Data Mining - Lab 2

Huỳnh Thị Thắm - 18110209

In [1]:

```
path = "G:\\University_Learning\\data-mining\\Lab02\\"
import os
os.chdir(path)
currentWorkingDir = %pwd
currentWorkingDir
```

Out[1]:

```
'G:\\University_Learning\\data-mining\\Lab02'
```

In [2]:

```python
# Read data and look statistics
import pandas as pd
data = pd.read_csv("Dataset\\Titanic.csv")

print("Display all first of 5 rows :")
display(data.head())
print("The shape of data in (nrows,ncols)")
print(data.shape)
```

```
Display all first of 5 rows :
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

```
The shape of data in (nrows,ncols)
(891, 12)
```

In [3]:

```python
# Library
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")

pd.set_option('max.columns',100)
pd.set_option('max.rows',500)
```

In [4]:

```
def find_missing_percent(data , showresult = True):
    miss_df = pd.DataFrame({'ColumnName':[],'TotalMissingVals':[],'PercentMissing':[]})
    for col in data.columns:
        sum_miss_val = data[col].isnull().sum()
        percent_miss_val = round((sum_miss_val/data.shape[0])*100,2)
        missinginfo = {"ColumnName" : col, "TotalMissingVals" : sum_miss_val, "PercentMissing" : percent_miss_val}
        miss_df = miss_df.append(missinginfo, ignore_index = True)

    miss_df = miss_df[miss_df["PercentMissing"] > 0.0]
    miss_df = miss_df.reset_index(drop = True)
    miss_features = miss_df["ColumnName"].values
    if(showresult):
        print(data.shape)
        display(data.head())
        display(miss_df)
    return miss_df
```

In [5]:

```
miss_df = find_missing_percent(data)
```

```
(891, 12)
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

	ColumnName	TotalMissingVals	PercentMissing
0	Age	177.0	19.87
1	Cabin	687.0	77.10
2	Embarked	2.0	0.22

In [6]:

```
drop_cols = list(miss_df[miss_df['PercentMissing'] > 60.0].ColumnName)
print(drop_cols)
data = data.drop(drop_cols,axis=1)
miss_df = find_missing_percent(data)
```

```
['Cabin']
(891, 11)
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	S

	ColumnName	TotalMissingVals	PercentMissing
0	Age	177.0	19.87
1	Embarked	2.0	0.22

Missing Handling

Listwise Deletion

In [7]:
```
def listwise_deletion(data):
    for col in data.columns:
        miss_ind = data[col][data[col].isnull()].index
        data = data.drop(miss_ind, axis = 0)
    return data

data_lwd = listwise_deletion(data)
miss_df = find_missing_percent(data_lwd)
```

```
(712, 11)
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	S

ColumnName	TotalMissingVals	PercentMissing

Mean/Mode

In [8]:
```
numeric_cols = data.select_dtypes(['float','int']).columns
categoric_cols = data.select_dtypes('object').columns
print(f"Numeric Columns : {numeric_cols}")
print(f"Categoric Columns : {categoric_cols}")
```

```
Numeric Columns : Index(['PassengerId', 'Survived', 'Pclass', 'Age', 'SibSp', 'Parch', 'Fare'], dtype='object')
Categoric Columns : Index(['Name', 'Sex', 'Ticket', 'Embarked'], dtype='object')
```

In [9]:

```
def mean_imputation(data_numeric):
    for col in data_numeric.columns:
        mean = data_numeric[col].mean()
        data_numeric[col] = data_numeric[col].fillna(mean)
    return data_numeric
def mode_imputation(data_categoric):
    for col in data_categoric.columns:
        mode = data_categoric[col].mode().iloc[0]
        data_categoric[col] = data_categoric[col].fillna(mode)
    return data_categoric
```

In [10]:

```
data_numeric = data[numeric_cols]
data_numeric_mean_imp = mean_imputation(data_numeric)
data_categoric = data[categoric_cols]
data_categoric_mode_imp = mode_imputation(data_categoric)

data_imputed_value = pd.concat([data_numeric_mean_imp, data_categoric_mode_imp], axis = 1)
miss_df = find_missing_percent(data_imputed_value)
```

```
(891, 11)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name	Sex	Ticket	Embarked
0	1	0	3	22.0	1	0	7.2500	Braund, Mr. Owen Harris	male	A/5 21171	S
1	2	1	1	38.0	1	0	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	PC 17599	C
2	3	1	3	26.0	0	0	7.9250	Heikkinen, Miss. Laina	female	STON/O2. 3101282	S
3	4	1	1	35.0	1	0	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	113803	S
4	5	0	3	35.0	0	0	8.0500	Allen, Mr. William Henry	male	373450	S

ColumnName	TotalMissingVals	PercentMissing

XGBoosting

In [11]:

```
!pip install xgboost
```

```
Requirement already satisfied: xgboost in g:\users\user\anaconda3\lib\site-packages (1.5.2)
Requirement already satisfied: numpy in g:\users\user\anaconda3\lib\site-packages (from xgboost) (1.20.3)
Requirement already satisfied: scipy in g:\users\user\anaconda3\lib\site-packages (from xgboost) (1.7.1)
```

In [12]:

```
import xgboost
from sklearn.experimental import enable_iterative_imputer
from sklearn.impute import IterativeImputer
from sklearn.preprocessing import OrdinalEncoder
from sklearn.ensemble import (GradientBoostingRegressor, GradientBoostingClassifier)
```

In [13]:

```
def find_missing_index(data_numeric_xgboost, target_cols):
    miss_index_dict = {}
    for tcol in target_cols:
        index = data_numeric_xgboost[tcol][data_numeric_xgboost[tcol].isnull()].index
        miss_index_dict[tcol] = index
    return miss_index_dict

def xgboost_imputation(data_numeric_xgboost, target_cols, miss_index_dict):
    predictors = data_numeric_xgboost.drop(target_cols, axis =1)
    for tcol in target_cols:
        y = data_numeric_xgboost[tcol]
        y = y.fillna(y.mean())
        xgb = xgboost.XGBRegressor(objective="reg:squarederror", random_state=42)
        xgb.fit(predictors, y)
        predictions = pd.Series(xgb.predict(predictors),index= y.index)
        index = miss_index_dict[tcol]
        data_numeric_xgboost[tcol].loc[index] = predictions.loc[index]
    return data_numeric_xgboost
```

In [14]:

```
miss_df = find_missing_percent(data, showresult = False)
miss_features = miss_df["ColumnName"].values
target_cols = [feature for feature in miss_features if feature in numeric_cols]
print(target_cols)

data_numeric_xgboost = data[numeric_cols]
miss_index_dict = find_missing_index(data_numeric_xgboost, target_cols)
data_numeric_xgboost = xgboost_imputation(data_numeric_xgboost, target_cols, miss_index_dict)
data_imputed_xgboost = pd.concat([data_numeric_xgboost, data_categoric_mode_imp], axis = 1)

miss_df = find_missing_percent(data_imputed_xgboost)
```

```
['Age']
(891, 11)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name	Sex	Ticket	Embarked
0	1	0	3	22.0	1	0	7.2500	Braund, Mr. Owen Harris	male	A/5 21171	S
1	2	1	1	38.0	1	0	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	PC 17599	C
2	3	1	3	26.0	0	0	7.9250	Heikkinen, Miss. Laina	female	STON/O2. 3101282	S
3	4	1	1	35.0	1	0	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	113803	S
4	5	0	3	35.0	0	0	8.0500	Allen, Mr. William Henry	male	373450	S

ColumnName	TotalMissingVals	PercentMissing

MICE

In [15]:
```
def mice_imputation_numeric(train_numeric):
    iter_imp_numeric = IterativeImputer(GradientBoostingRegressor())
    imputed_train = iter_imp_numeric.fit_transform(train_numeric)
    train_numeric_imp = pd.DataFrame(imputed_train, columns = train_numeric.columns, index= train_numeric.index)
    return train_numeric_imp

def mice_imputation_categoric(train_categoric):
    ordinal_dict={}
    for col in train_categoric:
        ordinal_dict[col] = OrdinalEncoder()
        nn_vals = np.array(train_categoric[col][train_categoric[col].notnull()]).reshape(-1,1)
        nn_vals_arr = np.array(ordinal_dict[col].fit_transform(nn_vals)).reshape(-1,)
        train_categoric[col].loc[train_categoric[col].notnull()] = nn_vals_arr

    iter_imp_categoric = IterativeImputer(GradientBoostingClassifier(), max_iter =5, initial_strategy='most_frequent')
    imputed_train = iter_imp_categoric.fit_transform(train_categoric)
    train_categoric_imp = pd.DataFrame(imputed_train, columns =train_categoric.columns,index = train_categoric.index).as

    for col in train_categoric_imp.columns:
        oe = ordinal_dict[col]
        train_arr= np.array(train_categoric_imp[col]).reshape(-1,1)
        train_categoric_imp[col] = oe.inverse_transform(train_arr)

    return train_categoric_imp
```

```
In [16]: data_numeric_imp  = mice_imputation_numeric(data_numeric)
         data_categoric_imp = mice_imputation_categoric(data_categoric)

         data_imputed_mice = pd.concat([data_numeric_imp, data_categoric_imp], axis = 1)
         miss_df = find_missing_percent(data_imputed_mice)
```

```
(891, 11)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name	Sex	Ticket	Embarked
0	1.0	0.0	3.0	22.0	1.0	0.0	7.2500	Braund, Mr. Owen Harris	male	A/5 21171	S
1	2.0	1.0	1.0	38.0	1.0	0.0	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	PC 17599	C
2	3.0	1.0	3.0	26.0	0.0	0.0	7.9250	Heikkinen, Miss. Laina	female	STON/O2. 3101282	S
3	4.0	1.0	1.0	35.0	1.0	0.0	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	113803	S
4	5.0	0.0	3.0	35.0	0.0	0.0	8.0500	Allen, Mr. William Henry	male	373450	S

ColumnName	TotalMissingVals	PercentMissing

Data Modelling

Listwise Deletion

In [17]:

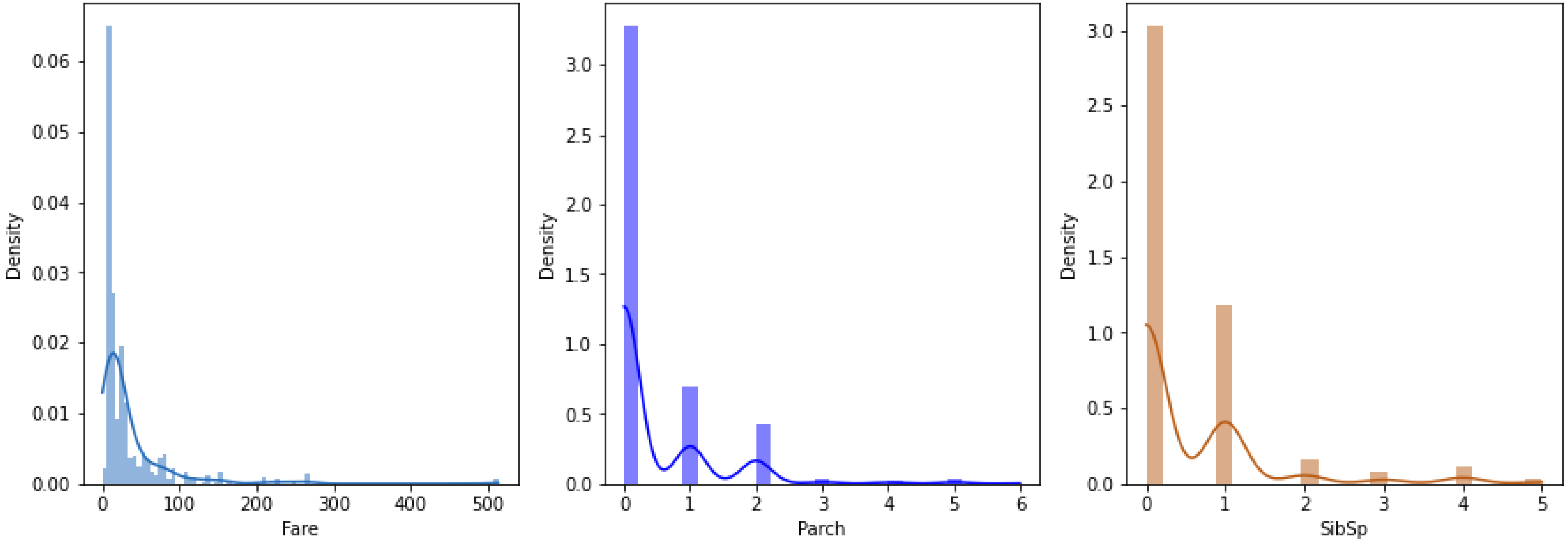
```
data_modelling = data_lwd.copy()

skew_limit = 0.5
skew_vals = data_modelling[numeric_cols].skew()
skew_cols = (skew_vals
             .sort_values(ascending=False)
             .to_frame()
             .rename(columns={0:'Skew'})
             .query('abs(Skew) > {0}'.format(skew_limit)))
display(skew_cols.T)
```

	Fare	Parch	SibSp
Skew	4.667009	2.614177	2.515107

In [18]:

```
fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()
```



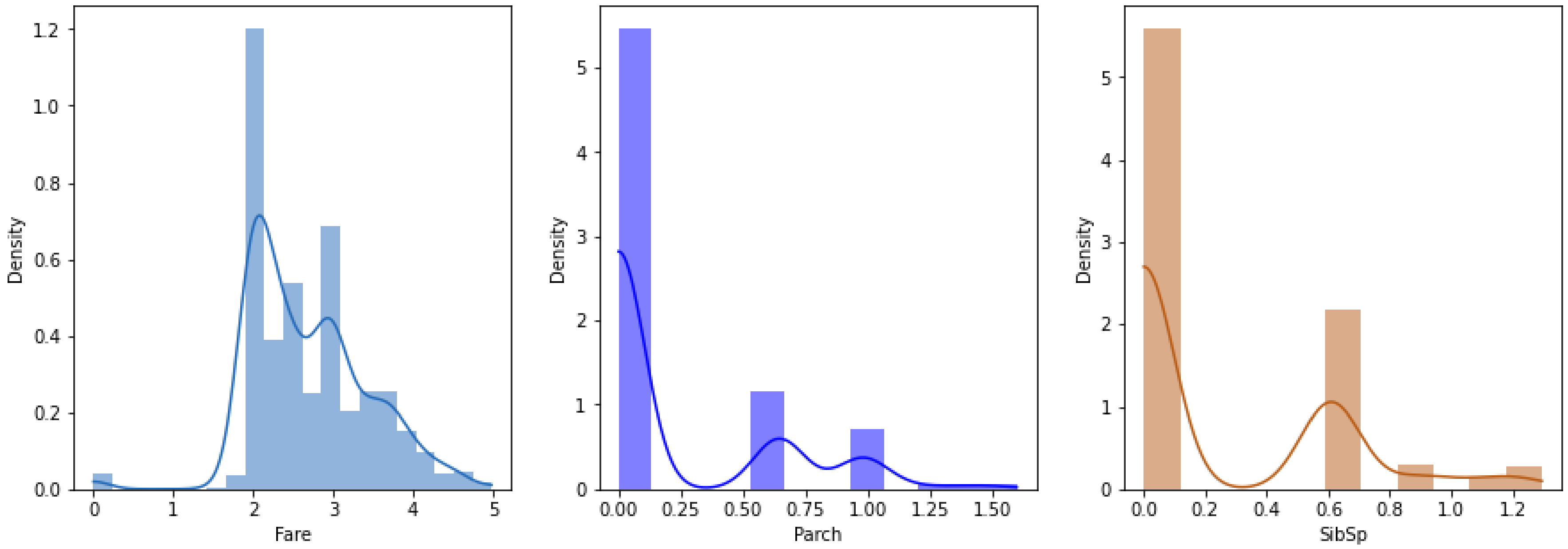
In [19]:

```
def NormalizeSkewedFeatures(data_modelling):
    from scipy.special import boxcox1p
    from scipy.stats import boxcox_normmax
    for col in skew_cols.index:
        if(col != 'SalePrice'):
            try:
                data_modelling[col] = boxcox1p(data_modelling[col], boxcox_normmax(data_modelling[col] + 1))
            except:
                print(f"column {col} can not apply BoxCox")
                continue
    return data_modelling

data_modelling = NormalizeSkewedFeatures(data_modelling)
```

In [20]:

```
fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()
```



In [21]:
```
def FeatureEncoding(data_modelling):
    data_modelling = pd.get_dummies(data_modelling, columns=categoric_cols, drop_first=True)
    return data_modelling

data_modelling = FeatureEncoding(data_modelling)
display(data_modelling.head())
print(data_modelling.shape)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name_Abbott, Mr. Rossmore Edward	Name_Abbott, Mrs. Stanton (Rosa Hunt)	Name_Abelson, Mr. Samuel	Name_Abelson, Mrs. Samuel (Hannah Wizosky)	Name_Adahl, Mr. Mauritz Nils Martin	Na
0	1	0	3	22.0	0.608512	0.0	1.951200	0	0	0	0	0	
1	2	1	1	38.0	0.608512	0.0	3.659614	0	0	0	0	0	
2	3	1	3	26.0	0.000000	0.0	2.018098	0	0	0	0	0	
3	4	1	1	35.0	0.608512	0.0	3.447342	0	0	0	0	0	
4	5	0	3	35.0	0.000000	0.0	2.029888	0	0	0	0	0	

5 rows × 1261 columns

```
(712, 1261)
```

In [22]:

```
from sklearn.ensemble import RandomForestClassifier
from sklearn import metrics
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score

def DataSplitTrainTest(data_modelling):
    train = data_modelling.copy()
    X = train.drop('Survived', axis=1)
    y = train['Survived']
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=12345)
    print("Train Data", X_train.shape)
    print("Test Data", X_test.shape)
    return X_train, X_test, y_train, y_test

X_train, X_test, y_train, y_test = DataSplitTrainTest(data_modelling)
```

```
Train Data (498, 1260)
Test Data (214, 1260)
```

In [23]:

```
def random_forest(X_train,X_test,y_train,y_test):
    '''
      Purpose: Perform Random Forest Classifier
      Input: X_train,y_train,X_test,y_test - DataFrame
      Output: The accuracy score of Random Forest
    '''
    rdf=RandomForestClassifier(random_state=0)
    rdf.fit(X_train,y_train)
    y_pred=rdf.predict(X_test)
    return metrics.accuracy_score(y_test,y_pred)

acc_lwd = random_forest(X_train, X_test, y_train, y_test)
acc_lwd
```

Out[23]:

```
0.8598130841121495
```

Mean/Mode Imputation

In [24]:

```
data_modelling = data_imputed_value.copy()

skew_limit = 0.5
skew_vals = data_modelling[numeric_cols].skew()
skew_cols = (skew_vals
             .sort_values(ascending=False)
             .to_frame()
             .rename(columns={0:'Skew'})
             .query('abs(Skew) > {0}'.format(skew_limit)))
display(skew_cols.T)
```

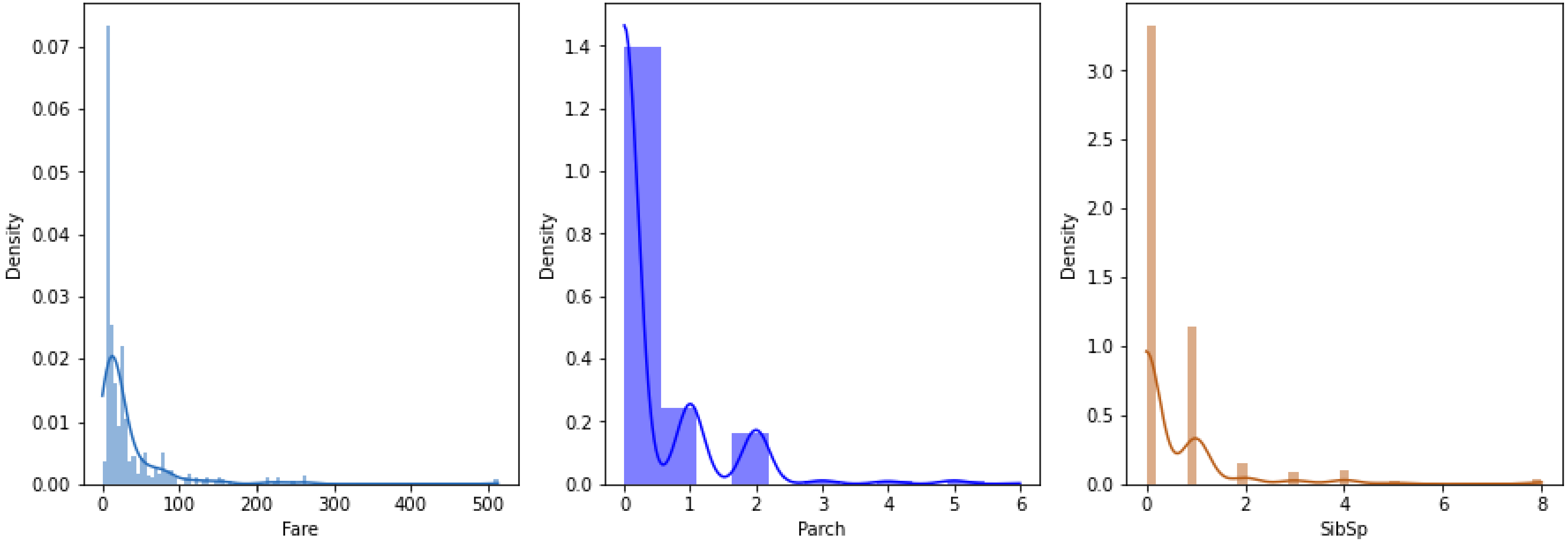
	Fare	SibSp	Parch	Pclass
Skew	4.787317	3.695352	2.749117	-0.630548

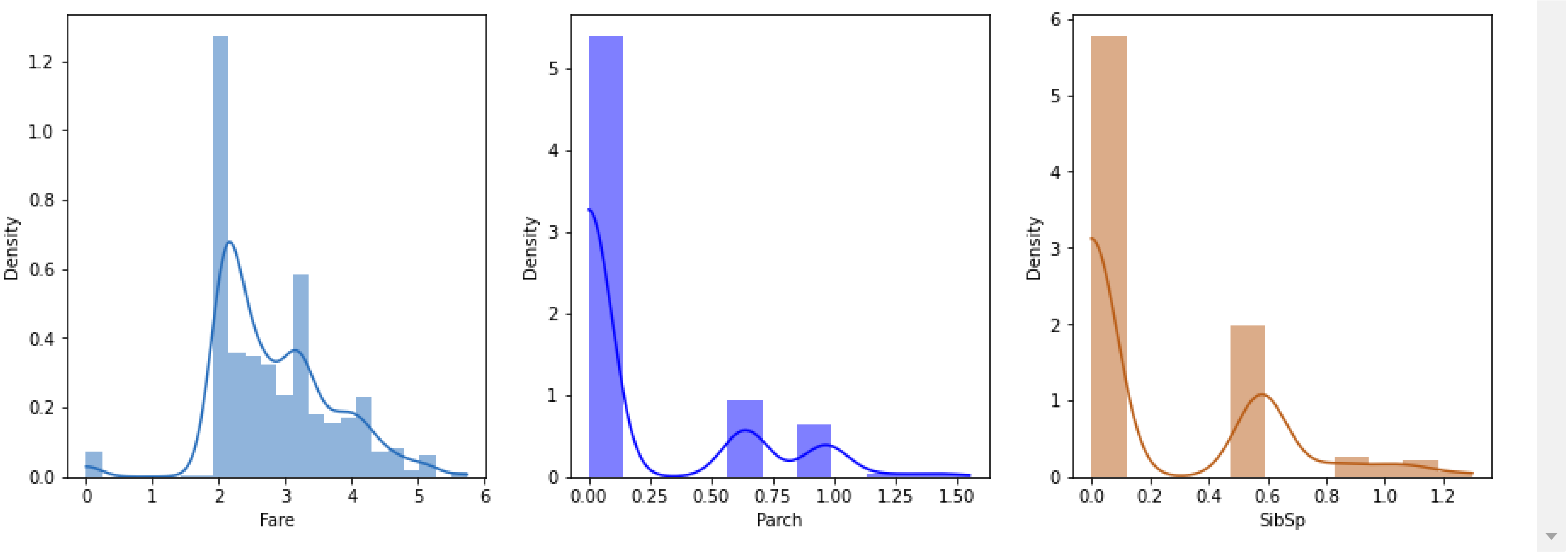
In [25]:

```
fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()

data_modelling = NormalizeSkewedFeatures(data_modelling)

fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()
```




Density
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
Fare
Density
5
4
3
2
1
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Parch
Density
6
5
4
3
2
1
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
SibSp

In [26]:

```
data_modelling = FeatureEncoding(data_modelling)
display(data_modelling.head())
print(data_modelling.shape)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name_Abbott, Mr. Rossmore Edward	Name_Abbott, Mrs. Stanton (Rosa Hunt)	Name_Abelson, Mr. Samuel	Name_Abelson, Mrs. Samuel (Hannah Wizosky)	Name_Adahl, Mr. Mauritz Nils Martin
0	1	0	5.602496	22.0	0.580385	0.0	2.050402	0	0	0	0	0
1	2	1	1.321015	38.0	0.580385	0.0	4.039238	0	0	0	0	0
2	3	1	5.602496	26.0	0.000000	0.0	2.124550	0	0	0	0	0
3	4	1	1.321015	35.0	0.580385	0.0	3.780503	0	0	0	0	0
4	5	0	5.602496	35.0	0.000000	0.0	2.137647	0	0	0	0	0

5 rows × 1580 columns

```
(891, 1580)
```

In [27]:

```
X_train, X_test, y_train, y_test = DataSplitTrainTest(data_modelling)
```

```
Train Data (623, 1579)
Test Data (268, 1579)
```

In [28]:

```
acc_mm = random_forest(X_train, X_test, y_train, y_test)
acc_mm
```

Out[28]:

```
0.7798507462686567
```

XGBoosting

In [29]:

```
data_modelling = data_imputed_xgboost.copy()

skew_limit = 0.5
skew_vals = data_modelling[numeric_cols].skew()
skew_cols = (skew_vals
             .sort_values(ascending=False)
             .to_frame()
             .rename(columns={0:'Skew'})
             .query('abs(Skew) > {0}'.format(skew_limit)))
display(skew_cols.T)
```

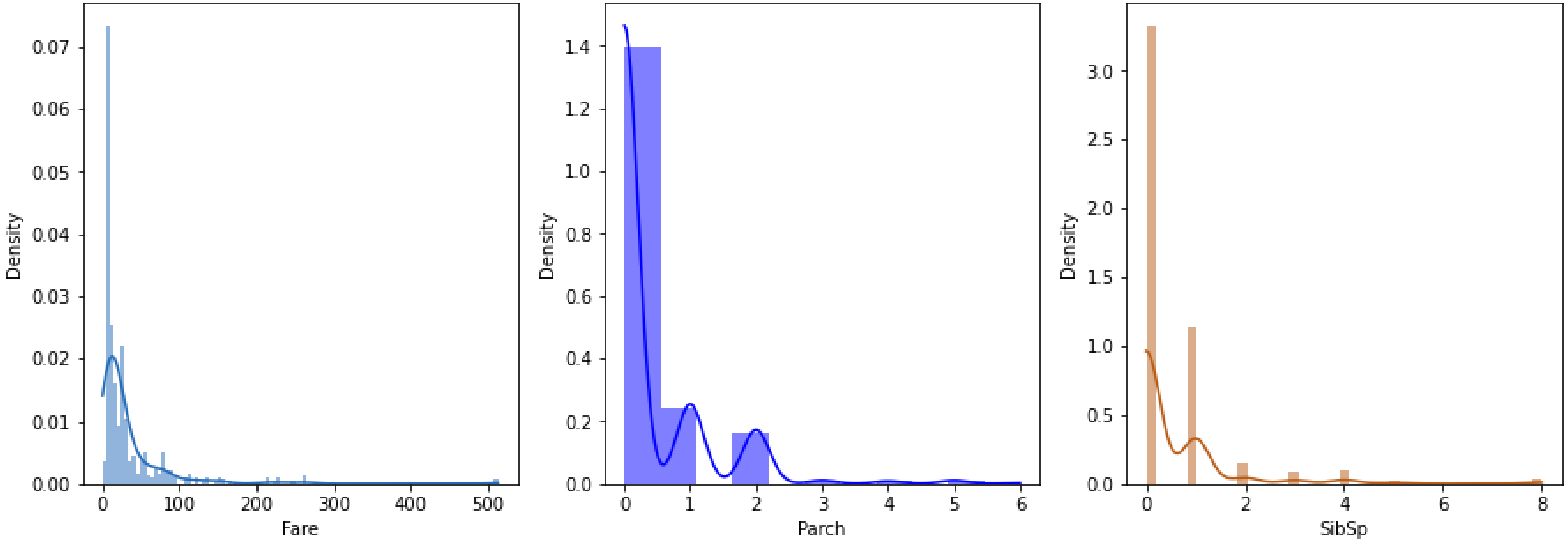
	Fare	SibSp	Parch	Pclass
Skew	4.787317	3.695352	2.749117	-0.630548

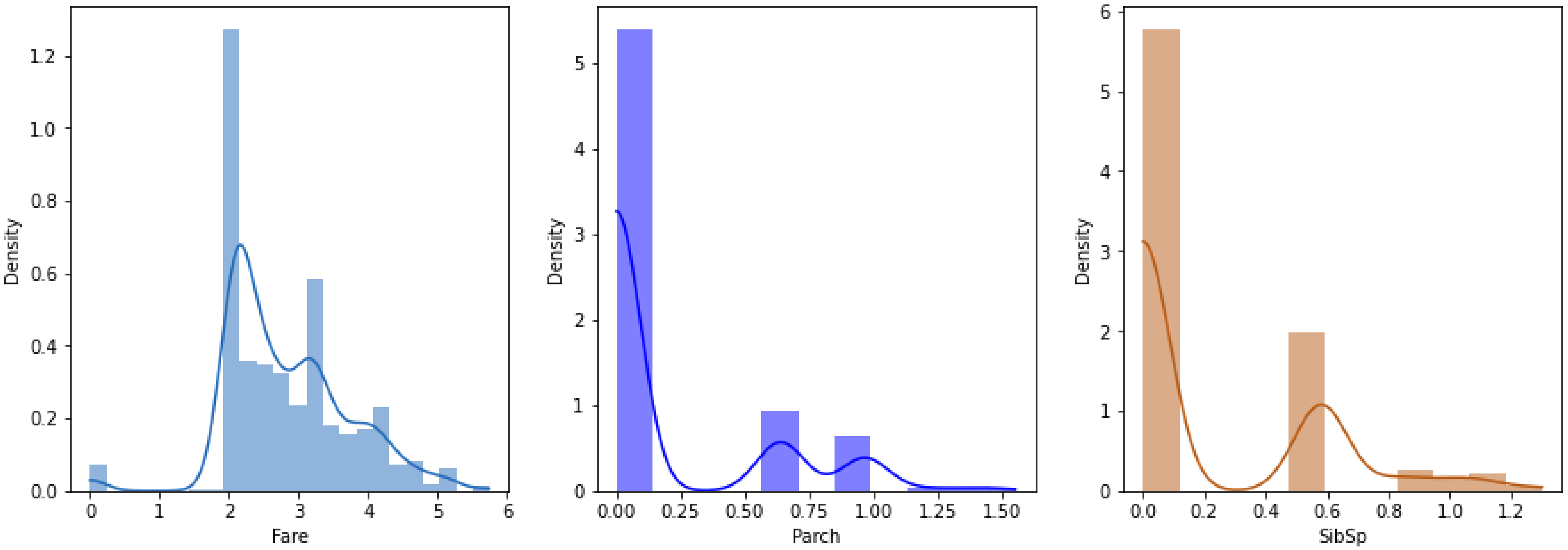
In [30]:

```
fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()

data_modelling = NormalizeSkewedFeatures(data_modelling)

fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()
```





Density
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
Fare
Density
5
4
3
2
1
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Parch
Density
6
5
4
3
2
1
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
SibSp

In [31]:
```
data_modelling = FeatureEncoding(data_modelling)
display(data_modelling.head())
print(data_modelling.shape)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name_Abbott, Mr. Rossmore Edward	Name_Abbott, Mrs. Stanton (Rosa Hunt)	Name_Abelson, Mr. Samuel	Name_Abelson, Mrs. Samuel (Hannah Wizosky)	Name_Adahl, Mr. Mauritz Nils Martin
0	1	0	5.602496	22.0	0.580385	0.0	2.050402	0	0	0	0	0
1	2	1	1.321015	38.0	0.580385	0.0	4.039238	0	0	0	0	0
2	3	1	5.602496	26.0	0.000000	0.0	2.124550	0	0	0	0	0
3	4	1	1.321015	35.0	0.580385	0.0	3.780503	0	0	0	0	0
4	5	0	5.602496	35.0	0.000000	0.0	2.137647	0	0	0	0	0

5 rows × 1580 columns

```
(891, 1580)
```

In [32]:
```
X_train, X_test, y_train, y_test = DataSplitTrainTest(data_modelling)
acc_xgboost = random_forest(X_train, X_test, y_train, y_test)
acc_xgboost
```

```
Train Data (623, 1579)
Test Data (268, 1579)
```

Out[32]:
```
0.7798507462686567
```

MICE

In [33]:

```
data_modelling = data_imputed_mice.copy()

skew_limit = 0.5
skew_vals = data_modelling[numeric_cols].skew()
skew_cols = (skew_vals
             .sort_values(ascending=False)
             .to_frame()
             .rename(columns={0:'Skew'})
             .query('abs(Skew) > {0}'.format(skew_limit)))
display(skew_cols.T)
```

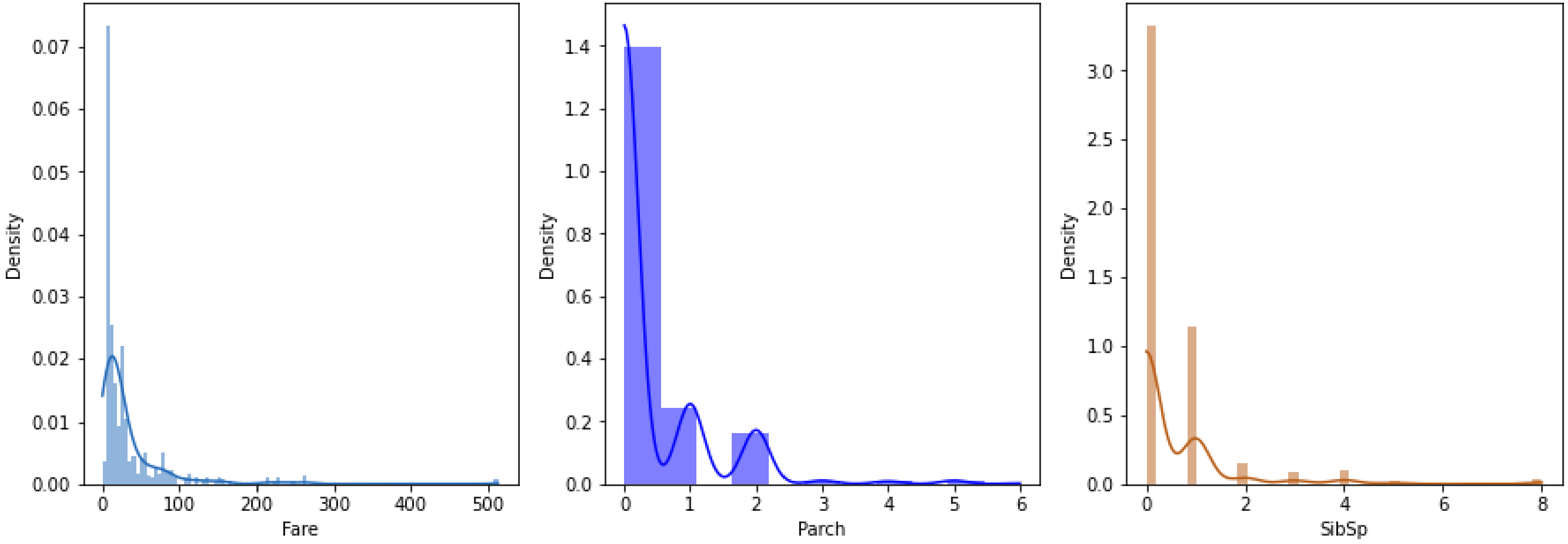
	Fare	SibSp	Parch	Pclass
Skew	4.787317	3.695352	2.749117	-0.630548

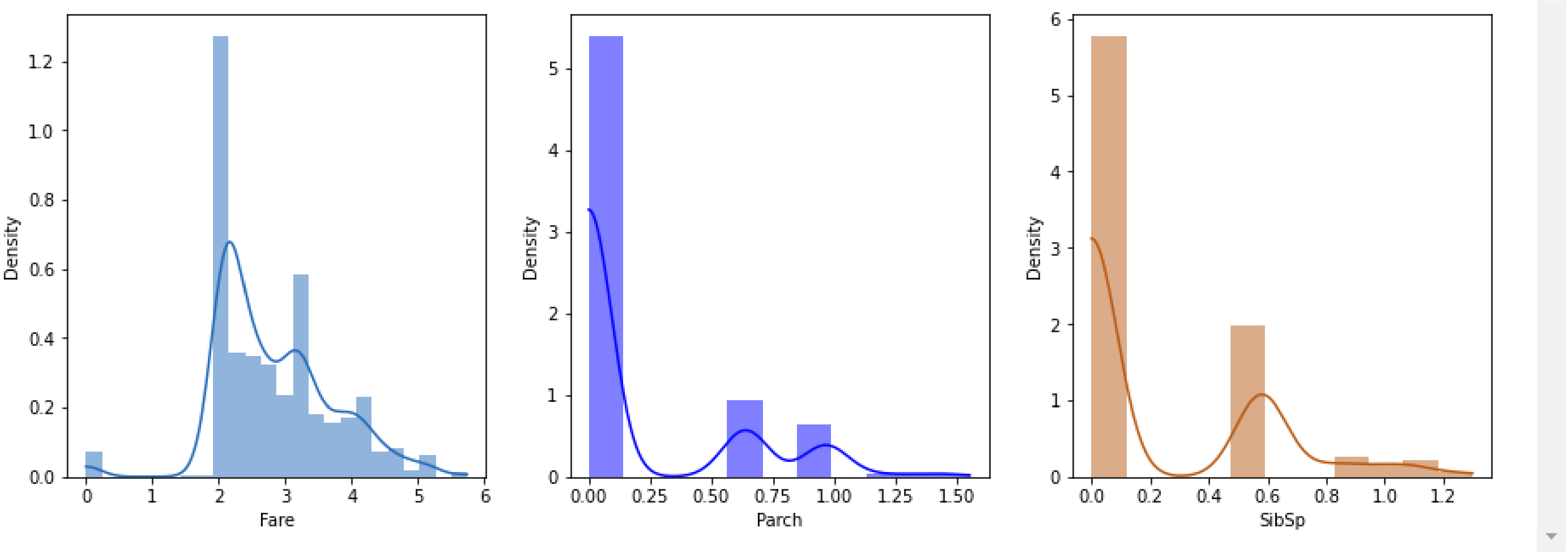
In [34]:

```
fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()

data_modelling = NormalizeSkewedFeatures(data_modelling)

fig, (ax_positive, ax_target, ax_negative) = plt.subplots(1, 3, figsize=(15, 5))
sns.histplot(data_modelling['Fare'],kde=True, stat='density', linewidth=0, color = '#236AB9', ax=ax_positive)
sns.histplot(data_modelling['Parch'],kde=True, stat='density', linewidth=0, color = 'blue', ax=ax_target)
sns.histplot(data_modelling['SibSp'], kde=True, stat='density', linewidth=0,color='#B85B14', ax=ax_negative)
plt.show()
```




Density
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
Fare
Density
5
4
3
2
1
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Parch
Density
6
5
4
3
2
1
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
SibSp

In [35]:

```
data_modelling = FeatureEncoding(data_modelling)
display(data_modelling.head())
print(data_modelling.shape)
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Name_Abbott, Mr. Rossmore Edward	Name_Abbott, Mrs. Stanton (Rosa Hunt)	Name_Abelson, Mr. Samuel	Name_Abelson, Mrs. Samuel (Hannah Wizosky)	Name_Adahl, Mr. Mauritz Nils Martin
0	1.0	0.0	5.602496	22.0	0.580385	0.0	2.050402	0	0	0	0	0
1	2.0	1.0	1.321015	38.0	0.580385	0.0	4.039238	0	0	0	0	0
2	3.0	1.0	5.602496	26.0	0.000000	0.0	2.124550	0	0	0	0	0
3	4.0	1.0	1.321015	35.0	0.580385	0.0	3.780503	0	0	0	0	0
4	5.0	0.0	5.602496	35.0	0.000000	0.0	2.137647	0	0	0	0	0

5 rows × 1580 columns

```
(891, 1580)
```

In [36]:

```
X_train, X_test, y_train, y_test = DataSplitTrainTest(data_modelling)
acc_mice = random_forest(X_train, X_test, y_train, y_test)
acc_mice
```

```
Train Data (623, 1579)
Test Data (268, 1579)
```

Out[36]:

```
0.7798507462686567
```

In [37]:

```
print("Listwise Deletion: ", acc_lwd)
print("Mean/Mode Imputation: ", acc_mm)
print("XGBoosting: ", acc_xgboost)
print("MICE: ", acc_mice)
```

```
Listwise Deletion:  0.8598130841121495
Mean/Mode Imputation:  0.7798507462686567
XGBoosting:  0.7798507462686567
MICE:  0.7798507462686567
```