In [1]:
```
import matplotlib as mpl
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
from __future__ import print_function
print(plt.style.available)
mpl.style.use(['ggplot'])
```

```
['Solarize_Light2', '_classic_test_patch', '_mpl-gallery', '_mpl-gallery-nogrid', 'bmh', 'classic', 'dark_background', 'fast', 'fivethirtyeight', 'ggplot', 'grayscale', 'seab
orn-v0_8', 'seaborn-v0_8-bright', 'seaborn-v0_8-colorblind', 'seaborn-v0_8-dark', 'seaborn-v0_8-dark-palette', 'seaborn-v0_8-darkgrid', 'seaborn-v0_8-deep', 'seaborn-v0_8-mut
ed', 'seaborn-v0_8-notebook', 'seaborn-v0_8-paper', 'seaborn-v0_8-pastel', 'seaborn-v0_8-poster', 'seaborn-v0_8-talk', 'seaborn-v0_8-ticks', 'seaborn-v0_8-white', 'seaborn-v0
_8-whitegrid', 'tableau-colorblind10']
```

In [4]:
```
rc = pd.read_excel(
'/Users/scarlettattensil/Downloads/RCCL_DAandAI_NewHireTest[94]/satisfaction.xlsx',
sheet_name = "satisfaction_v2"
)
```

In [5]:
```
rc.describe(include = 'all')
```

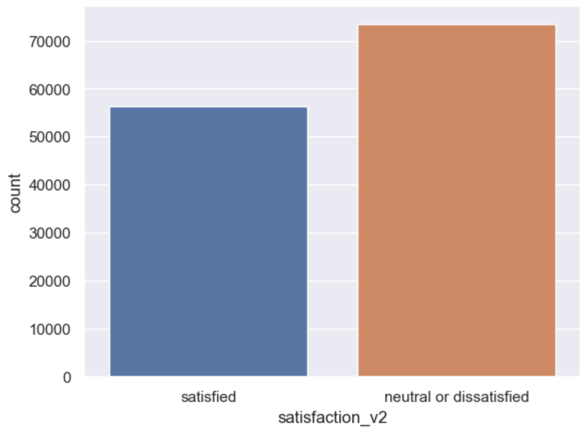
Out[5]:

	id	satisfaction_v2	Gender	Customer Type	Age	Type of Travel	Class	Flight Distance	Inflight wifi service	Departure/Arrival time convenient	...	Seat comfort	Inflight entertainment	On-board service	Leg roo servic
count	129880.000000	129880	129880	129880	129880.000000	129880	129880	129880.000000	129880.000000	129880.000000	...	129880.000000	129880.000000	129880.000000	129880.00000
unique	NaN	2	2	2	NaN	2	3	NaN	NaN	NaN	...	NaN	NaN	NaN	Na
top	NaN	neutral or dissatisfied	Female	Loyal Customer	NaN	Business travel	Business	NaN	NaN	NaN	...	NaN	NaN	NaN	Na
freq	NaN	73452	65899	106100	NaN	89693	62160	NaN	NaN	NaN	...	NaN	NaN	NaN	Na
mean	64940.500000	NaN	NaN	NaN	39.427957	NaN	NaN	1190.316392	2.728696	3.057599	...	3.441361	3.358077	3.383023	3.35087
std	37493.270818	NaN	NaN	NaN	15.119360	NaN	NaN	997.452477	1.329340	1.526741	...	1.319289	1.334049	1.287099	1.31625
min	1.000000	NaN	NaN	NaN	7.000000	NaN	NaN	31.000000	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.00000
25%	32470.750000	NaN	NaN	NaN	27.000000	NaN	NaN	414.000000	2.000000	2.000000	...	2.000000	2.000000	2.000000	2.00000
50%	64940.500000	NaN	NaN	NaN	40.000000	NaN	NaN	844.000000	3.000000	3.000000	...	4.000000	4.000000	4.000000	4.00000
75%	97410.250000	NaN	NaN	NaN	51.000000	NaN	NaN	1744.000000	4.000000	4.000000	...	5.000000	4.000000	4.000000	4.00000
max	129880.000000	NaN	NaN	NaN	85.000000	NaN	NaN	4983.000000	5.000000	5.000000	...	5.000000	5.000000	5.000000	5.00000

11 rows × 24 columns

In [17]:
```
sns.set(font_scale=1)
sns.countplot(data=rc,x="satisfaction_v2")
```

Out[17]:
```
<Axes: xlabel='satisfaction_v2', ylabel='count'>
```



In [6]:
```
features = list(np.delete(rc.columns, [0,1,2,3,4,5,6,7,22,23]))
```

In [7]:
```
features
```

Out[7]:
```
['Inflight wifi service',
 'Departure/Arrival time convenient',
 'Ease of Online booking',
 'Gate location',
 'Food and drink',
 'Online boarding',
 'Seat comfort',
 'Inflight entertainment',
 'On-board service',
 'Leg room service',
 'Baggage handling',
 'Checkin service',
 'Inflight service',
 'Cleanliness']
```

In [8]:
```
mdf = df = pd.melt(rc,id_vars=['satisfaction_v2'],value_vars=features,
             var_name='feature', value_name='value')
```

In [9]:
```
mdf
```

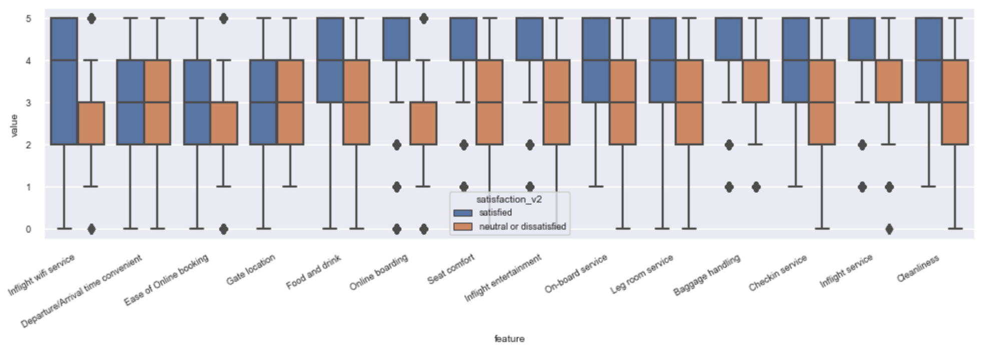
Out[9]:

	satisfaction_v2	feature	value
0	satisfied	Inflight wifi service	0
1	satisfied	Inflight wifi service	0
2	satisfied	Inflight wifi service	0
3	satisfied	Inflight wifi service	0
4	satisfied	Inflight wifi service	0
...	...	...	...
1818315	satisfied	Cleanliness	4
1818316	satisfied	Cleanliness	5
1818317	satisfied	Cleanliness	2
1818318	satisfied	Cleanliness	5
1818319	satisfied	Cleanliness	5

1818320 rows × 3 columns

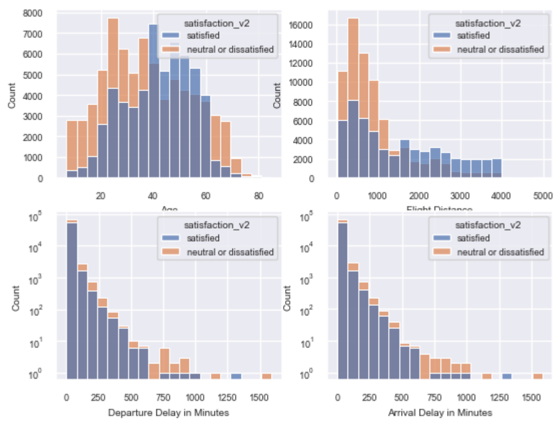
In [36]:
```python
plt.figure(figsize=(12,3))
sns.set(font_scale=.6)
ax = sns.boxplot(x="feature", y="value", hue="satisfaction_v2", data=mdf)
ax.set_xticklabels(ax.get_xticklabels(), rotation=30, horizontalalignment='right')
```

Out[36]:
```
[Text(0, 0, 'Inflight wifi service'),
 Text(1, 0, 'Departure/Arrival time convenient'),
 Text(2, 0, 'Ease of Online booking'),
 Text(3, 0, 'Gate location'),
 Text(4, 0, 'Food and drink'),
 Text(5, 0, 'Online boarding'),
 Text(6, 0, 'Seat comfort'),
 Text(7, 0, 'Inflight entertainment'),
 Text(8, 0, 'On-board service'),
 Text(9, 0, 'Leg room service'),
 Text(10, 0, 'Baggage handling'),
 Text(11, 0, 'Checkin service'),
 Text(12, 0, 'Inflight service'),
 Text(13, 0, 'Cleanliness')]
```



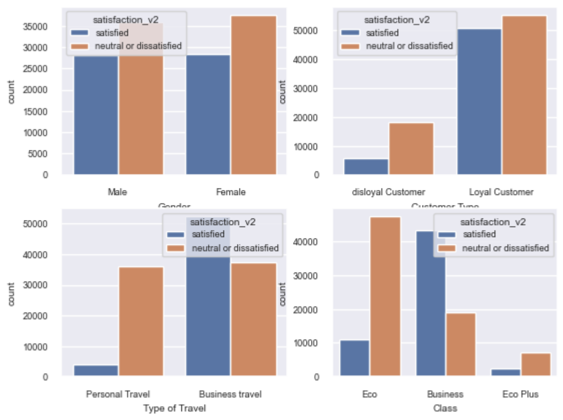
In [21]:
```python
variables = ['Age','Flight Distance','Departure Delay in Minutes','Arrival Delay in Minutes']
```

In [38]:
```python
sns.set(font_scale=.6)
fig, axs = plt.subplots(nrows=2, ncols=2)
i = j = 0
for variable in variables:
    g = sns.histplot(data = rc
            ,x = variable
            ,alpha = .7
            ,bins = 20
            ,hue = 'satisfaction_v2'
            ,ax=axs[i][j])
    j += 1
    if i>0:
        g.set(yscale="log")
    if j>1:
        i += 1; j = 0
```



In [13]:
```python
features_cat = ['Gender','Customer Type','Type of Travel','Class']
```

In [37]:
```python
sns.set(font_scale=.6)
fig, axs = plt.subplots(nrows=2, ncols=2)
i = j = 0
for feature in features_cat:
    g = sns.countplot(data=rc, x=feature, hue="satisfaction_v2", ax=axs[i][j])
    j += 1
    if j>1:
        i += 1; j = 0
```



In [112…

```
from sklearn.tree import DecisionTreeClassifier # Import Decision Tree Classifier
from sklearn.model_selection import train_test_split # Import train_test_split function
from sklearn import metrics #Import scikit-learn metrics module for accuracy calculation
from sklearn import tree
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
```

In [58]:

```
features_dummy = pd.get_dummies(rc[features_cat])
features_dummy = features_dummy.drop(features_dummy.columns[[0,3,5,6]],axis = 1)
```

In [90]:

```
#all features for model
model_features = pd.concat(
    [rc[features],rc[variables],features_dummy],
    axis=1
)
```

In [88]:

```
model_features.isna().sum(axis = 0)
```

Out[88]:

```
Inflight wifi service                  0
Departure/Arrival time convenient      0
Ease of Online booking                 0
Gate location                          0
Food and drink                         0
Online boarding                        0
Seat comfort                           0
Inflight entertainment                 0
On-board service                       0
Leg room service                       0
Baggage handling                       0
Checkin service                        0
Inflight service                       0
Cleanliness                            0
Age                                    0
Flight Distance                        0
Departure Delay in Minutes             0
Arrival Delay in Minutes             393
Gender_Male                            0
Customer Type_Loyal Customer           0
Type of Travel_Business travel         0
Class_Eco                              0
Class_Eco Plus                         0
dtype: int64
```

In [93]:

```
X = model_features[model_features["Arrival Delay in Minutes"].notnull()]
y = rc.satisfaction_v2[model_features["Arrival Delay in Minutes"].notnull()]
```

In [94]:

```
# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1) # 70% training and 30% test
```

In [95]:

```
# Create Decision Tree classifer object
clf = DecisionTreeClassifier()

# Train Decision Tree Classifer
clf = clf.fit(X_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(X_test)
```

In [119…

```
clf.classes_
```

Out[119]:

```
array(['neutral or dissatisfied', 'satisfied'], dtype=object)
```

In [96]:

```
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

```
Accuracy: 0.9448606069966793
```

In [122…

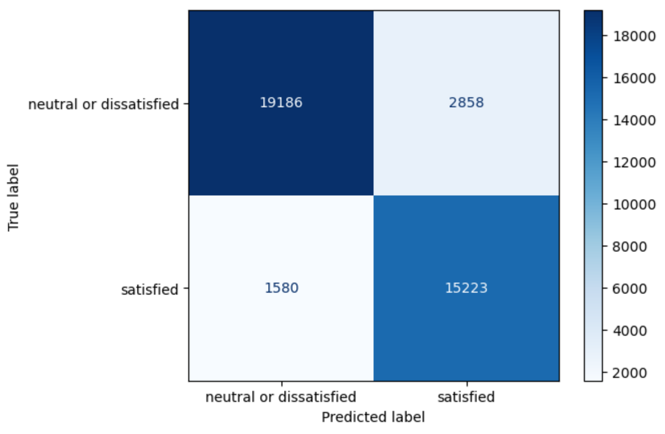
```
y_test
```

Out[122]:

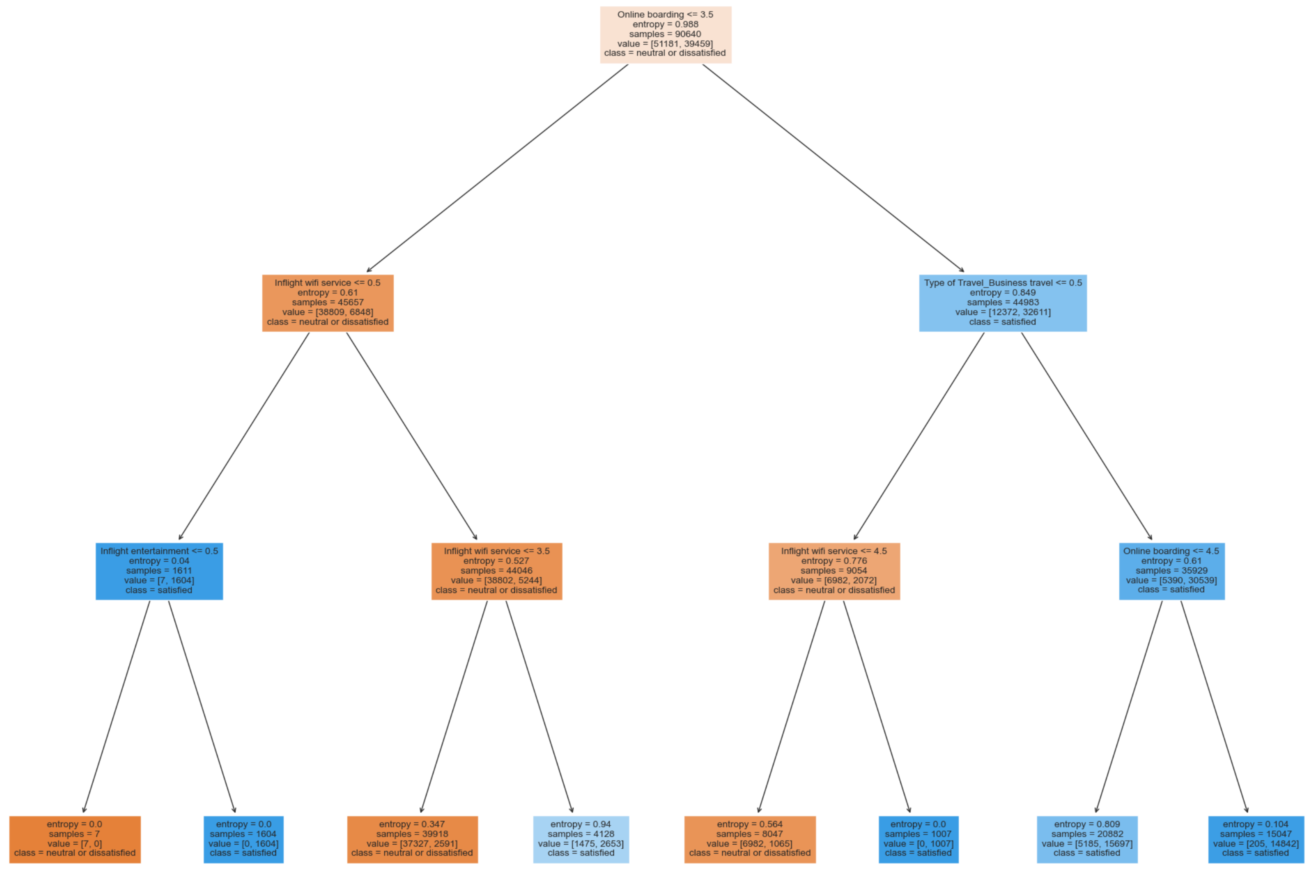
```
9718      neutral or dissatisfied
85580     neutral or dissatisfied
108838                  satisfied
89646                   satisfied
27209     neutral or dissatisfied
                   ...
94510                   satisfied
91587                   satisfied
124822                  satisfied
115428                  satisfied
14489     neutral or dissatisfied
Name: satisfaction_v2, Length: 38847, dtype: object
```

In [132…

```
sns.reset_orig()
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(cm,display_labels=clf.classes_)
disp = disp.plot(include_values=True, cmap='Blues', ax=None, xticks_rotation='horizontal')
plt.show()
```



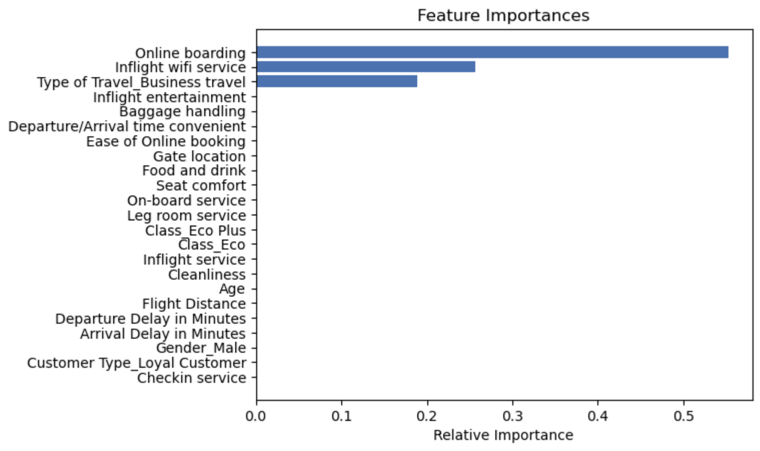
```
In [121…  fig = plt.figure(figsize=(25,20))
          _ = tree.plot_tree(clf,
                             feature_names=X.columns.values.tolist(),
                             class_names=clf.classes_,
                             filled=True)
```



```
In [134…  #Feature Importance
          importances=clf.feature_importances_

          features = X.columns.values.tolist()
          importances = clf.feature_importances_
          indices = np.argsort(importances)

          plt.title('Feature Importances')
          plt.barh(range(len(indices)), importances[indices], color='b', align='center')
          plt.yticks(range(len(indices)), [features[i] for i in indices])
          plt.xlabel('Relative Importance')
          plt.show()
```



Feature Importances
Online boarding
Inflight wifi service
Type of Travel_Business travel
Inflight entertainment
Baggage handling
Departure/Arrival time convenient
Ease of Online booking
Gate location
Food and drink
Seat comfort
On-board service
Leg room service
Class_Eco Plus
Class_Eco
Inflight service
Cleanliness
Age
Flight Distance
Departure Delay in Minutes
Arrival Delay in Minutes
Gender_Male
Customer Type_Loyal Customer
Checkin service
0.0
0.1
0.2
0.3
0.4
0.5
Relative Importance

```
In [ ]:
```