In [1]:
```
#importing the necessary libraries
import pandas as pd
import numpy as np
from math import *
import matplotlib.pyplot as plt
import seaborn as sns
import warnings; warnings.simplefilter('ignore')
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, roc_auc_score, roc_curve, co
nfusion_matrix, auc, classification_report
from sklearn.ensemble import RandomForestClassifier
```

```
/Users/dishasaha/opt/anaconda3/lib/python3.7/site-packages/statsmodels/
tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecated.
Use the functions in the public API at pandas.testing instead.
  import pandas.util.testing as tm
```

Looking at the data

In [2]:
```
df_data=pd.read_csv("hotel_bookings.csv")#read the csv for dataset
df_data.head()#look at the first few rows for the train dataset
```

Out[2]:

	hotel	is_canceled	lead_time	arrival_date_year	arrival_date_month	arrival_date_week_number
0	Resort Hotel	0	342	2015	July	27
1	Resort Hotel	0	737	2015	July	27
2	Resort Hotel	0	7	2015	July	27
3	Resort Hotel	0	13	2015	July	27
4	Resort Hotel	0	14	2015	July	27

5 rows × 32 columns

In [3]:
```
print("Rows in data:", df_data.shape[0])#Getting number of Rows
print("\nNumber of Columns in data:", df_data.shape[1])#Getting number o
f Columns
print ("\nFeatures : \n" ,df_data.columns.tolist())#Getting the column n
ames
```

```
Rows in data: 119390

Number of Columns in data: 32

Features :
 ['hotel', 'is_canceled', 'lead_time', 'arrival_date_year', 'arrival_da
te_month', 'arrival_date_week_number', 'arrival_date_day_of_month', 'st
ays_in_weekend_nights', 'stays_in_week_nights', 'adults', 'children',
'babies', 'meal', 'country', 'market_segment', 'distribution_channel',
'is_repeated_guest', 'previous_cancellations', 'previous_bookings_not_c
anceled', 'reserved_room_type', 'assigned_room_type', 'booking_change
s', 'deposit_type', 'agent', 'company', 'days_in_waiting_list', 'custom
er_type', 'adr', 'required_car_parking_spaces', 'total_of_special_reque
sts', 'reservation_status', 'reservation_status_date']
```

In [4]:
```
df_data.info() #looking at the dataset
```

```
<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 [5]:
```
print("The number of NaN per column:", df_data.isnull().sum(), sep='\n')
```

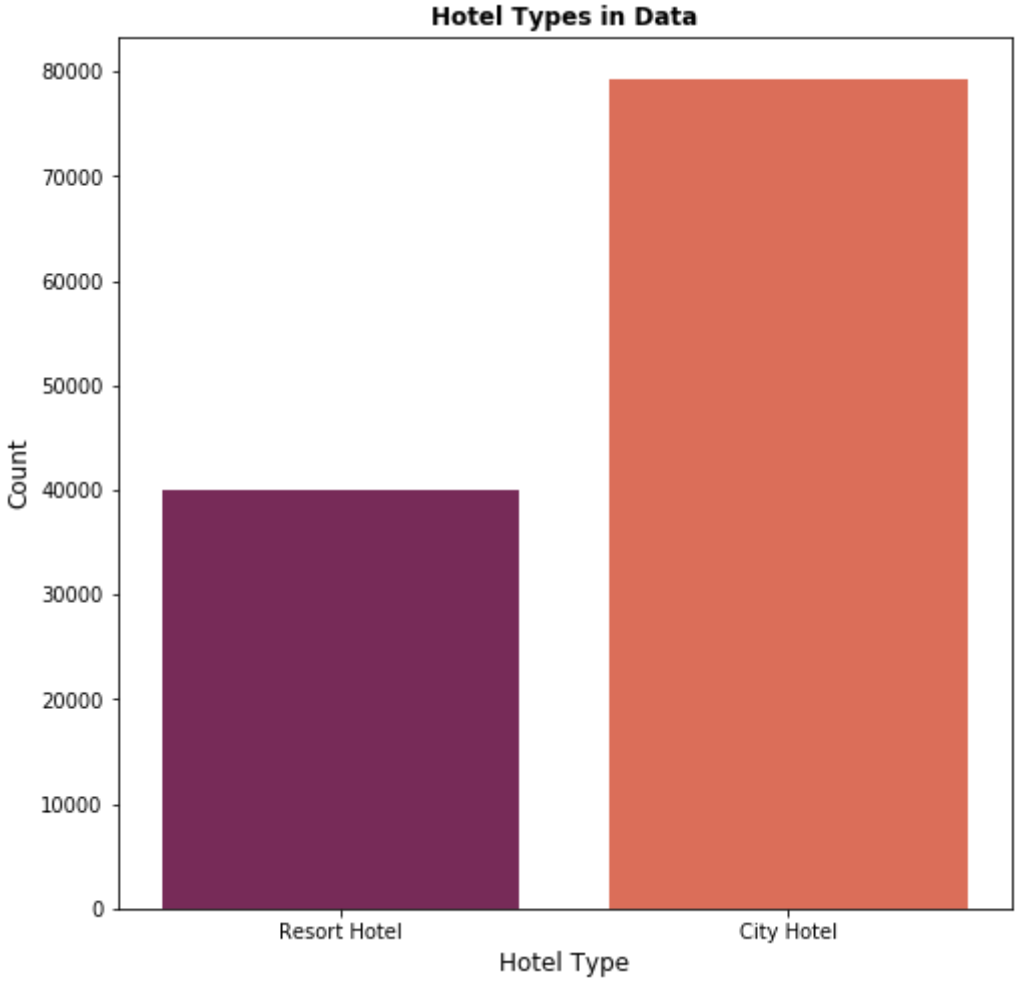
```
The number of NaN per column:
hotel                                0
is_canceled                          0
lead_time                            0
arrival_date_year                    0
arrival_date_month                   0
arrival_date_week_number             0
arrival_date_day_of_month            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
```

There are missing values in Country, agent, and company. However I am not concerned about these columns.

EDA

In [6]:
```
plt.figure(figsize=(8,8))
sns.countplot(x='hotel', data = df_data, palette='rocket')
plt.title('Hotel Types in Data', weight='bold')
plt.xlabel('Hotel Type', fontsize=12)
plt.ylabel('Count', fontsize=12)
```

Out[6]: Text(0, 0.5, 'Count')



After my preliminary review of the dataset, I have decided to focus my analysis on the rows that are just for the Resort Hotel. As a result, I will be dropping the City hotel data from my dataset. I have decided to do the analysis only on the data acquired from the Resort Hotel because I didn't want my prediction to have a variability based on the hotel type.

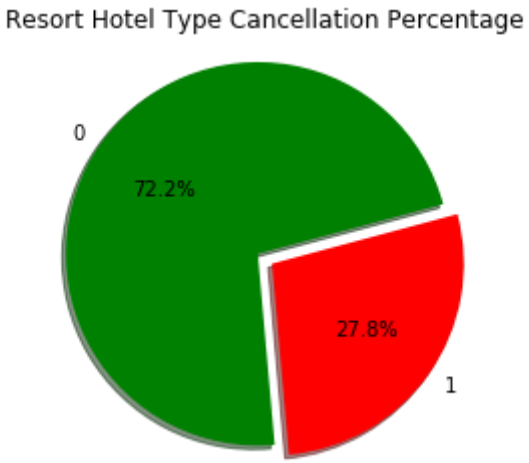
In [7]:
```
resort_df=df_data.loc[df_data['hotel']=='Resort Hotel']#filtering the da
taset to resort hotel
resort_df.shape #checking to see how many rows and columns
```

Out[7]: (40060, 32)

In [8]:
```
resort_df_typeinfo = resort_df["is_canceled"].value_counts()
print(resort_df_typeinfo)#looking at the overall values in cancellation
s, where 1 means cancelled
```

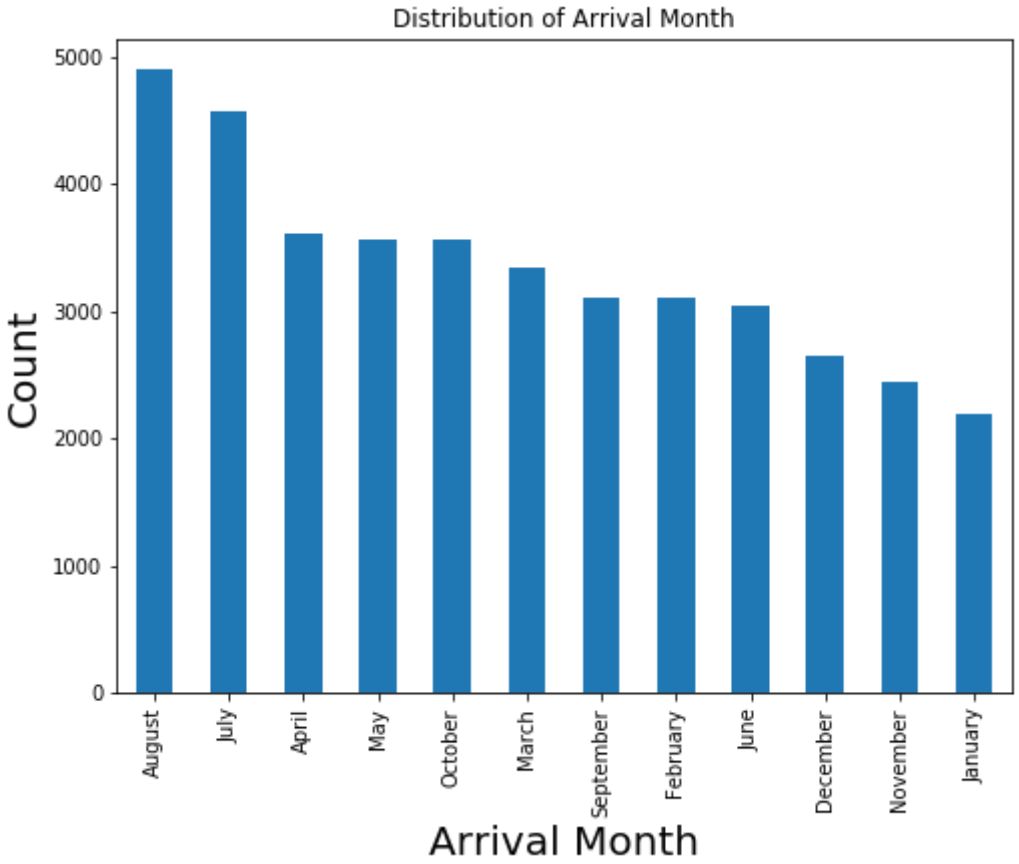
```
0    28938
1    11122
Name: is_canceled, dtype: int64
```

In [9]:
```
Cancel_Hotel = resort_df["is_canceled"].value_counts()#choosing the data
in the cancel column to graph
my_labels = "0","1"
my_colors = ['green','red']
my_explode = (0, 0.09)
plt.pie(Cancel_Hotel,labels=my_labels,autopct='%1.1f%%', startangle=15,
shadow = True, colors=my_colors, explode=my_explode)
plt.title('Resort Hotel Type Cancellation Percentage')
plt.axis('equal')
plt.show()
```



In [10]:
```
#Now going to graph out the distribution of Arrival Month
arrive = resort_df["arrival_date_month"].value_counts()
resort_df["arrival_date_month"].replace({'January' : '1', #replacing the
month by its corresponding number
        'February' : '2',
        'March' : '3',
        'April' : '4',
        'May' : '5',
        'June' : '6',
        'July' : '7',
        'August' : '8',
        'September' : '9',
        'October' : '10',
        'November' : '11',
        'December' : '12'}, inplace=True)
resort_df["arrival_date_month"].sort_index(inplace=True)
arrive_plot = arrive.plot.bar(title='Distribution of Arrival Month', fig
size=(8,6))
arrive_plot.set_xlabel('Arrival Month',size=20)
arrive_plot.set_ylabel('Count',size=20)
```

Out[10]:
```
Text(0, 0.5, 'Count')
```

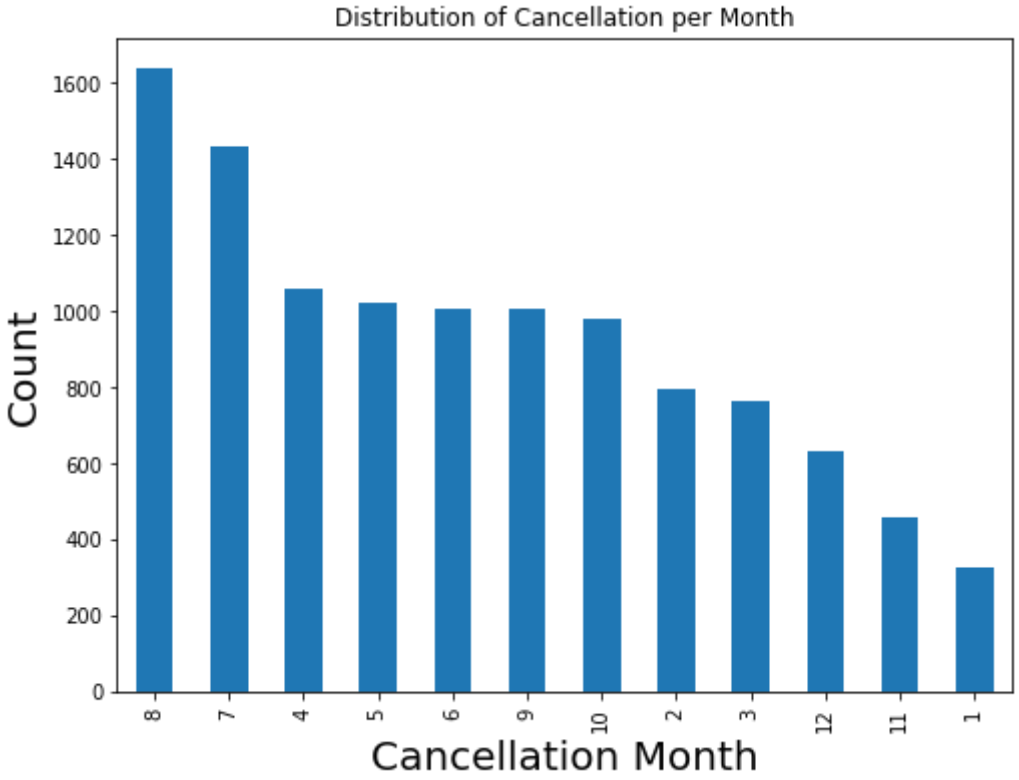


In [11]:
```
#creating a canceled dataframe
canceled_df=resort_df.loc[resort_df['is_canceled']==1]#filtering the dat
aset to canceled
canceled_df.shape #checking to see how many rows and columns
```

Out[11]:
```
(11122, 32)
```

In [12]:
```
#Now going to graph out the distribution of which month had the highest
 cancelations
arrive_ca = canceled_df["arrival_date_month"].value_counts()
arrive_ca_plot = arrive_ca.plot.bar(title='Distribution of Cancellation
 per Month', figsize=(8,6))
arrive_ca_plot.set_xlabel('Cancellation Month',size=20)
arrive_ca_plot.set_ylabel('Count',size=20)
```

Out[12]: Text(0, 0.5, 'Count')



Looking at the two previous graphs, its evident that August and July are the busiest months for Arrival,and Cancelation

I want to look for correlations next but I would want to dig into the columns that had missues values.

Preprocessing of Data

In [13]:
```
#looking at the perentage of missing values in my new Resort hotel dataf
rame
def missing_percent(x, y):
    percent = y.isnull().sum() / len(x) * 100
    return percent

#printing out the statements
print('Percentage of missing values:\nCountry: {}\nAgent: {}\nCompany:
{}'.
      format(missing_percent(resort_df, resort_df['country']),missing_pe
rcent(resort_df, resort_df['agent']),
             missing_percent(resort_df, resort_df['company'])))
```

```
Percentage of missing values:
Country: 1.1582626060908638
Agent: 20.4917623564653
Company: 92.24163754368448
```

In [14]:
```
resort_df["country"].value_counts().count()#getting the count of differe
n countries present
```

Out[14]: 125

In [15]:
```
resort_df["agent"].value_counts().count()#getting the count of differen
 agents present
```

Out[15]: 185

In [16]:
```
resort_df["company"].value_counts().count()#getting the count of differe
n companies present
```

Out[16]: 235

Looking at the pecentage of missing values for each column that had null values and looking at its distribution of the differet values it has, and based on my background research I don't believe that these will impact my prediction so I will drop these columns.

In [17]:
```
new_resort= resort_df.copy()#creating a new resort dataframe
new_resort.shape
```

Out[17]: (40060, 32)

In [18]:
```
# country, agent and company is dropped
new_resort = new_resort.drop(['country'], axis = 1)
new_resort = new_resort.drop(['agent'], axis = 1)
new_resort = new_resort.drop(['company'], axis = 1)
new_resort.shape
```

Out[18]: (40060, 29)

After dropping those three columns, we have 29 columns left.

In [19]:
```
corr_matrix1 = new_resort.corr()
corr_matrix1["is_canceled"].sort_values(ascending=False)
```

Out[19]:
```
is_canceled                      1.000000
lead_time                        0.229444
previous_cancellations           0.114173
adr                              0.109317
children                         0.081234
adults                           0.080546
stays_in_weekend_nights          0.078569
stays_in_week_nights             0.078477
arrival_date_year                0.043624
arrival_date_week_number         0.021601
arrival_date_day_of_month       -0.009386
babies                          -0.023254
days_in_waiting_list            -0.036301
previous_bookings_not_canceled  -0.076767
total_of_special_requests       -0.101295
is_repeated_guest               -0.103563
booking_changes                 -0.114835
required_car_parking_spaces     -0.243863
Name: is_canceled, dtype: float64
```

In [20]:
```
# Fill in missing data for the 4 missing children. I am guessing these i
nstances people didn't have children.
new_resort['children'] =  new_resort['children'].fillna(0)
```

In [21]:
```
new_resort.isnull().sum() #now doing a final check for any null values
```

Out[21]:
```
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
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 [22]:
```
new_resort.info() #looking at the datatypes again
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 40060 entries, 0 to 40059
Data columns (total 29 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   hotel                           40060 non-null  object 
 1   is_canceled                     40060 non-null  int64  
 2   lead_time                       40060 non-null  int64  
 3   arrival_date_year               40060 non-null  int64  
 4   arrival_date_month              40060 non-null  object 
 5   arrival_date_week_number        40060 non-null  int64  
 6   arrival_date_day_of_month       40060 non-null  int64  
 7   stays_in_weekend_nights         40060 non-null  int64  
 8   stays_in_week_nights            40060 non-null  int64  
 9   adults                          40060 non-null  int64  
 10  children                        40060 non-null  float64
 11  babies                          40060 non-null  int64  
 12  meal                            40060 non-null  object 
 13  market_segment                  40060 non-null  object 
 14  distribution_channel            40060 non-null  object 
 15  is_repeated_guest               40060 non-null  int64  
 16  previous_cancellations          40060 non-null  int64  
 17  previous_bookings_not_canceled  40060 non-null  int64  
 18  reserved_room_type              40060 non-null  object 
 19  assigned_room_type              40060 non-null  object 
 20  booking_changes                 40060 non-null  int64  
 21  deposit_type                    40060 non-null  object 
 22  days_in_waiting_list            40060 non-null  int64  
 23  customer_type                   40060 non-null  object 
 24  adr                             40060 non-null  float64
 25  required_car_parking_spaces     40060 non-null  int64  
 26  total_of_special_requests       40060 non-null  int64  
 27  reservation_status              40060 non-null  object 
 28  reservation_status_date         40060 non-null  object 
dtypes: float64(2), int64(16), object(11)
memory usage: 9.2+ MB
```

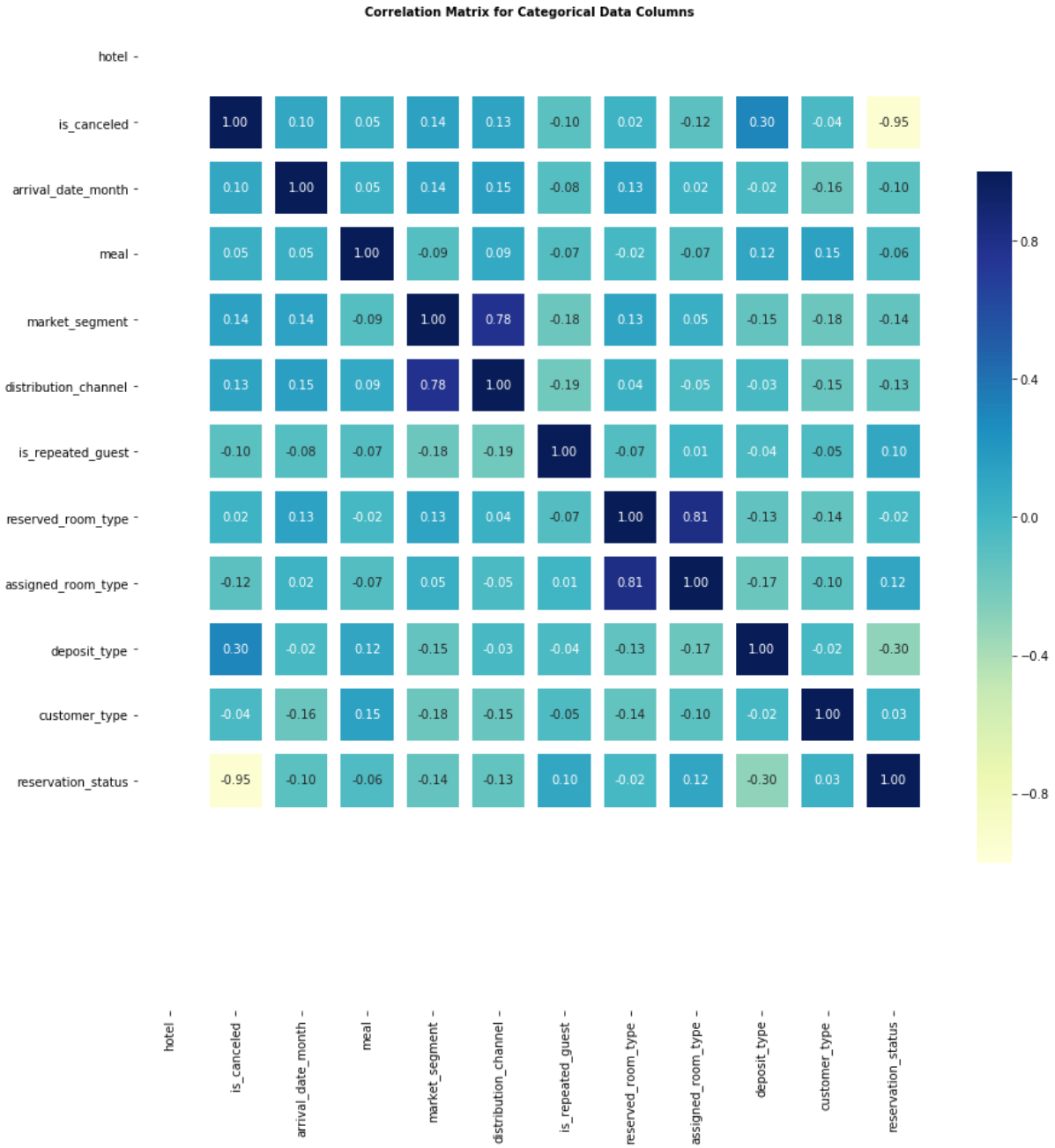
Need to convert categorical/object variables to numbers in order to process them

In [23]:
```
#going to use the label encoder method

labelencoder = LabelEncoder()
new_resort['hotel'] = labelencoder.fit_transform(new_resort['hotel'])
new_resort['arrival_date_month'] = labelencoder.fit_transform(new_resort
['arrival_date_month'])
new_resort['meal'] = labelencoder.fit_transform(new_resort['meal'])
new_resort['market_segment']= labelencoder.fit_transform(new_resort['mar
ket_segment'])
new_resort['distribution_channel']=labelencoder.fit_transform(new_resort
['distribution_channel'])
new_resort['is_repeated_guest'] = labelencoder.fit_transform(new_resort[
'is_repeated_guest'])
new_resort['reserved_room_type'] = labelencoder.fit_transform(new_resort
['reserved_room_type'])
new_resort['assigned_room_type'] = labelencoder.fit_transform(new_resort
['assigned_room_type'])
new_resort['deposit_type'] = labelencoder.fit_transform(new_resort['depo
sit_type'])
new_resort['customer_type'] = labelencoder.fit_transform(new_resort['cus
tomer_type'])
new_resort['reservation_status'] = labelencoder.fit_transform(new_resort
['reservation_status'])
```

In [24]:
```
#New dataframe for the categorical coloumns
cat_resort= new_resort[['hotel','is_canceled','arrival_date_month','mea
l',
                                        'market_segment','distribution_chan
nel',
                                        'is_repeated_guest', 'reserved_room
_type',
                                        'assigned_room_type','deposit_type'
,
                                        'customer_type','reservation_statu
s']]
```

In [25]:
```
# Correlation Matrix with Spearman method for the Categorical data

plt.figure(figsize=(15,15))
corr_categorical=cat_resort.corr(method='spearman')
mask_categorical = np.triu(np.ones_like(corr_categorical, dtype=np.bool
))
sns.heatmap(corr_categorical, annot=True, fmt=".2f", cmap='YlGnBu', vmin
=-1, vmax=1, center= 0,
            square=True, linewidths=10, cbar_kws={"shrink": .7}).set(yli
m=(15, 0))
plt.title("Correlation Matrix for Categorical Data Columns ",size=10, we
ight='bold')
```

Out[25]: Text(0.5, 1, 'Correlation Matrix for Categorical Data Columns ')

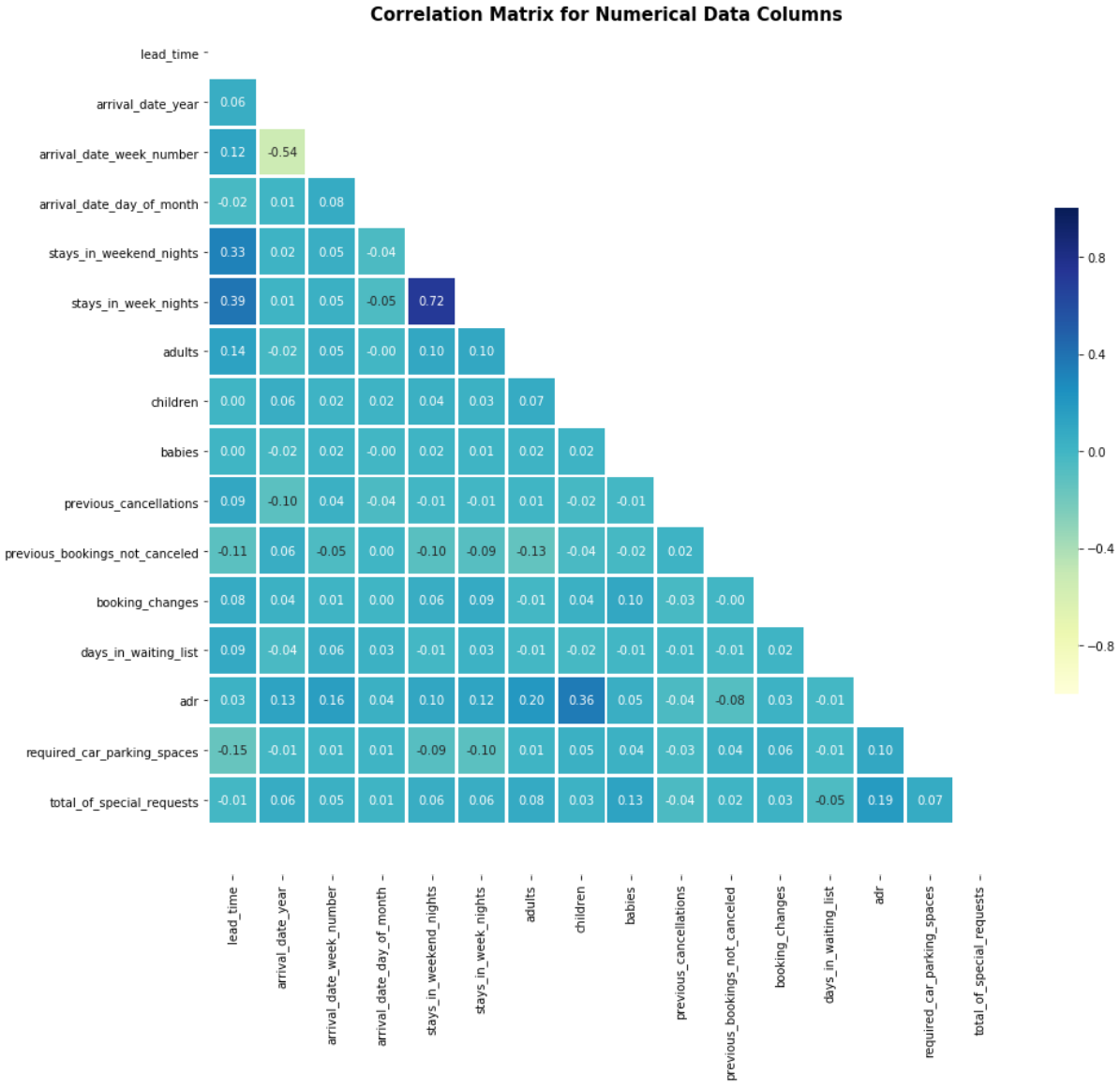


In [26]:
```
num_resort= new_resort.copy()#creating a data frame for numerical resort
dataframe

#now dropping the categorical columns to be left with numberical columns
num_resort= num_resort.drop(['hotel','is_canceled','arrival_date_month',
'meal',
                             'market_segment','distribution_chan
nel',
                             'is_repeated_guest', 'reserved_room
_type',
                             'assigned_room_type','deposit_type'
,
                             'customer_type','reservation_statu
s'], axis=1)
num_resort.info()#as shown dataframe now has numerical features
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 40060 entries, 0 to 40059
Data columns (total 17 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   lead_time                       40060 non-null  int64
 1   arrival_date_year               40060 non-null  int64
 2   arrival_date_week_number        40060 non-null  int64
 3   arrival_date_day_of_month       40060 non-null  int64
 4   stays_in_weekend_nights         40060 non-null  int64
 5   stays_in_week_nights            40060 non-null  int64
 6   adults                          40060 non-null  int64
 7   children                        40060 non-null  float64
 8   babies                          40060 non-null  int64
 9   previous_cancellations          40060 non-null  int64
 10  previous_bookings_not_canceled  40060 non-null  int64
 11  booking_changes                 40060 non-null  int64
 12  days_in_waiting_list            40060 non-null  int64
 13  adr                             40060 non-null  float64
 14  required_car_parking_spaces     40060 non-null  int64
 15  total_of_special_requests       40060 non-null  int64
 16  reservation_status_date         40060 non-null  object
dtypes: float64(2), int64(14), object(1)
memory usage: 5.5+ MB
```

In [27]:
```
# Correlation Matrix with pearson method for numerical Columns

plt.figure(figsize=(15,15))
corr_numerical=num_resort.corr(method='pearson')
mask_numerical = np.triu(np.ones_like(corr_numerical, dtype=np.bool))
sns.heatmap(corr_numerical, annot=True, fmt=".2f", cmap='YlGnBu', mask=
mask_numerical, vmin=-1, vmax=1, center= 0,
            square=True, linewidths=2, cbar_kws={"shrink": .5}).set(ylim
=(17, 0))
plt.title("Correlation Matrix for Numerical Data Columns",size=15, weigh
t='bold')
```

Out[27]: Text(0.5, 1, 'Correlation Matrix for Numerical Data Columns')



In [28]:
```
#splitting the data
X = (new_resort.loc[:, new_resort.columns != 'is_canceled'])
y = (new_resort.loc[:, new_resort.columns == 'is_canceled'])
```

In [29]:
```
x_columns = X.columns
#selecting object data types
object_column_name = X.select_dtypes('object').columns
print (object_column_name)

object_column_index = X.columns.get_indexer(X.select_dtypes('object').co
lumns)
print (object_column_index)
```

```
Index(['reservation_status_date'], dtype='object')
[27]
```

In [30]:
```
print (x_columns) #printing all the columns used
```

```
Index(['hotel', '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', 'ch
ildren',
       'babies', 'meal', 'market_segment', 'distribution_channel',
       'is_repeated_guest', 'previous_cancellations',
       'previous_bookings_not_canceled', 'reserved_room_type',
       'assigned_room_type', 'booking_changes', 'deposit_type',
       'days_in_waiting_list', 'customer_type', 'adr',
       'required_car_parking_spaces', 'total_of_special_requests',
       'reservation_status', 'reservation_status_date'],
      dtype='object')
```

In [31]:
```
print(X.shape)

columnTransformer = ColumnTransformer([('encoder', OneHotEncoder(), obje
ct_column_index)], remainder='passthrough')

X = columnTransformer.fit_transform(X)
print(X.shape)
```

```
(40060, 28)
(40060, 940)
```

In [32]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.
30, random_state = 25)
```

In [33]:
```
#define model
def model(al):
    al_model = al.fit(X_train, y_train)
    global y_prob, y_pred
    y_prob = al.predict_proba(X_test)[:,1]
    y_pred = al_model.predict(X_test)

    print('Accuracy Score: {}\n\nConfusion Matrix:\n {}\n\nClassificatio
n Report:\n {}'
      .format(accuracy_score(y_test,y_pred), confusion_matrix(y_test,y_p
red),roc_auc_score(y_test,y_pred)))
    print(classification_report(y_test,y_pred))
```

In [34]:
```
print('Logistic Regression\n')#logistic regression model
model(LogisticRegression(solver = "saga"))
```

```
Logistic Regression

Accuracy Score: 0.7582792477949742

Confusion Matrix:
 [[8516  212]
 [2693  597]]

Classification Report:
 0.5785846620177802
              precision    recall  f1-score   support

           0       0.76      0.98      0.85      8728
           1       0.74      0.18      0.29      3290

    accuracy                           0.76     12018
   macro avg       0.75      0.58      0.57     12018
weighted avg       0.75      0.76      0.70     12018
```

In [35]:
```
print('Random Forest\n')#random forest model
model(RandomForestClassifier())
```

```
Random Forest

Accuracy Score: 0.9929272757530371

Confusion Matrix:
 [[8727    1]
 [  84 3206]]

Classification Report:
 0.9871767556604325
              precision    recall  f1-score   support

           0       0.99      1.00      1.00      8728
           1       1.00      0.97      0.99      3290

    accuracy                           0.99     12018
   macro avg       1.00      0.99      0.99     12018
weighted avg       0.99      0.99      0.99     12018
```

Per the model results Random Forest gave the highest accuracy score with an accuracy with 99%

In [ ]:
```

```