```
import pandas as pd
import numpy as np

from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.model_selection import cross_val_score, train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import confusion_matrix, classification_report

## The matplotlib and seaborn library for result visualization and analysis
import matplotlib.pyplot as plt
import seaborn as sns

sns.set_theme(style='darkgrid')
```

Loading the Dataset

First we load the dataset and find out the number of columns, rows, NULL values, etc.

```
train = pd.read_csv('train.csv')
test = pd.read_csv('test.csv')
```

```
train.shape, test.shape
```

```
((891, 12), (418, 11))
```

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  891 non-null    int64  
 1   Survived     891 non-null    int64  
 2   Pclass       891 non-null    int64  
 3   Name         891 non-null    object 
 4   Sex          891 non-null    object 
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64  
 7   Parch        891 non-null    int64  
 8   Ticket       891 non-null    object 
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object 
 11  Embarked     889 non-null    object 
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
```

```
test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  418 non-null    int64  
 1   Pclass       418 non-null    int64  
 2   Name         418 non-null    object 
 3   Sex          418 non-null    object 
 4   Age          332 non-null    float64
 5   SibSp        418 non-null    int64  
 6   Parch        418 non-null    int64  
 7   Ticket       418 non-null    object 
 8   Fare         417 non-null    float64
 9   Cabin        91 non-null     object 
 10  Embarked     418 non-null    object 
dtypes: float64(2), int64(4), object(5)
memory usage: 36.0+ KB
```

```
train.head()
```

	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

Next steps: Generate code with `train` View recommended plots New interactive sheet

```
test.head()
```

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	892	3	Kelly, Mr. James	male	34.5	0	0	330911	7.8292	NaN	Q
1	893	3	Wilkes, Mrs. James (Ellen Needs)	female	47.0	1	0	363272	7.0000	NaN	S
2	894	2	Myles, Mr. Thomas Francis	male	62.0	0	0	240276	9.6875	NaN	Q
3	895	3	Wirz, Mr. Albert	male	27.0	0	0	315154	8.6625	NaN	S
4	896	3	Hirvonen, Mrs. Alexander (Helga E Lindqvist)	female	22.0	1	1	3101298	12.2875	NaN	S

Next steps: Generate code with `test` View recommended plots New interactive sheet

```
train.describe()
```

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

```
test.describe()
```

	PassengerId	Pclass	Age	SibSp	Parch	Fare
count	418.000000	418.000000	332.000000	418.000000	418.000000	417.000000
mean	1100.500000	2.265550	30.272590	0.447368	0.392344	35.627188
std	120.810458	0.841838	14.181209	0.896760	0.981429	55.907576
min	892.000000	1.000000	0.170000	0.000000	0.000000	0.000000
25%	996.250000	1.000000	21.000000	0.000000	0.000000	7.895800
50%	1100.500000	3.000000	27.000000	0.000000	0.000000	14.454200
75%	1204.750000	3.000000	39.000000	1.000000	0.000000	31.500000
max	1309.000000	3.000000	76.000000	8.000000	9.000000	512.329200

```
train.nunique()
```

	0
PassengerId	891
Survived	2
Pclass	3
Name	891
Sex	2
Age	88
SibSp	7
Parch	7
Ticket	681
Fare	248
Cabin	147
Embarked	3

```
test.nunique()
```

	0
PassengerId	418
Pclass	3
Name	418
Sex	2
Age	79
SibSp	7
Parch	8
Ticket	363
Fare	169
Cabin	76
Embarked	3

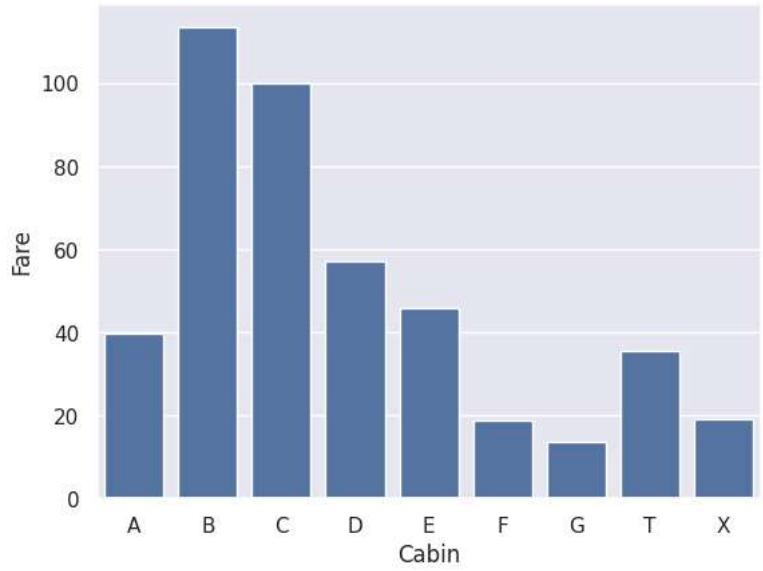
Handling Missing Values

Train Cabin and Fare

```
train['Cabin'].fillna(value='X', inplace=True)
train['Cabin'] = train['Cabin'].str[0]
df_tr = train[['Cabin', 'Fare']].groupby('Cabin').mean().reset_index()
a = sns.barplot(x=df_tr['Cabin'], y=df_tr['Fare'])
```

```
<ipython-input-12-d25661922abb>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignm
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting valu

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].me
```

```
train['Cabin'].fillna(value='X', inplace=True)
```



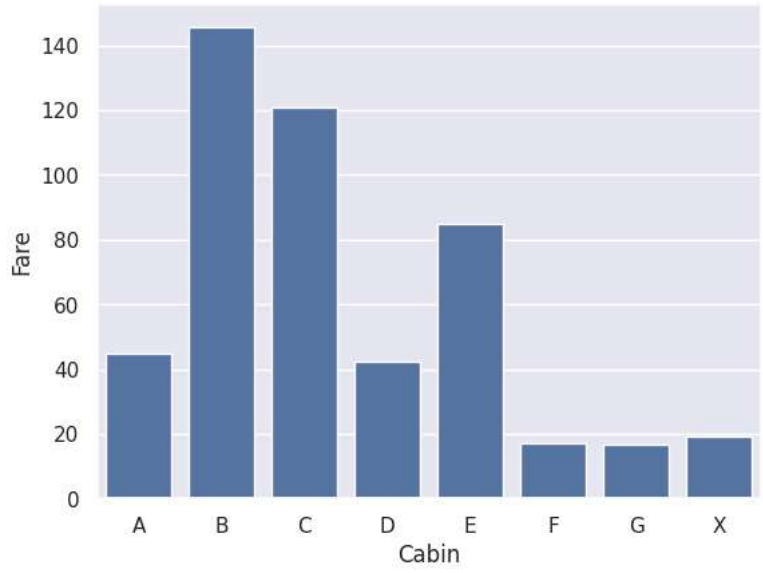

```
## Defining a function which reassigns the cabin according to the fare. After that, it is
## applied to the dataframe to fill all the cabin column's missing value.
def reasign_cabin_tr(cabin_fare):

    cabin = cabin_fare[0]
    fare = cabin_fare[1]

    if cabin == 'X':
        df_tr_copy = df_tr.copy()
        df_tr_copy['Fare'] = abs(df_tr_copy['Fare']-pd.Series([fare]*len(df_tr_copy)))
        minimum = df_tr_copy['Fare'].min()
        return list(df_tr_copy[df_tr_copy['Fare'] == minimum].Cabin)[0]
    return cabin

train['Cabin'] = train[['Cabin', 'Fare']].apply(reasign_cabin_tr, axis=1)
train['Cabin'] = train.Cabin.astype("category").cat.codes
```

```
<ipython-input-13-785eb09eb78f>:5: FutureWarning: Series.__getitem__ treating keys as positions is deprecated. In a future version, inte
  cabin = cabin_fare[0]
<ipython-input-13-785eb09eb78f>:6: FutureWarning: Series.__getitem__ treating keys as positions is deprecated. In a future version, inte
  fare = cabin_fare[1]
```

Train Cabin and Fare

```
test['Fare'].fillna(value=test.Fare.mean(), inplace=True)
test['Cabin'].fillna(value='X', inplace=True)
test['Cabin'] = test['Cabin'].str[0]
df_te = test[['Cabin', 'Fare']].groupby('Cabin').mean().reset_index()
a = sns.barplot(x=df_te['Cabin'], y=df_te['Fare'])
```

```
<ipython-input-14-b51b39c66bc6>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignm
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting valu

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].me


  test['Fare'].fillna(value=test.Fare.mean(), inplace=True)
<ipython-input-14-b51b39c66bc6>:2: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignm
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting valu

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].me


  test['Cabin'].fillna(value='X', inplace=True)
```




```
def reasign_cabin_te(cabin_fare):

    cabin = cabin_fare[0]
    fare = cabin_fare[1]

    if cabin == 'X':
        df_te_copy = df_te.copy()
        df_te_copy['Fare'] = abs(df_te_copy['Fare']-pd.Series([fare]*len(df_te_copy)))
        minimum = df_te_copy['Fare'].min()
        return list(df_te_copy[df_te_copy['Fare'] == minimum].Cabin)[0]
    return cabin

test['Cabin'] = test[['Cabin', 'Fare']].apply(reasign_cabin_te, axis=1)
test['Cabin'] = test.Cabin.astype("category").cat.codes
```

```
<ipython-input-15-c7eb573c60a4>:3: FutureWarning: Series.__getitem__ treating keys as positions is deprecated. In a future version, inte
  cabin = cabin_fare[0]
<ipython-input-15-c7eb573c60a4>:4: FutureWarning: Series.__getitem__ treating keys as positions is deprecated. In a future version, inte
  fare = cabin_fare[1]
```

Train Embarked

```
train['Embarked'] = train.Embarked.fillna(train.Embarked.dropna().max())
```

Train & Test Age from Pclass and Sex

```
# we will guess the age from Pclass and Sex:

guess_ages = np.zeros((2,3))
guess_ages
```

```
array([[0., 0., 0.],
       [0., 0., 0.]])
```

Now we iterate over Sex (0 or 1) and Pclass (1, 2, 3) to calculate guessed values of Age for the six combinations.

```
combine = [train , test]

# Converting Sex categories (male and female) to 0 and 1:
for dataset in combine:
    dataset['Sex'] = dataset['Sex'].map( {'female': 1, 'male': 0} ).astype(int)

# Filling missed age feature:
for dataset in combine:
    for i in range(0, 2):
        for j in range(0, 3):
            guess_df = dataset[(dataset['Sex'] == i) & \
                               (dataset['Pclass'] == j+1)]['Age'].dropna()
            age_guess = guess_df.median()

            # Convert random age float to nearest .5 age
            guess_ages[i,j] = int( age_guess/0.5 + 0.5 ) * 0.5

    for i in range(0, 2):
        for j in range(0, 3):
            dataset.loc[ (dataset.Age.isnull()) & (dataset.Sex == i) & (dataset.Pclass == j+1),\
                    'Age'] = guess_ages[i,j]

    dataset['Age'] = dataset['Age'].astype(int)

train.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	0	22	1	0	A/5 21171	7.2500	6	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	1	38	1	0	PC 17599	71.2833	2	C
2	3	1	3	Heikkinen, Miss. Laina	1	26	0	0	STON/O2. 3101282	7.9250	6	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	1	35	1	0	113803	53.1000	2	S

Next steps: Generate code with train | View recommended plots | New interactive sheet

```
train.isna().sum()
```

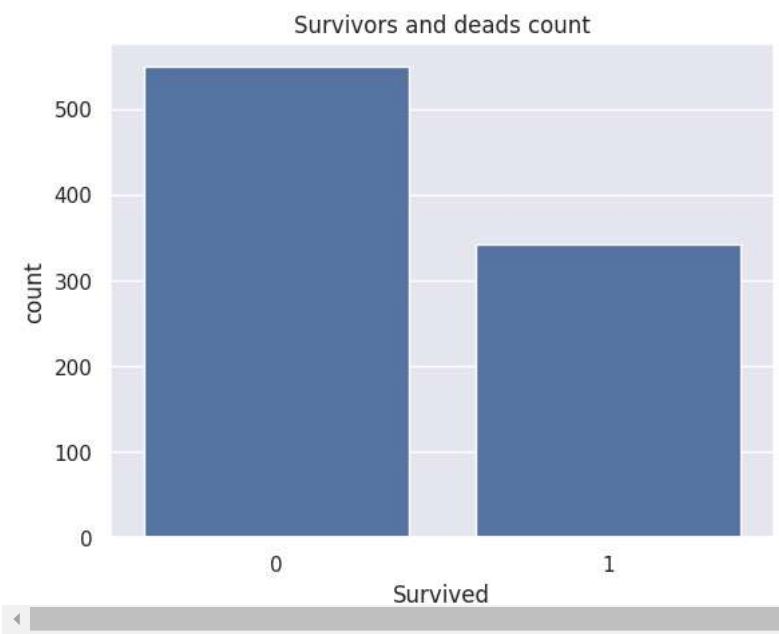
	0
PassengerId	0
Survived	0
Pclass	0
Name	0
Sex	0
Age	0
SibSp	0
Parch	0
Ticket	0
Fare	0
Cabin	0
Embarked	0

```
test.isna().sum()
```

	0
PassengerId	0
Pclass	0
Name	0
Sex	0
Age	0
SibSp	0
Parch	0
Ticket	0
Fare	0
Cabin	0
Embarked	0

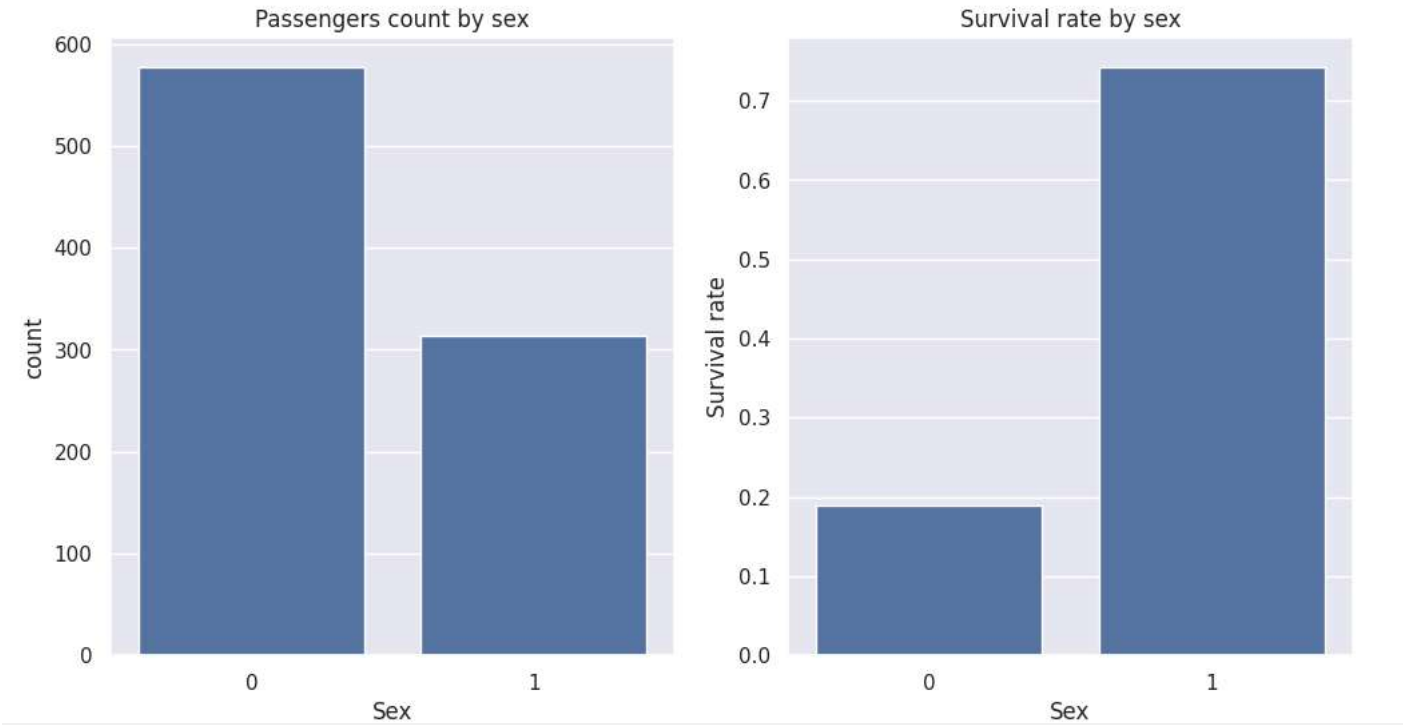
Exploratory Data Analysis

```
g = sns.countplot(x=train['Survived']).set_title('Survivors and deads count')
```



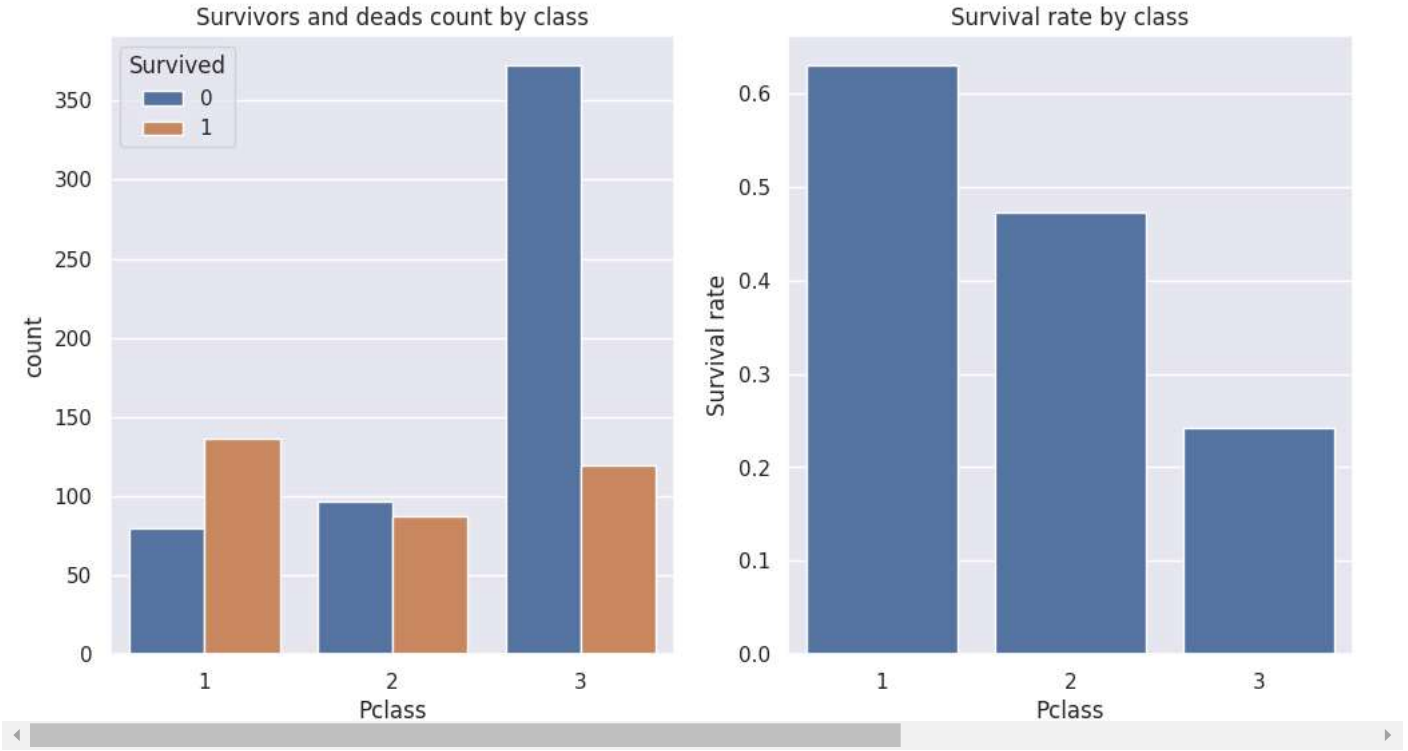

```
# Ladies first??
fig, axarr = plt.subplots(1, 2, figsize=(12,6))
a = sns.countplot(x=train['Sex'], ax=axarr[0]).set_title('Passengers count by sex')
axarr[1].set_title('Survival rate by sex')
b = sns.barplot(x='Sex', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```

```
<ipython-input-22-f93cd1769605>:5: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  b = sns.barplot(x='Sex', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```



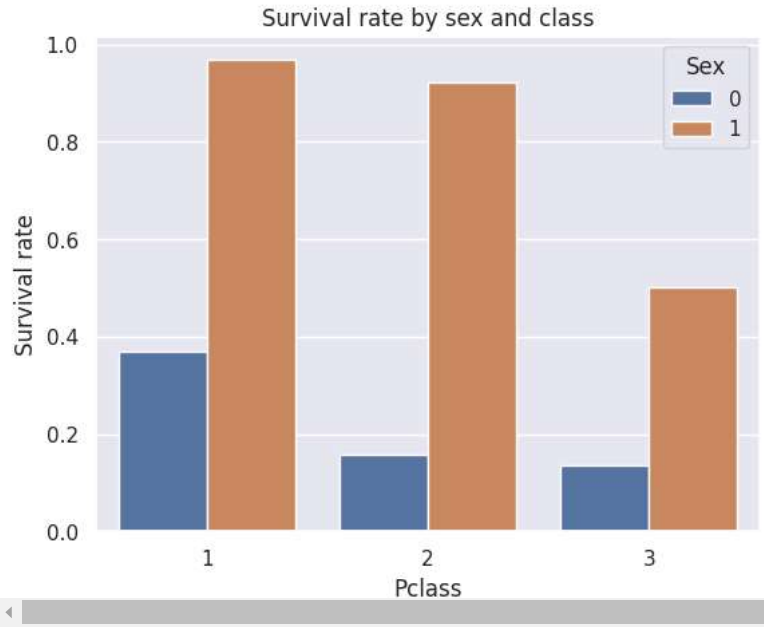

```
# Little dependent on pclass
fig, axarr = plt.subplots(1,2,figsize=(12,6))
a = sns.countplot(x='Pclass', hue='Survived', data=train, ax=axarr[0]).set_title('Survivors and deads count by class')
axarr[1].set_title('Survival rate by class')
b = sns.barplot(x='Pclass', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```

```
<ipython-input-23-53f7e1181ac2>:5: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  b = sns.barplot(x='Pclass', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```

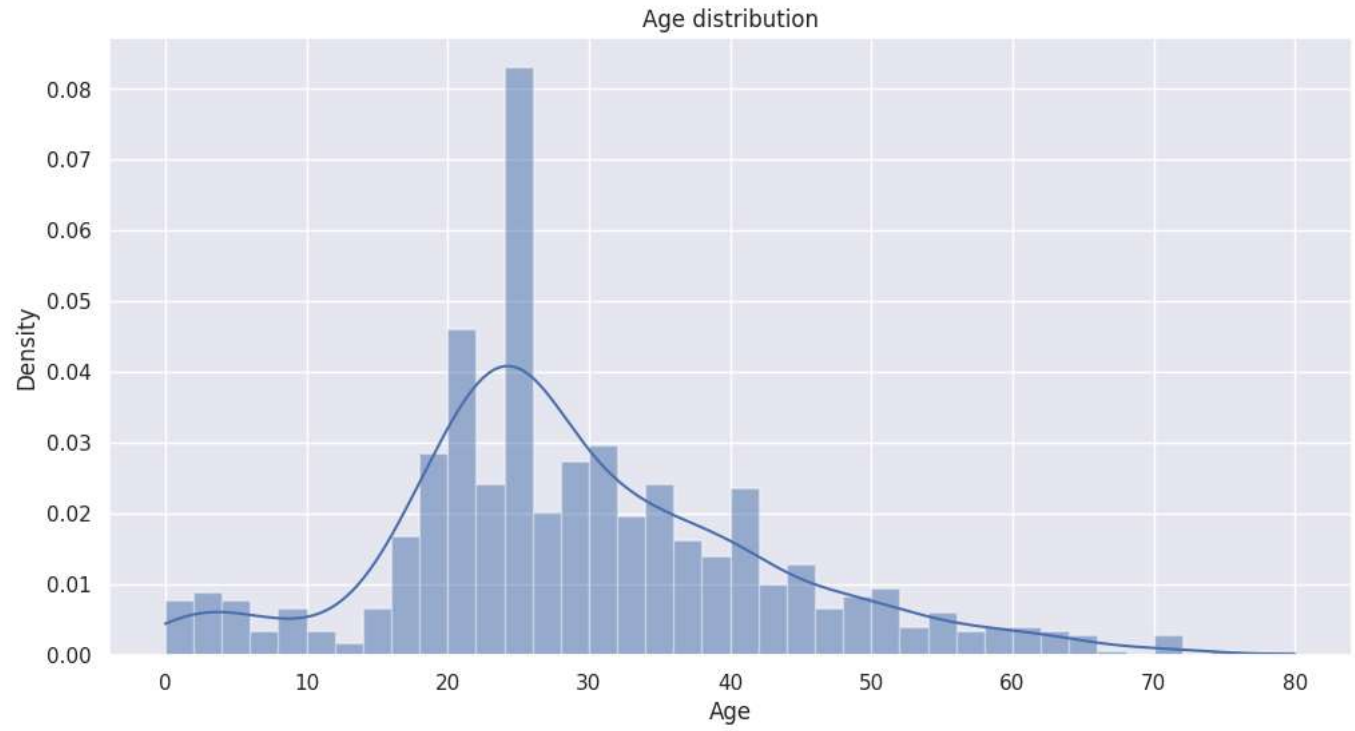


```
plt.title('Survival rate by sex and class')
g = sns.barplot(x='Pclass', y='Survived', hue='Sex', data=train, ci=None).set_ylabel('Survival rate')
```

```
<ipython-input-24-fee7f3ef63fa>:2: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  g = sns.barplot(x='Pclass', y='Survived', hue='Sex', data=train, ci=None).set_ylabel('Survival rate')
```

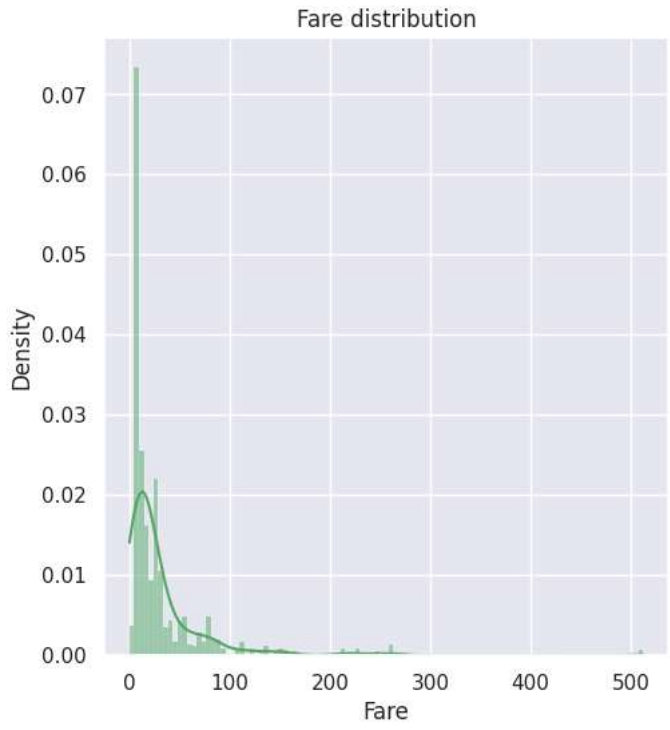


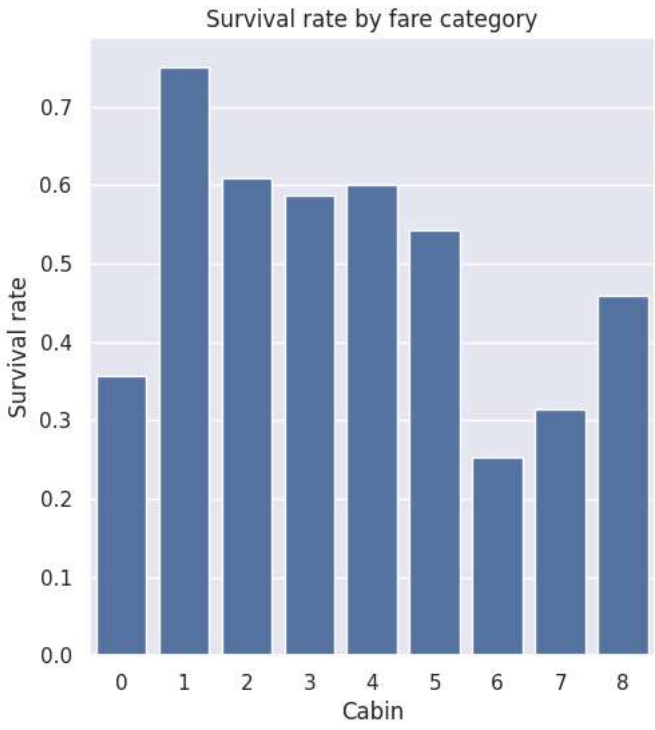

```
# Normal?
fig = plt.figure(figsize=(12,6))
sns.histplot(x=train['Age'], bins=40, kde=True, stat="density", edgecolor=(1,1,1,0.3)).set_title('Age distribution')
plt.show()
```



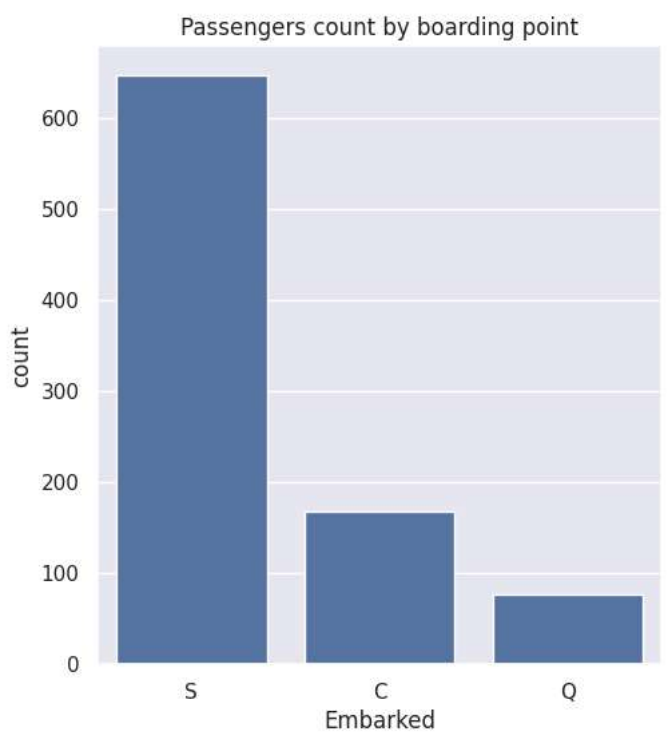

```
fig, axarr = plt.subplots(1,2,figsize=(12,6))
f = sns.histplot(x=train.Fare, color='g', ax=axarr[0], kde=True, stat="density", edgecolor=(1,1,1,0.3)).set_title('Fare distribution')
fare_ranges = pd.qcut(train.Fare, 4, labels = ['Low', 'Mid', 'High', 'Very high'])
axarr[1].set_title('Survival rate by fare category')
g = sns.barplot(x=train['Cabin'], y=train.Survived, ci=None, ).set_ylabel('Survival rate')
```

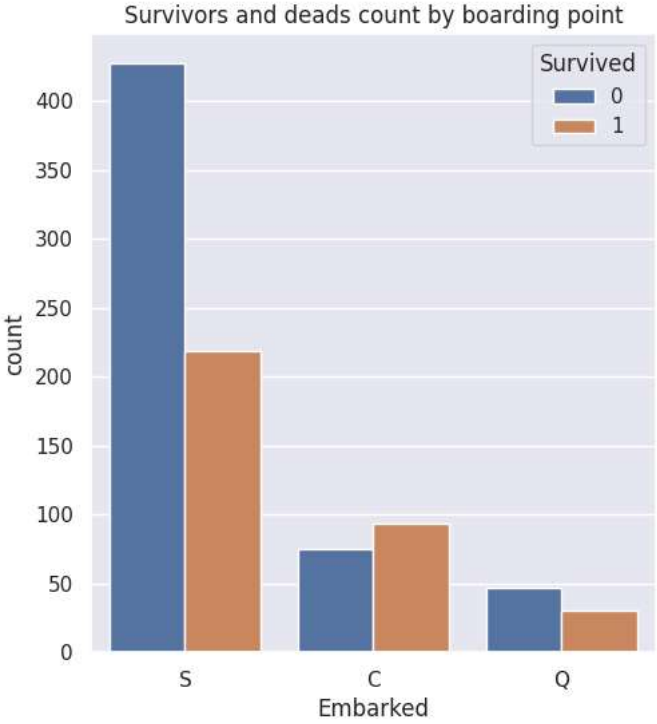
```
<ipython-input-26-0cde58bc4dc5>:5: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  g = sns.barplot(x=train['Cabin'], y=train.Survived, ci=None, ).set_ylabel('Survival rate')
```





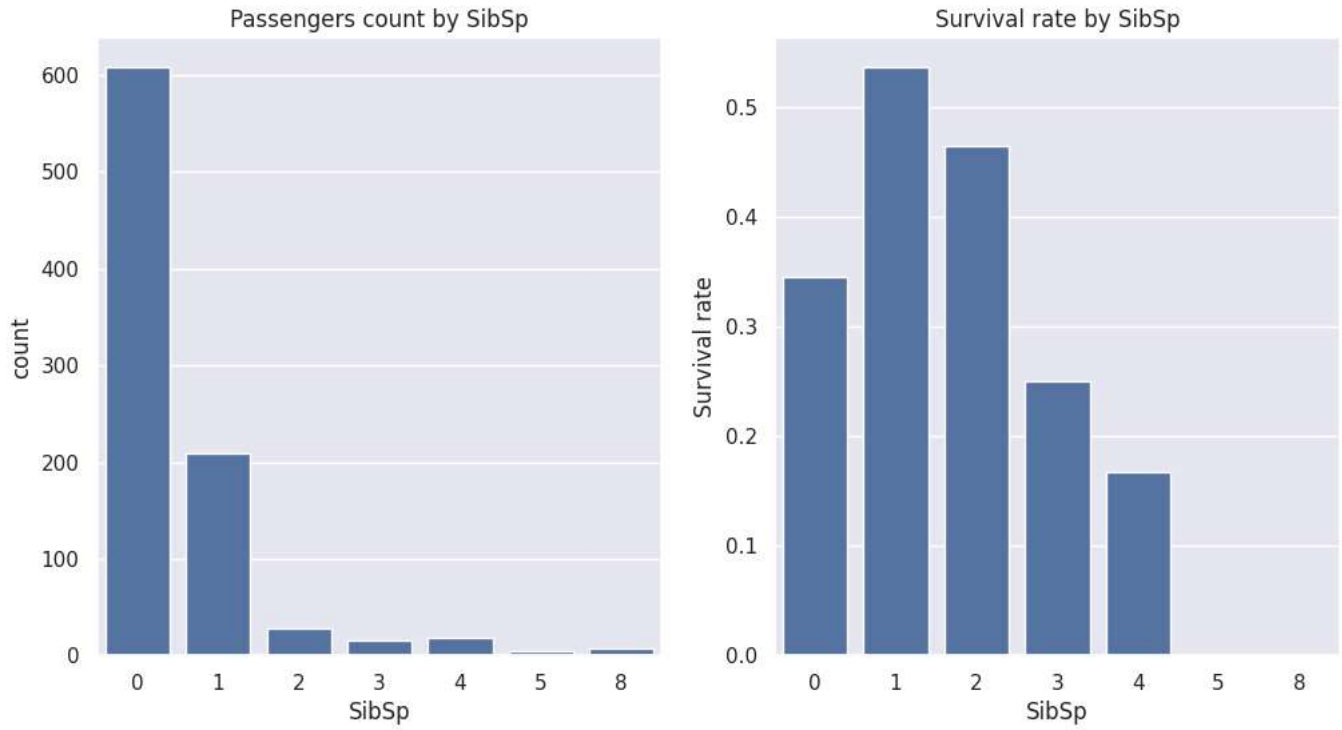

```
fig, axarr = plt.subplots(1,2,figsize=(12,6))
sns.countplot(x=train['Embarked'], ax=axarr[0]).set_title('Passengers count by boarding point')
p = sns.countplot(x = 'Embarked', hue = 'Survived', data = train,
                  ax=axarr[1]).set_title('Survivors and deads count by boarding point')
```





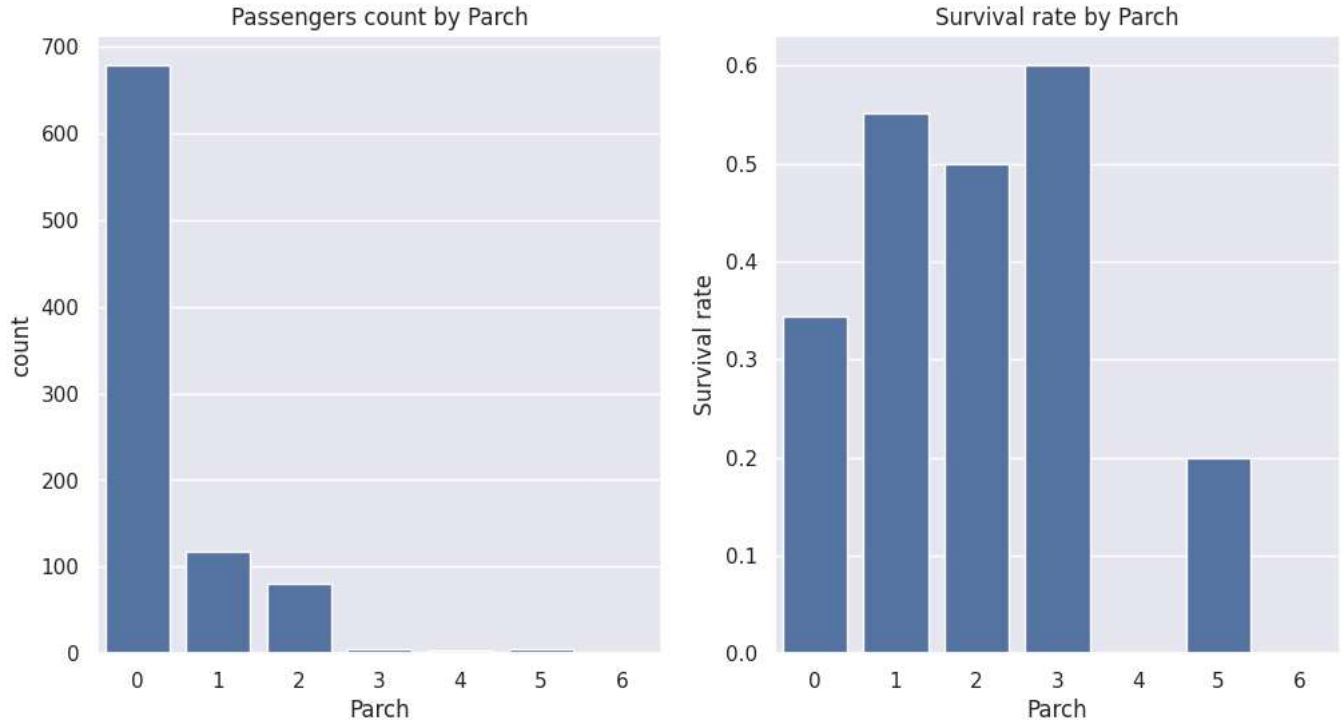

```
fig, axarr = plt.subplots(1,2,figsize=(12,6))
a = sns.countplot(x=train['SibSp'], ax=axarr[0]).set_title('Passengers count by SibSp')
axarr[1].set_title('Survival rate by SibSp')
b = sns.barplot(x='SibSp', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```

```
<ipython-input-28-0c377139206e>:4: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  b = sns.barplot(x='SibSp', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```




```
fig, axarr = plt.subplots(1,2,figsize=(12,6))
a = sns.countplot(x=train['Parch'], ax=axarr[0]).set_title('Passengers count by Parch')
axarr[1].set_title('Survival rate by Parch')
b = sns.barplot(x='Parch', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```

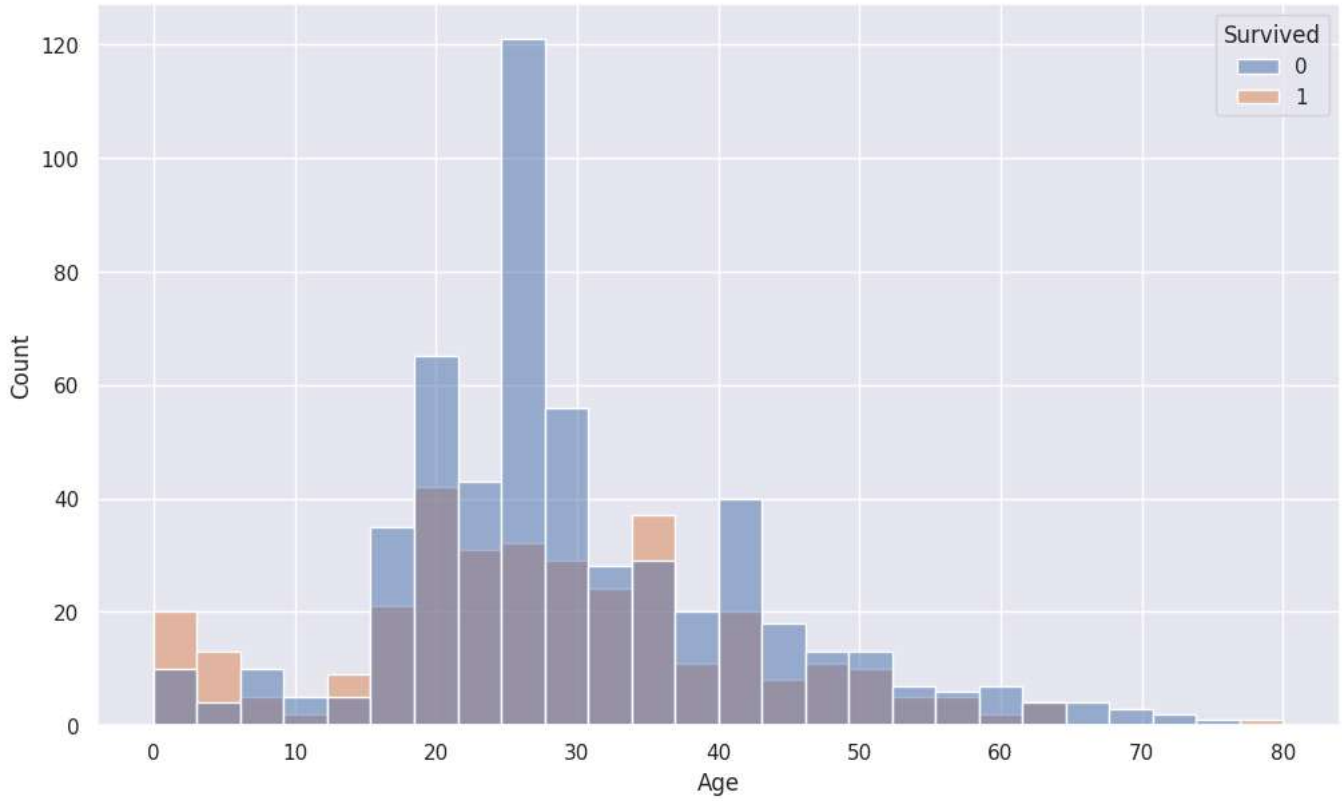
```
<ipython-input-29-2c61737fbf60>:4: FutureWarning:

The `ci` parameter is deprecated. Use `errorbar=None` for the same effect.

  b = sns.barplot(x='Parch', y='Survived', data=train, ax=axarr[1], ci=None).set_ylabel('Survival rate')
```




```
fig = plt.figure(figsize=(12,7))
```

```
sns.histplot(x=train['Age'], hue=train['Survived'])
```

```
<Axes: xlabel='Age', ylabel='Count'>
```




```
fig = plt.figure(figsize=(12,10))
sns.heatmap(train.corr(), annot=True, fmt='.2f')
plt.show()
```

Splitting the Dataset

Training and Test Set

```
train.drop(['PassengerId', 'Name', 'Ticket', 'Parch','Age','SibSp', 'Embarked'], axis=1, inplace=True)
test.drop(['PassengerId', 'Name', 'Ticket', 'Parch','Age','SibSp', 'Embarked'], axis=1, inplace=True)
```

```
train.shape, test.shape
```

```
((891, 5), (418, 4))
```

Separating Label and Features

```
X = train.iloc[:,1:]
y = train.iloc[:,0]
```

```
X_train, X_val, Y_train, Y_val = train_test_split(X, y, test_size=0.2 ,random_state=42)
```

```
ss = StandardScaler()
X_train = ss.fit_transform(X_train)
X_val = ss.transform(X_val)
test = ss.transform(test)
```

Machine Learning model

```
def print_scores(model, X_train, Y_train, predictions, cv_splites=10):
    print("The mean accuracy score of the train data is %.5f" % model.score(X_train, Y_train))
    CV_scores = cross_val_score(model, X_train, Y_train, cv=cv_splites)
    print("The individual cross-validation scores are: \n",CV_scores)
    print("The minimum cross-validation score is %.3f" % min(CV_scores))
    print("The maximum cross-validation score is %.3f" % max(CV_scores))
    print("The  mean   cross-validation score is %.5f ± %0.2f" % (CV_scores.mean(), CV_scores.std() * 2))


depth_range = range(1, 30, 1)
acc_vs_depth = {
    "depth": [],
    "train_acc": [],
    "valid_acc": []
}

for depth in depth_range:
    model = RandomForestClassifier(n_estimators=200, max_depth=depth, max_features=8, min_samples_split=2, random_state=7)
    model.fit(X_train, Y_train)
    X_train_pred = model.predict(X_train)
    X_val_pred = model.predict(X_val)
    acc_vs_depth["depth"].append(depth)
    acc_vs_depth["train_acc"].append((Y_train.to_numpy() == X_train_pred).mean())
    acc_vs_depth["valid_acc"].append((Y_val.to_numpy() == X_val_pred).mean())


acc_vs_depth_df = pd.DataFrame(acc_vs_depth)
acc_vs_depth_df.sample(5)
```

	depth	train_acc	valid_acc
1	2	0.792135	0.765363
9	10	0.908708	0.837989
14	15	0.919944	0.826816
0	1	0.787921	0.782123
23	24	0.919944	0.826816

Plotting results

```
fig = plt.figure(figsize=(10, 7))
plt.plot(acc_vs_depth_df.depth, acc_vs_depth_df.train_acc, label="Train Accuracy")
plt.plot(acc_vs_depth_df.depth, acc_vs_depth_df.valid_acc, label="Validation accuracy")
plt.legend(loc='upper left', frameon=False)
plt.xlabel('Tree Depth')
plt.ylabel('Accuracy')
plt.show()
```