In [2]:
```python
import pandas as pd
```

In [3]:
```python
df = pd.read_csv("C:\\UMAR DATA\\Data Sciences\\machine learning\\Projects\\Forage\\customer_booking.csv",encoding='latin1')
df.head()
```

Out[3]:

	num_passengers	sales_channel	trip_type	purchase_lead	length_of_stay	flight_hour	flight_day	route	booking_origin	wants_extra_baggage	wants_preferred_se
0	2	Internet	RoundTrip	262	19	7	Sat	AKLDEL	New Zealand	1	
1	1	Internet	RoundTrip	112	20	3	Sat	AKLDEL	New Zealand	0	
2	2	Internet	RoundTrip	243	22	17	Wed	AKLDEL	India	1	
3	1	Internet	RoundTrip	96	31	4	Sat	AKLDEL	New Zealand	0	
4	2	Internet	RoundTrip	68	22	15	Wed	AKLDEL	India	1	

Data Understanding

In [4]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50000 entries, 0 to 49999
Data columns (total 14 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   num_passengers         50000 non-null  int64
 1   sales_channel          50000 non-null  object
 2   trip_type              50000 non-null  object
 3   purchase_lead          50000 non-null  int64
 4   length_of_stay         50000 non-null  int64
 5   flight_hour            50000 non-null  int64
 6   flight_day             50000 non-null  object
 7   route                  50000 non-null  object
 8   booking_origin         50000 non-null  object
 9   wants_extra_baggage    50000 non-null  int64
 10  wants_preferred_seat   50000 non-null  int64
 11  wants_in_flight_meals  50000 non-null  int64
 12  flight_duration        50000 non-null  float64
 13  booking_complete       50000 non-null  int64
dtypes: float64(1), int64(8), object(5)
memory usage: 5.3+ MB
```

In [5]:
```python
df["flight_day"].unique()
```

Out[5]: array(['Sat', 'Wed', 'Thu', 'Mon', 'Sun', 'Tue', 'Fri'], dtype=object)

In [6]:
```python
mapping = {
    "Mon": 1,
    "Tue": 2,
    "Wed": 3,
    "Thu": 4,
    "Fri": 5,
    "Sat": 6,
    "Sun": 7,
}

df["flight_day"] = df["flight_day"].map(mapping)
```

In [7]:
```python
df["flight_day"].unique()
```

Out[7]: array([6, 3, 4, 1, 7, 2, 5], dtype=int64)

In [8]:
```python
df.describe()
```

Out[8]:

	num_passengers	purchase_lead	length_of_stay	flight_hour	flight_day	wants_extra_baggage	wants_preferred_seat	wants_in_flight_meals	flight_duration
count	50000.000000	50000.000000	50000.00000	50000.00000	50000.000000	50000.000000	50000.000000	50000.000000	50000.000000
mean	1.591240	84.940480	23.04456	9.06634	3.814420	0.668780	0.296960	0.427140	7.277561
std	1.020165	90.451378	33.88767	5.41266	1.992792	0.470657	0.456923	0.494668	1.496863
min	1.000000	0.000000	0.00000	0.00000	1.000000	0.000000	0.000000	0.000000	4.670000
25%	1.000000	21.000000	5.00000	5.00000	2.000000	0.000000	0.000000	0.000000	5.620000
50%	1.000000	51.000000	17.00000	9.00000	4.000000	1.000000	0.000000	0.000000	7.570000
75%	2.000000	115.000000	28.00000	13.00000	5.000000	1.000000	1.000000	1.000000	8.830000
max	9.000000	867.000000	778.00000	23.00000	7.000000	1.000000	1.000000	1.000000	9.500000

In [9]:
```python
df[['sales_channel', 'trip_type', 'booking_origin', 'route']].describe()
```

Out[9]:

	sales_channel	trip_type	booking_origin	route
count	50000	50000	50000	50000
unique	2	3	104	799
top	Internet	RoundTrip	Australia	AKLKUL
freq	44382	49497	17872	2680

In [10]:
```python
df_category=['wants_extra_baggage', 'wants_preferred_seat', 'flight_day', 'wants_in_flight_meals',
             'booking_complete']
for category in df_category:
    df[category]=df[category].astype('category')
df.describe(include='category')
```

Out[10]:

	flight_day	wants_extra_baggage	wants_preferred_seat	wants_in_flight_meals	booking_complete
count	50000	50000	50000	50000	50000
unique	7	2	2	2	2
top	1	1	0	0	0
freq	8102	33439	35152	28643	42522

Feature Engineering

In [11]:
```python
df['Origin_Country']=df['route'].str[:3]
df['Destination_Country']=df['route'].str[3:]
```

In [12]:
```python
Timing=[0,12,24]
labels=['AM','PM']
df['Day Timing']=pd.cut(df['flight_hour'],bins=Timing,labels=labels,right=False)
df.head()
```

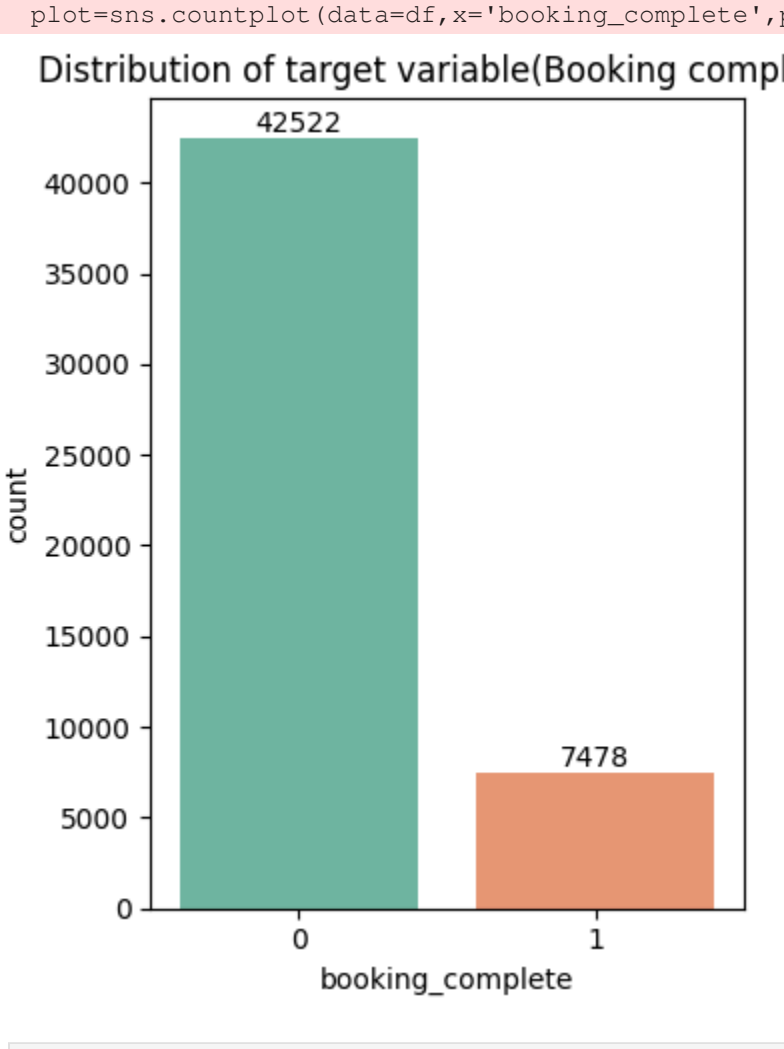
Out[12]:

	num_passengers	sales_channel	trip_type	purchase_lead	length_of_stay	flight_hour	flight_day	route	booking_origin	wants_extra_baggage	wants_preferred_se
0	2	Internet	RoundTrip	262	19	7	6	AKLDEL	New Zealand	1	
1	1	Internet	RoundTrip	112	20	3	6	AKLDEL	New Zealand	0	
2	2	Internet	RoundTrip	243	22	17	3	AKLDEL	India	1	
3	1	Internet	RoundTrip	96	31	4	6	AKLDEL	New Zealand	0	
4	2	Internet	RoundTrip	68	22	15	3	AKLDEL	India	1	

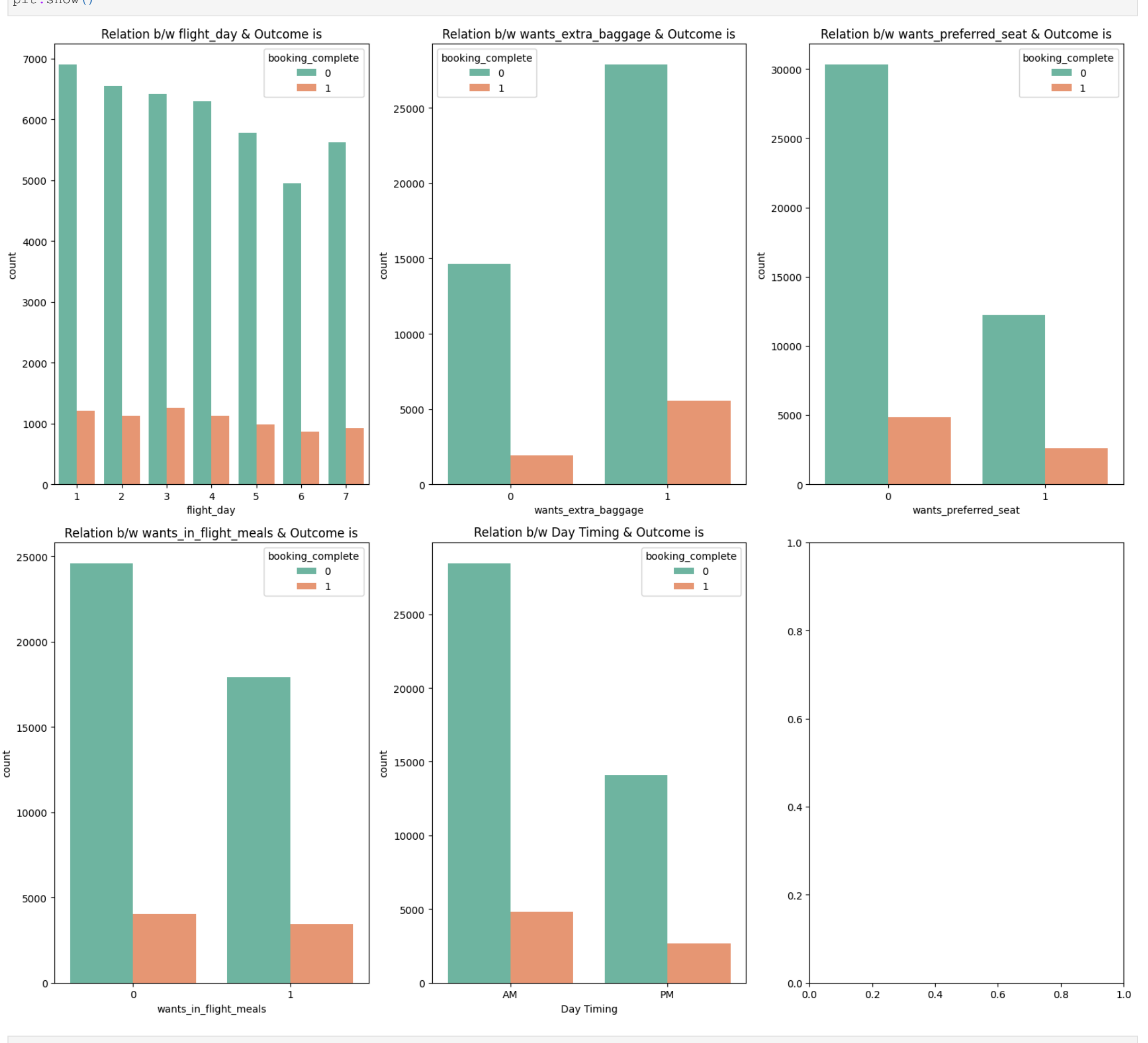
In [13]:
```python
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

In [14]:
```python
plt.figure(figsize=(4,5))
plot=sns.countplot(data=df,x='booking_complete',palette='Set2')
plt.title('Distribution of target variable(Booking complete)')
for p in plot.patches:
    count=int(p.get_height())
    plot.annotate(str(count),(p.get_x()+p.get_width()/2,p.get_height()+1),ha='center',va='bottom')
plt.tight_layout()
```

```
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_2488\1326082283.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  plot=sns.countplot(data=df,x='booking_complete',palette='Set2')
```



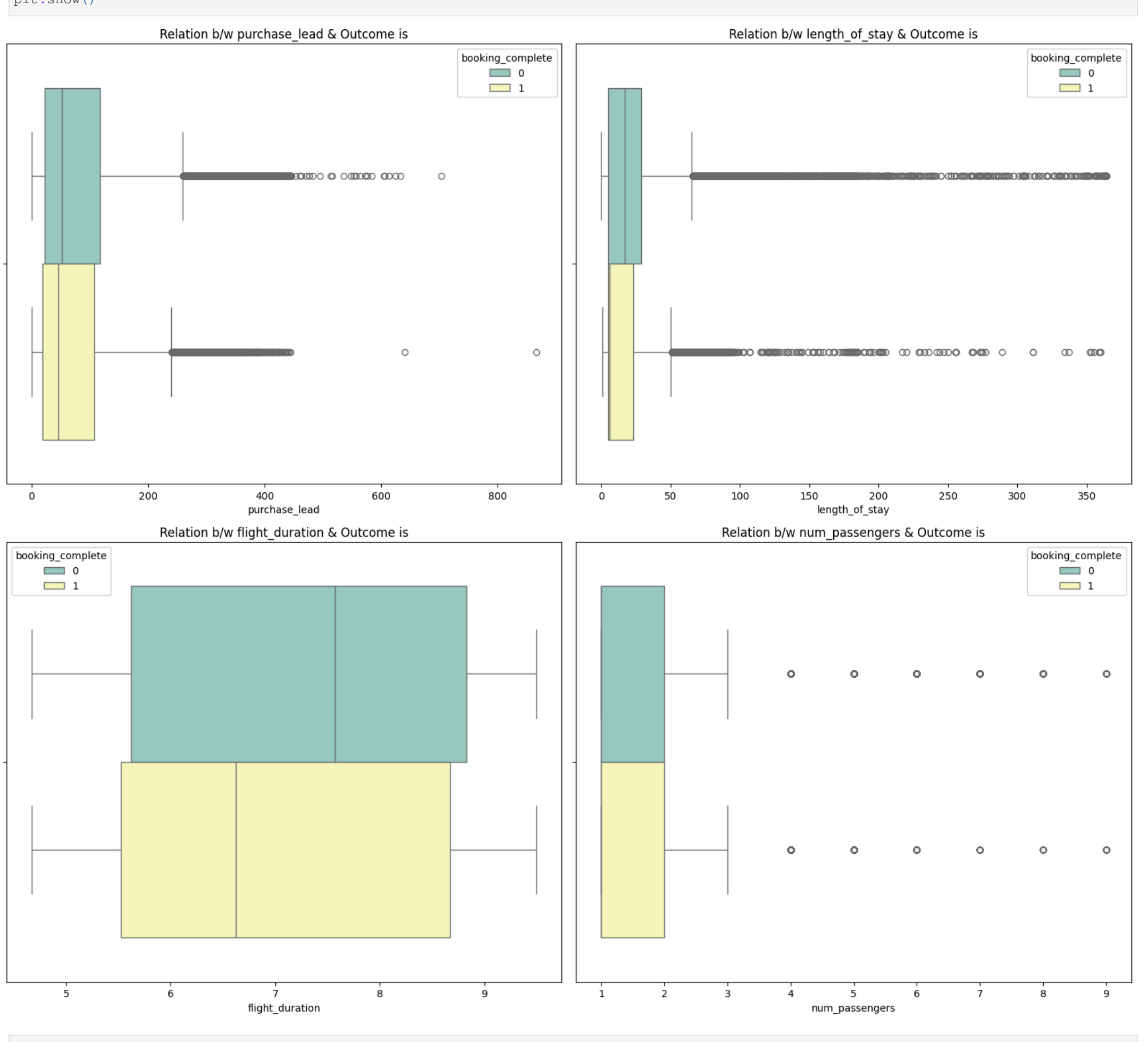
In [54]:
```python
categorical_features=['flight_day','wants_extra_baggage','wants_preferred_seat','wants_in_flight_meals',
                      'Day Timing']
fig,axis=plt.subplots(2,3,figsize=(16,14))
axis=axis.flatten()
for i,col in enumerate(categorical_features):
    ax=axis[i]
    plot=sns.countplot(data=df,x=col,hue='booking_complete',palette='Set2',ax=ax)
    ax.set_title(f'Relation b/w {col} & Outcome is')
plt.tight_layout()
plt.show()
```



In [59]:
```python
categorical_features=['flight_day','wants_extra_baggage','wants_preferred_seat','wants_in_flight_meals',
                      'Day Timing']
for feature in categorical_features:
    output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
    print(f'Value Count in feature {feature} is:\n {round(output*100,ndigits=2)}%')
```

```
Value Count in feature flight_day is:
 booking_complete  flight_day
0                 1             16.22
                  2             15.39
                  3             15.10
                  4             14.82
                  5             13.59
                  7             13.23
                  6             11.64
1                 3             16.74
                  1             16.10
                  2             15.10
                  4             15.00
                  5             13.15
                  7             12.40
                  6             11.51
Name: proportion, dtype: float64%
Value Count in feature wants_extra_baggage is:
 booking_complete  wants_extra_baggage
0                 1                      65.53
                  0                      34.47
1                 1                      74.53
                  0                      25.47
Name: proportion, dtype: float64%
Value Count in feature wants_preferred_seat is:
 booking_complete  wants_preferred_seat
0                 0                       71.26
                  1                       28.74
1                 0                       64.84
                  1                       35.16
Name: proportion, dtype: float64%
Value Count in feature wants_in_flight_meals is:
 booking_complete  wants_in_flight_meals
0                 0                        57.84
                  1                        42.16
1                 0                        54.16
                  1                        45.84
Name: proportion, dtype: float64%
Value Count in feature Day Timing is:
 booking_complete  Day Timing
0                 AM            66.91
                  PM            33.09
1                 AM            64.66
                  PM            35.34
Name: proportion, dtype: float64%
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_15380\3115519346.py:4: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_15380\3115519346.py:4: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_15380\3115519346.py:4: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_15380\3115519346.py:4: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
C:\Users\Qadri Laptop\AppData\Local\Temp\ipykernel_15380\3115519346.py:4: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  output=df.groupby('booking_complete')[feature].value_counts(normalize=True)
```

In [69]:
```python
numerical_features=['purchase_lead','length_of_stay','flight_duration','num_passengers']
fig,axis=plt.subplots(2,2,figsize=(16,14))
axis=axis.flatten()
for i,col in enumerate(numerical_features):
    ax=axis[i]
    plot=sns.boxplot(data=df,x=col,hue='booking_complete',palette='Set3',ax=ax)
    ax.set_title(f'Relation b/w {col} & Outcome is')
plt.tight_layout()
plt.show()
```



In [80]:
```python
df=df[df['length_of_stay']<365]
df.shape
```

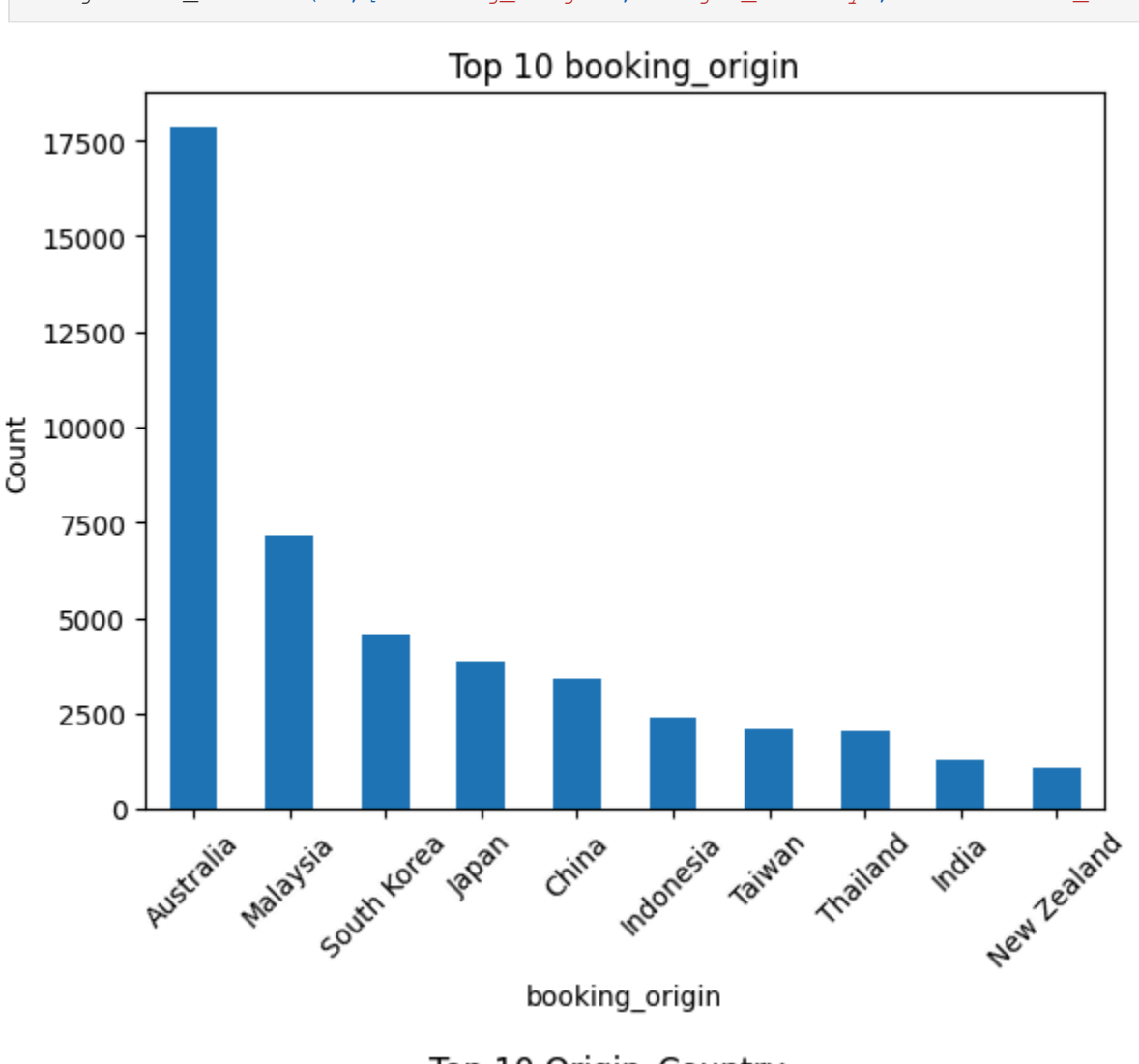
Out[80]: (49971, 17)

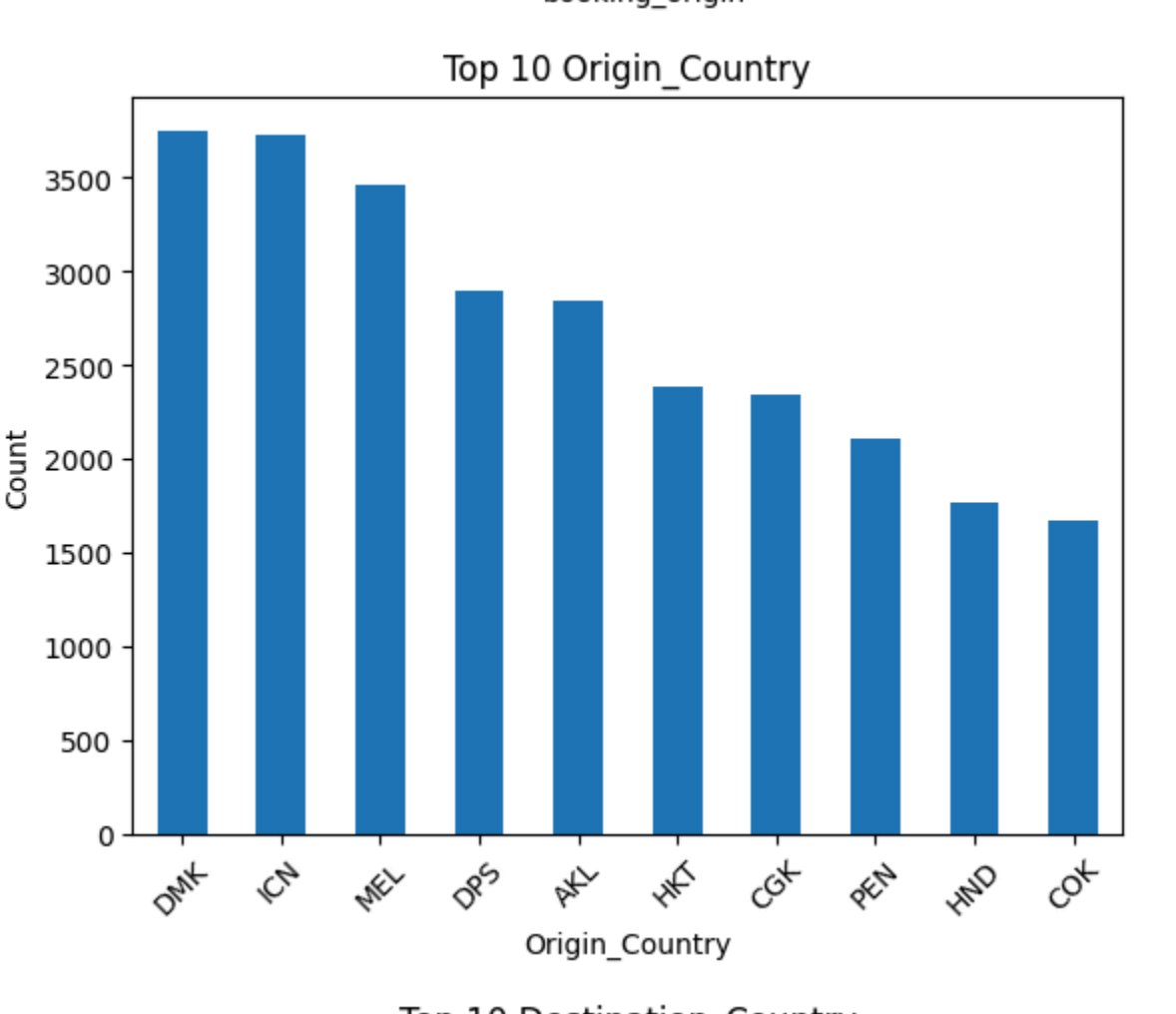
In [81]:
```python
len(df['booking_origin'].unique())
```

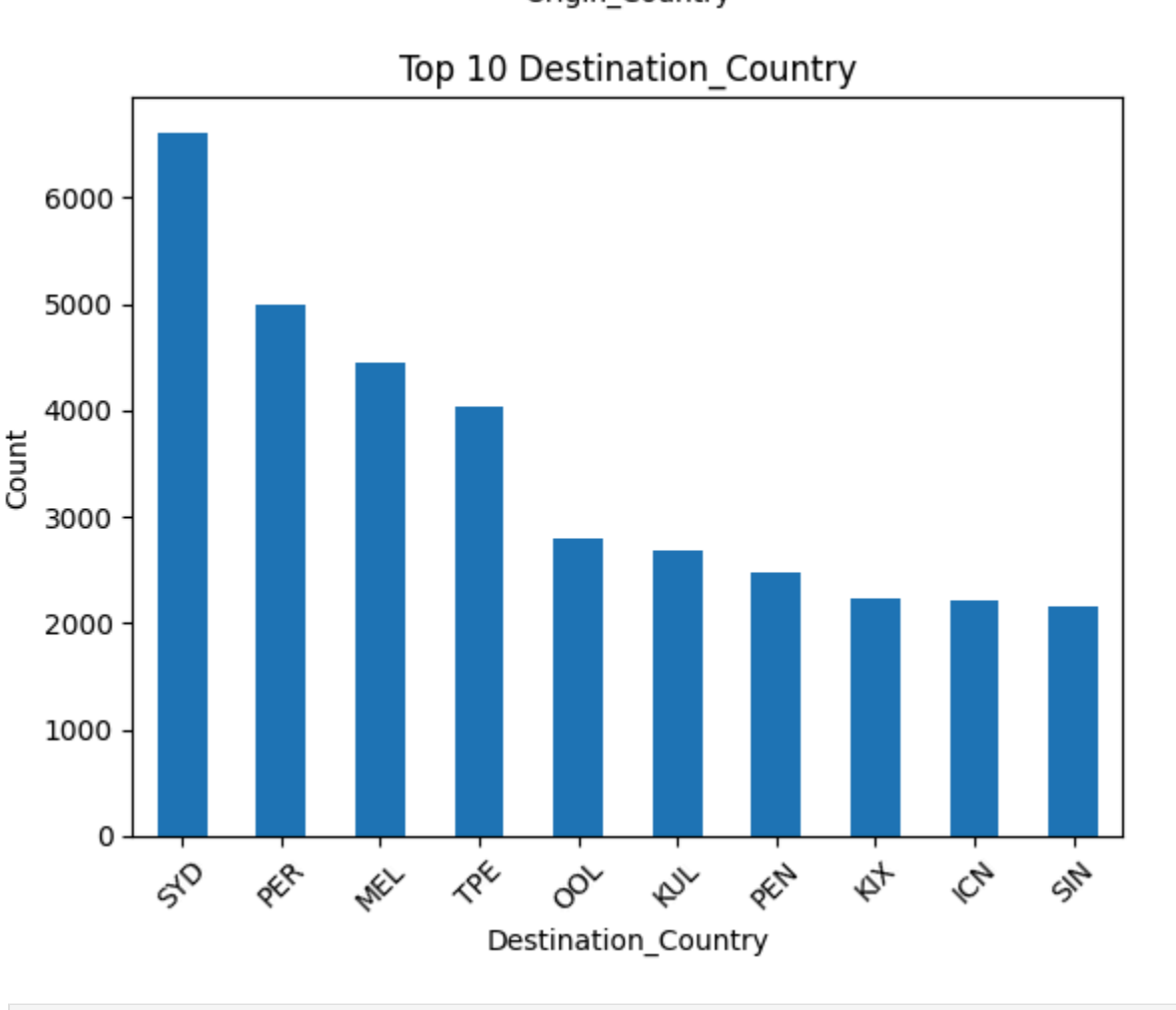
Out[81]: 104

In [93]:
```python
def categorical_feature(df,feature_list):
    for feature in feature_list:
        df[feature].value_counts().head(10).plot(kind='bar')
        plt.title(f"Top 10 {feature}")
        plt.xlabel(feature)
        plt.ylabel("Count")
        plt.xticks(rotation=45)
        plt.show()
```

In [94]:
```python
categorical_feature(df,['booking_origin','Origin_Country','Destination_Country'])
```



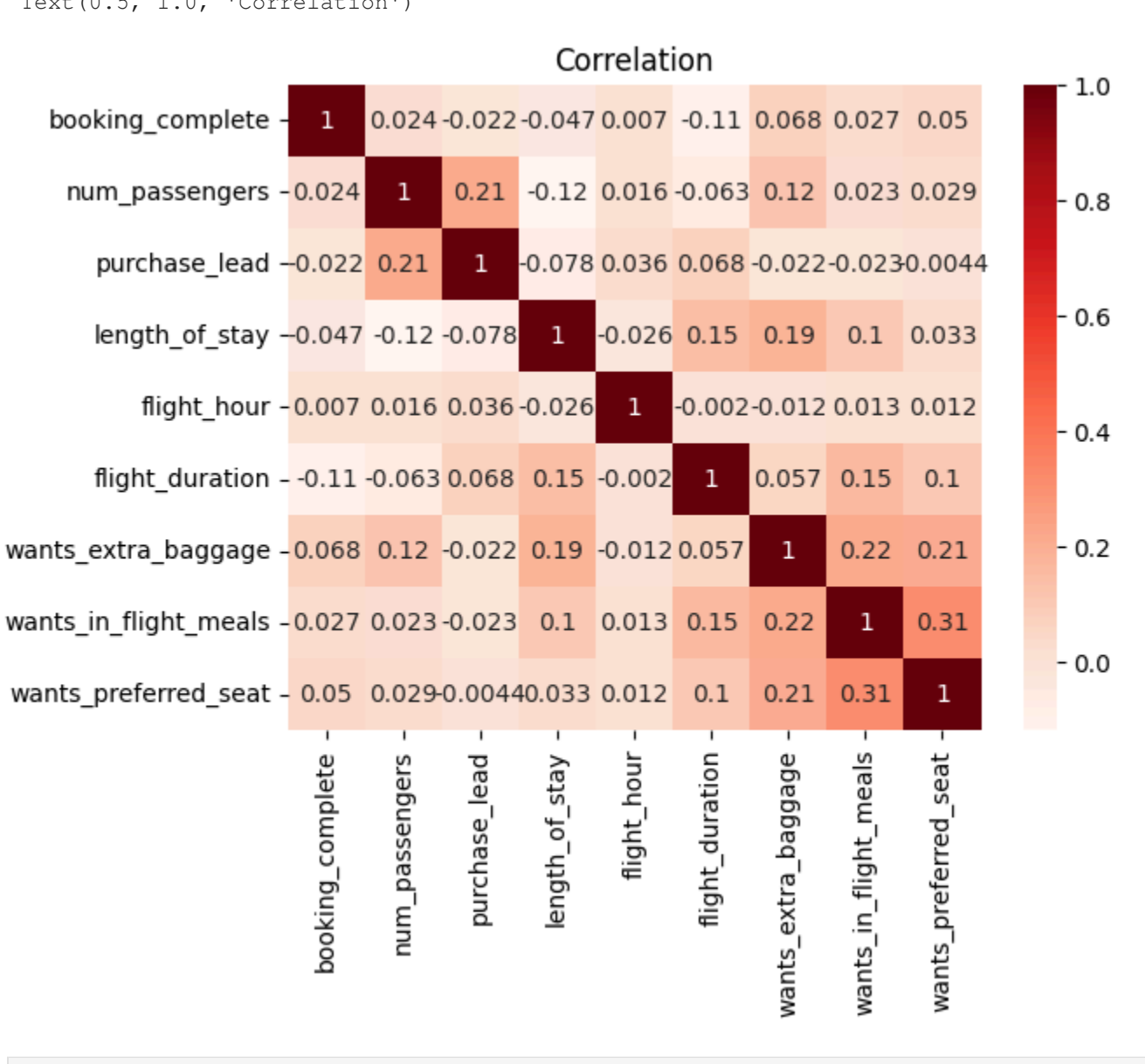




In [107…
```python
df_correlation=df[['booking_complete','num_passengers', 'purchase_lead', 'length_of_stay',
                   'flight_hour', 'flight_duration','wants_extra_baggage','wants_in_flight_meals',
                   'wants_preferred_seat']]
```

In [111…
```python
sns.heatmap(df_correlation.corr(),annot=True,cmap='Reds')
plt.title('Correlation')
```

Out[111… Text(0.5, 1.0, 'Correlation')



In [113…
```python
df_1=df.drop(['trip_type','flight_hour','sales_channel','Day Timing','route'],axis='columns')
df_1.head()
```

Out[113…

	num_passengers	purchase_lead	length_of_stay	flight_day	booking_origin	wants_extra_baggage	wants_preferred_seat	wants_in_flight_meals	flight_duration	booking
0	2	262	19	6	New Zealand	1	0	0	5.52	
1	1	112	20	6	New Zealand	0	0	0	5.52	
2	2	243	22	3	India	1	1	0	5.52	
3	1	96	31	6	New Zealand	0	0	1	5.52	
4	2	68	22	3	India	1	0	1	5.52	

In [117…
```python
def conversion(df,feature_list):
    for feature in feature_list:
        top_ten=df[feature].value_counts().head(10).index
        df[feature]=df[feature].apply(lambda x: x if x in top_ten else 'other')
    return df
```

In [123…
```python
df_2=conversion(df_1,['booking_origin','Origin_Country','Destination_Country'])
```

In [125…
```python
df_2=pd.get_dummies(data=df_2,drop_first=True)
df_2=df_2.astype(int)
```

In [130…
```python
df_2.columns
```

Out[130…
```
Index(['num_passengers', 'purchase_lead', 'length_of_stay', 'flight_duration',
       'flight_day_2', 'flight_day_3', 'flight_day_4', 'flight_day_5',
       'flight_day_6', 'flight_day_7', 'booking_origin_China',
       'booking_origin_India', 'booking_origin_Indonesia',
       'booking_origin_Japan', 'booking_origin_Malaysia',
       'booking_origin_South Korea', 'booking_origin_Taiwan',
       'booking_origin_Thailand', 'booking_origin_other',
       'wants_extra_baggage_1', 'wants_preferred_seat_1',
       'wants_in_flight_meals_1', 'booking_complete_1', 'Origin_Country_CGK',
       'Origin_Country_DMK', 'Origin_Country_DPS', 'Origin_Country_HKT',
       'Origin_Country_HND', 'Origin_Country_ICN', 'Origin_Country_MEL',
       'Origin_Country_PEN', 'Origin_Country_other', 'Destination_Country_KIX',
       'Destination_Country_KUL', 'Destination_Country_MEL',
       'Destination_Country_OOL', 'Destination_Country_PEN',
       'Destination_Country_PER', 'Destination_Country_SYD',
       'Destination_Country_TPE', 'Destination_Country_other'],
      dtype='object')
```

In [131…
```python
x=df_2.drop(['booking_complete_1'],axis='columns')
y=df_2['booking_complete_1']
```

Train The Model

In [184…
```python
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report,accuracy_score,confusion_matrix
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import StandardScaler
```

In [185…
```python
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,stratify=y,random_state=0,test_size=0.2)
```

In [186…
```python
preprocessor = ColumnTransformer(
   transformers=[
       ('num', StandardScaler(), x.columns),
   ])
```

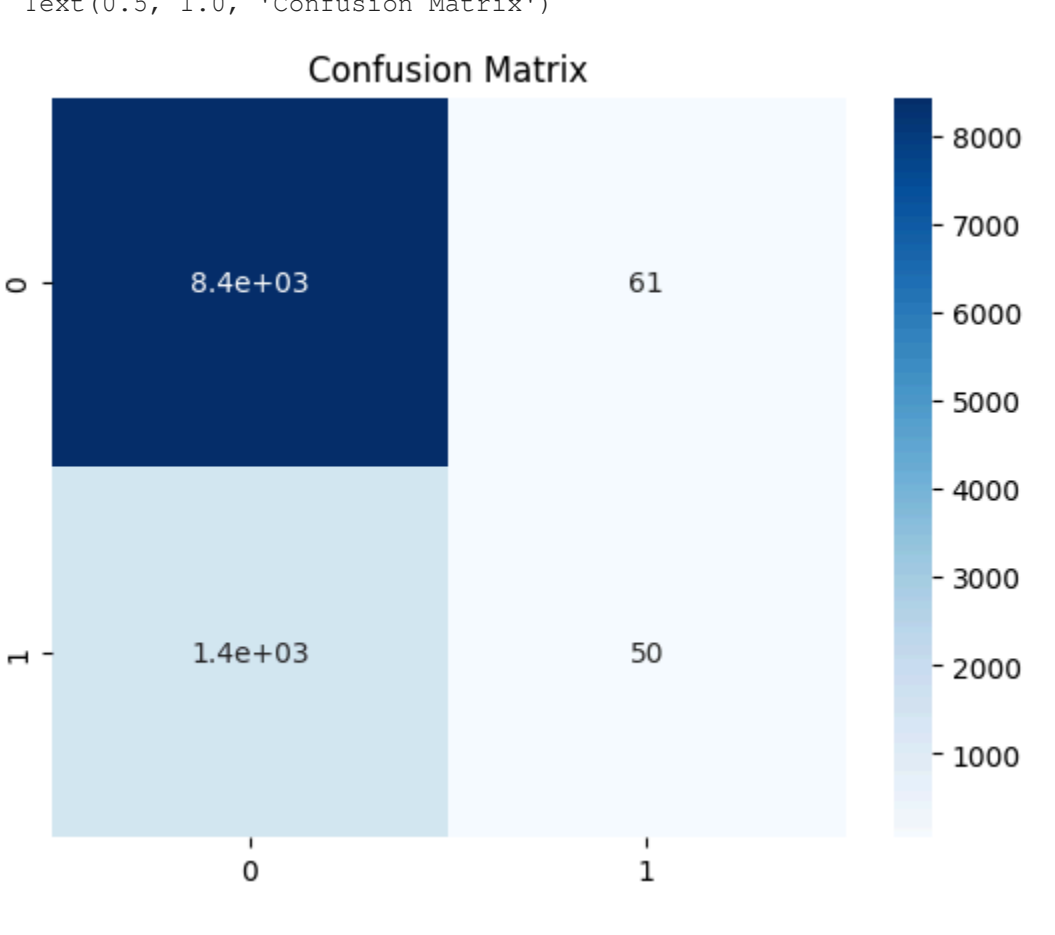
In [187…
```python
from sklearn.pipeline import Pipeline
pipe=Pipeline([
    ('preprocessor',preprocessor),
    ('model',RandomForestClassifier(n_estimators=100,class_weight='balanced'))
])
```

In [188…
```python
pipe.fit(x_train,y_train)
y_pred=pipe.predict(x_test)
print(f'The accuracy of this model is :{accuracy_score(y_test,y_pred)}\n')
print(f'The Classification report of this model is :\n{classification_report(y_test,y_pred)}')
```

```
The accuracy of this model is :0.8450225112556278

The Classification report of this model is :
              precision    recall  f1-score   support

           0       0.86      0.97      0.91      8501
           1       0.44      0.14      0.21      1494

    accuracy                           0.85      9995
   macro avg       0.65      0.55      0.56      9995
weighted avg       0.80      0.85      0.81      9995
```

In [204…
```python
con=confusion_matrix(y_test,y_pred)
sns.heatmap(data=con,annot=True,cmap='Blues')
plt.title('Confusion Matrix')
```

Out[204… Text(0.5, 1.0, 'Confusion Matrix')



Cross Validation

In [197…
```python
from sklearn.model_selection import GridSearchCV
param_grid = {
    'n_estimators': [100, 200, 300],
    'max_depth': [None, 10, 20, 30],
    'min_samples_split': [2, 5, 10],
    'min_samples_leaf': [1, 2, 4],
    'criterion' : ["gini", "entropy"]
}

RF= RandomForestClassifier(random_state=42)
grid_search = GridSearchCV(estimator=RF, param_grid=param_grid, cv=5, n_jobs=-1, verbose=0)
grid_search.fit(x_train, y_train)
best_params = grid_search.best_params_
print(f'Best Hyperparameters: {best_params}')
```

```
C:\Users\Qadri Laptop\PycharmProjects\numpy\venv\Lib\site-packages\numpy\ma\core.py:2820: RuntimeWarning: invalid value encountered in cast
  _data = np.array(data, dtype=dtype, copy=copy,
Best Hyperparameters: {'criterion': 'gini', 'max_depth': 20, 'min_samples_leaf': 4, 'min_samples_split': 2, 'n_estimators': 300}
```

In [201…
```python
y_pred=grid_search.predict(x_test)
print(f"Best Hyperparameter accuracy is :{grid_search.best_score_}\n")
print(f"Classification report of hperparameter is :\n\n{classification_report(y_test,y_pred)}\n\n")
print(f"Confusion matrix is :\n{confusion_matrix(y_test,y_pred)}")
```

```
Best Hyperparameter accuracy is :0.8523864308639624

Classification report of hperparameter is :

              precision    recall  f1-score   support

           0       0.85      0.99      0.92      8501
           1       0.45      0.03      0.06      1494

    accuracy                           0.85      9995
   macro avg       0.65      0.51      0.49      9995
weighted avg       0.79      0.85      0.79      9995



Confusion matrix is :
[[8440   61]
 [1444   50]]
```

Top Features Using Training

In [202…
```python
feature_names = pipe.named_steps['preprocessor'].get_feature_names_out()
importances = pipe.named_steps['model'].feature_importances_
import pandas as pd
importance_df = pd.DataFrame({
    'Feature': feature_names,
    'Importance': importances
}).sort_values(by='Importance', ascending=False)
importance_df.head(10)
```

Out[202…

	Feature	Importance
1	num__purchase_lead	0.244491
2	num__length_of_stay	0.174109
0	num__num_passengers	0.063744
14	num__booking_origin_Malaysia	0.055183
3	num__flight_duration	0.045565
21	num__wants_in_flight_meals_1	0.030880
20	num__wants_preferred_seat_1	0.027069
19	num__wants_extra_baggage_1	0.024222
5	num__flight_day_3	0.021323
4	num__flight_day_2	0.020665

In [ ]: