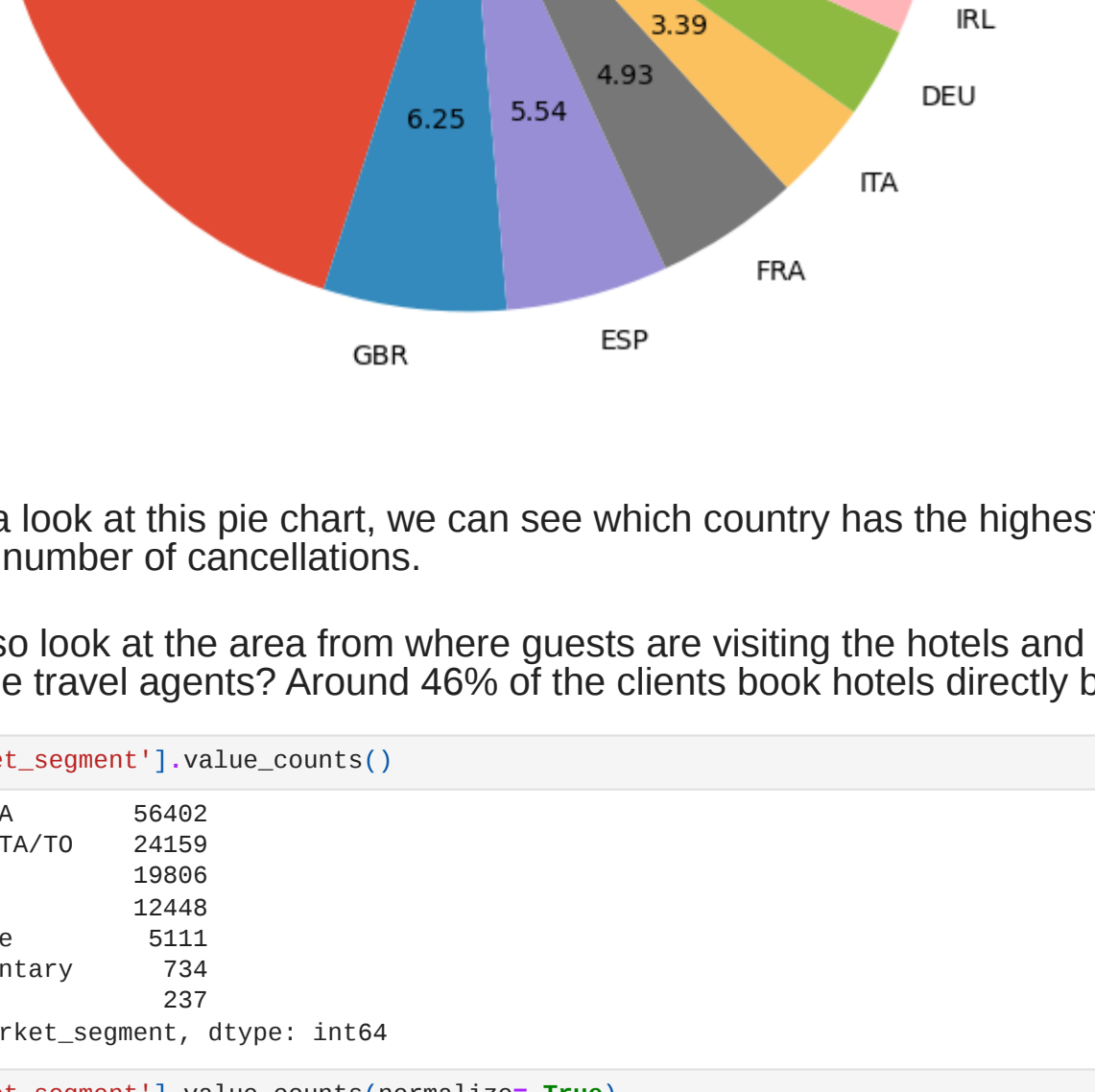
From above,we have developed the grouped bar graph to analyze the months with the highest and lowest reservation levels according to reservation status. As can be seen,both the number of confirmed reservations and the number of cancelled reservations are largest in the month of Auust. Whereas January is the month with the most cancelled reservations.

In [117…
```
plt.figure(figsize=(15, 8))
plt.title('ADR per month for Canceled Reservations', fontsize=30)
data_to_plot = df[df['is_canceled'] == 1].groupby('month')[['adr']].sum().reset_index()
sns.barplot(x='month', y='adr', data=data_to_plot)
plt.xlabel('Month', fontsize=20)
plt.ylabel('ADR', fontsize=20)
plt.show()
```



This bar graph demonstrates that cancellations are most common when prices are greatest and are least when they are lowest. Therefore,the cost of the accomodation is solely responsible for the cancellation.

In [118…
```
cancelled_data = df[df['is_canceled']==1]
top_10_country = cancelled_data['country'].value_counts()[:10]
plt.figure(figsize = (8,8))
plt.title('Top 10 Countries with Reservation Cancelled')
plt.pie(top_10_country, autopct = '%.2f',labels= top_10_country.index)
plt.show()
```



Taking a look at this pie chart, we can see which country has the highest reservation cancelled. The top country is Portugal with the highest number of cancellations.

Let's also look at the area from where guests are visiting the hotels and making reservations. Is it coming from Direct or Groups,Online or Offline travel agents? Around 46% of the clients book hotels directly by visiting them and making reservations.

In [119…
```
df['market_segment'].value_counts()
```

Out[119]:
```
Online TA        56402
Offline TA/TO    24159
Groups           19806
Direct           12448
Corporate         5111
Complementary      734
Aviation           237
Name: market_segment, dtype: int64
```

In [120…
```
df['market_segment'].value_counts(normalize= True)
```

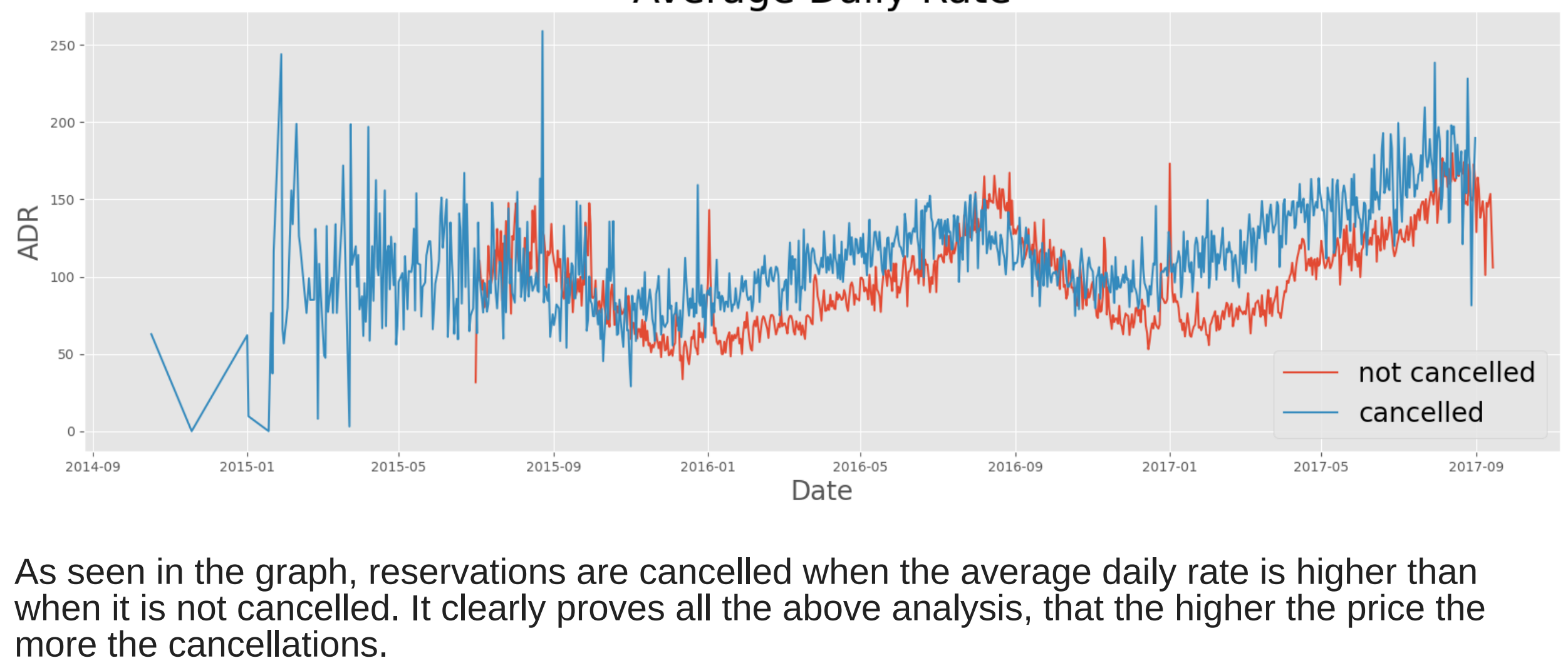
Out[120]:
```
Online TA        0.474377
Offline TA/TO    0.203193
Groups           0.166581
Direct           0.104696
Corporate        0.042987
Complementary    0.006173
Aviation         0.001993
Name: market_segment, dtype: float64
```

In [121…
```
cancelled_data['market_segment'].value_counts(normalize = True)
```

Out[121]:
```
Online TA        0.469696
Groups           0.273985
Offline TA/TO    0.187466
Direct           0.043486
Corporate        0.022151
Complementary    0.002038
Aviation         0.001178
Name: market_segment, dtype: float64
```

In [ ]:

In [134…
```
cancelled_df_adr = cancelled_data.groupby('reservation_status_date')[['adr' ]].mean ()
cancelled_df_adr.reset_index(inplace = True)
cancelled_df_adr.sort_values ('reservation_status_date', inplace = True)
not_cancelled_data = df[df['is_canceled'] == 0]
not_cancelled_df_adr = not_cancelled_data.groupby('reservation_status_date')[['adr']].mean()
not_cancelled_df_adr.reset_index(inplace = True)
not_cancelled_df_adr.sort_values('reservation_status_date', inplace = True)
plt.figure(figsize = (20, 6))
plt.title('Average Daily Rate',fontsize=30)
plt.plot (not_cancelled_df_adr['reservation_status_date'],not_cancelled_df_adr['adr'], label = 'not cancelled')
plt.plot (cancelled_df_adr['reservation_status_date'],cancelled_df_adr['adr'], label = 'cancelled')
plt.xlabel('Date', fontsize=20)
plt.ylabel('ADR', fontsize=20)
plt.legend(fontsize =0)
plt.show()
```



As seen in the graph, reservations are cancelled when the average daily rate is higher than when it is not cancelled. It clearly proves all the above analysis, that the higher the price the more the cancellations.

Suggestions

1. Cancellation rates rise as the price does. In order to prevent cancellations of reservations, hotels could work on their pricing strategies and try to lower the rates for specific hotels based on locations. They can also provide some discounts to the consumers.

2. As the ratio of the cancellation and not cancellation of the resort hotel is higher in the resort hotel than the city hotels. So the hotels should provide a reasonable discount on the room prices on weekends or on holidays.

3. In the month of January, hotels can start campaigns or marketing with a reasonable amount to increase their revenue as the cancellation is the highest in this month

4. They can also increase the quality of their hotels and their services mainly in Portugal to reduce the cancellation rate.

In [ ]: