```
import pandas as pd
import numpy as np
import seaborn as snb
from matplotlib import pyplot as plt
from matplotlib import style
from sklearn import linear_model
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC, LinearSVC
from sklearn.naive_bayes import GaussianNB


test_df = pd.read_csv("test.csv")
train_df = pd.read_csv("train.csv")


train_df.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
```

```
train_df.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

```
total = train_df.isnull().sum().sort_values(ascending=False)
percent_1 =train_df.isnull().sum()/train_df.isnull().count()*100
percent_2 = (round(percent_1,1)).sort_values(ascending=False)
missing_data = pd.concat([total, percent_2], axis=1, keys=['Total','%'])
```

```
missing_data.head(5)
```

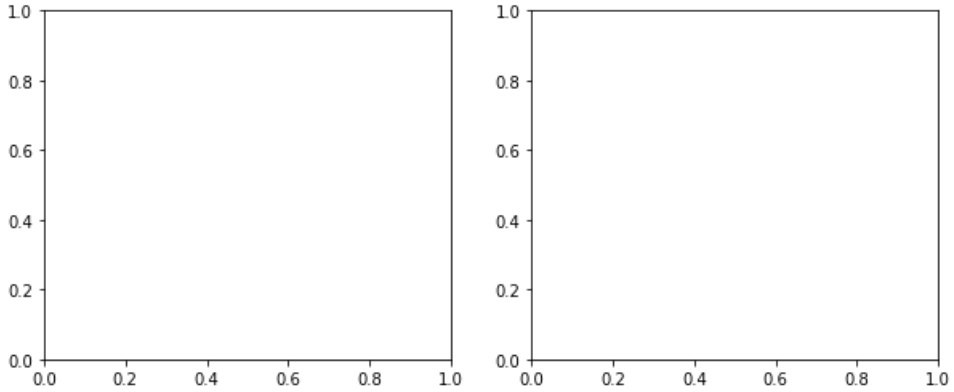
	Total	%
Cabin	687	77.1
Age	177	19.9
Embarked	2	0.2
PassengerId	0	0.0
Survived	0	0.0

```
train_df.columns.values
```

```
array(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'], dtype=object)
```

```
survived ='survived'
not_survived ='not survived'
```

```
fig, axes = plt.subplots(nrows=1, ncols=2,figsize=(10, 4))
```




```
women = train_df[train_df['Sex']=='female']
men = train_df[train_df['Sex']=='male']
```

```
ax = snb.distplot(women[women['Survived']==1].Age.dropna(), bins=18, label = survived,  ax =axes[0], kde =False)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version.
  warnings.warn(msg, FutureWarning)
```

```
ax = snb.distplot(women[women['Survived']==0].Age.dropna(), bins=40, label = not_survived, ax =
axes[0], kde =False)
```

```
ax.legend()
```

```
<matplotlib.legend.Legend at 0x7efc35456f50>
```

```
ax.set_title('Female')
```

```
Text(0.5, 1.0, 'Female')
```

```
ax = snb.distplot(men[men['Survived']==1].Age.dropna(), bins=18, label
= survived, ax = axes[1], kde = False)
```

```
ax = snb.distplot(men[men['Survived']==0].Age.dropna(), bins=40, label
= not_survived, ax = axes[1], kde = False)
```

```
ax.legend()
```

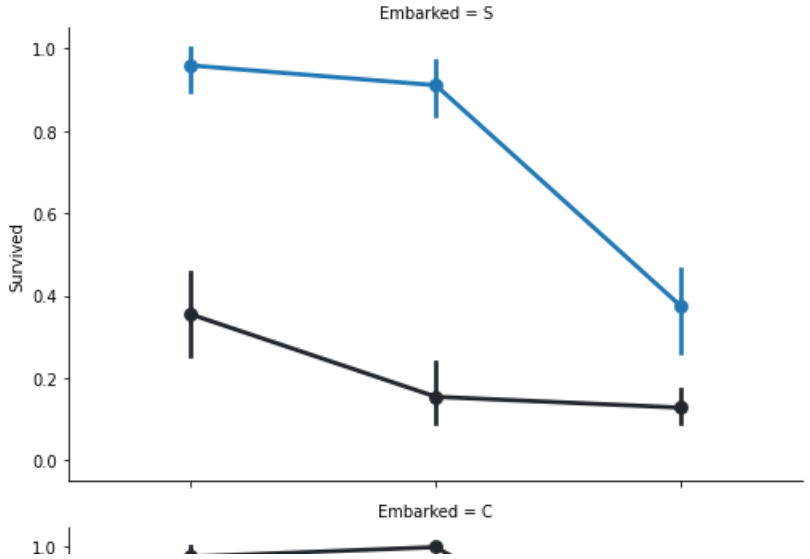
```
<matplotlib.legend.Legend at 0x7efc33155f50>
```

```
ax.set_title('Male')
```

```
Text(0.5, 1.0, 'Male')
```

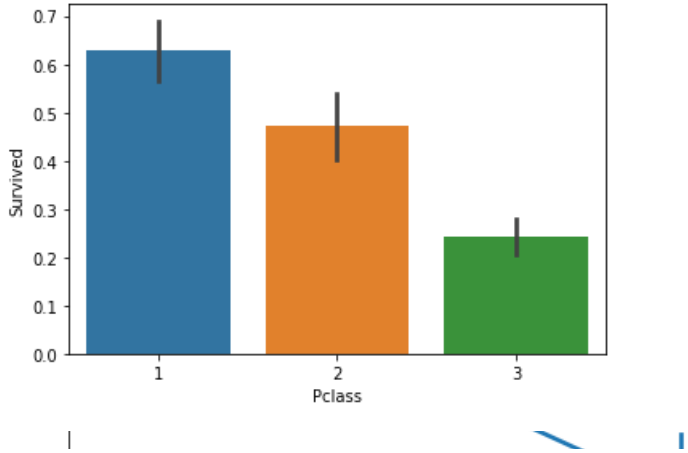
```
FacetGrid = snb.FacetGrid(train_df, row='Embarked', size=4.5, aspect=1.6)
FacetGrid.map(snb.pointplot, 'Pclass', 'Survived', 'Sex',
palette=None, order=None, hue_order=None )
FacetGrid.add_legend()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning: The `size` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
<seaborn.axisgrid.FacetGrid at 0x7efc330e5950>
```



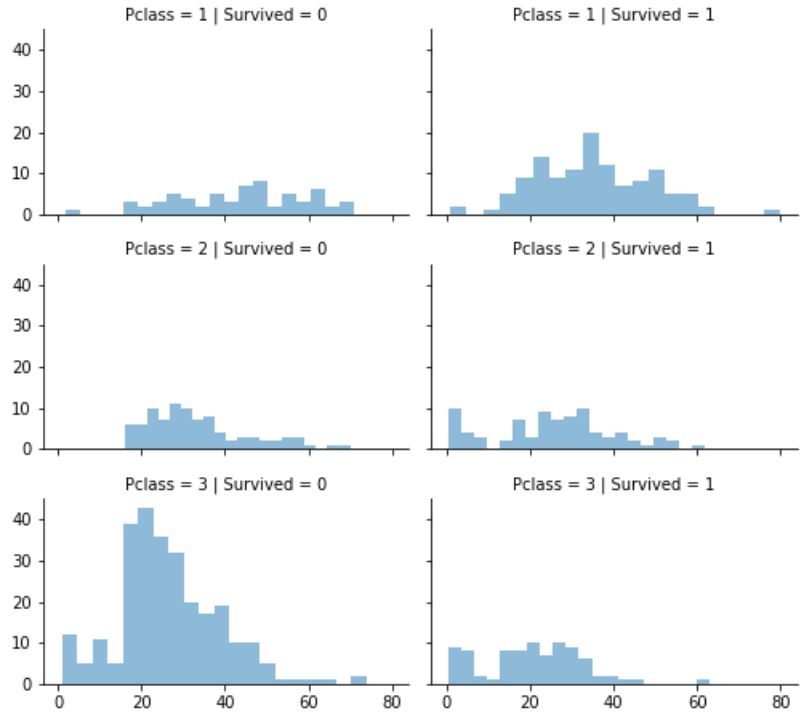

```
snb.barplot(x='Pclass', y='Survived', data=train_df)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7efc306d3650>
```



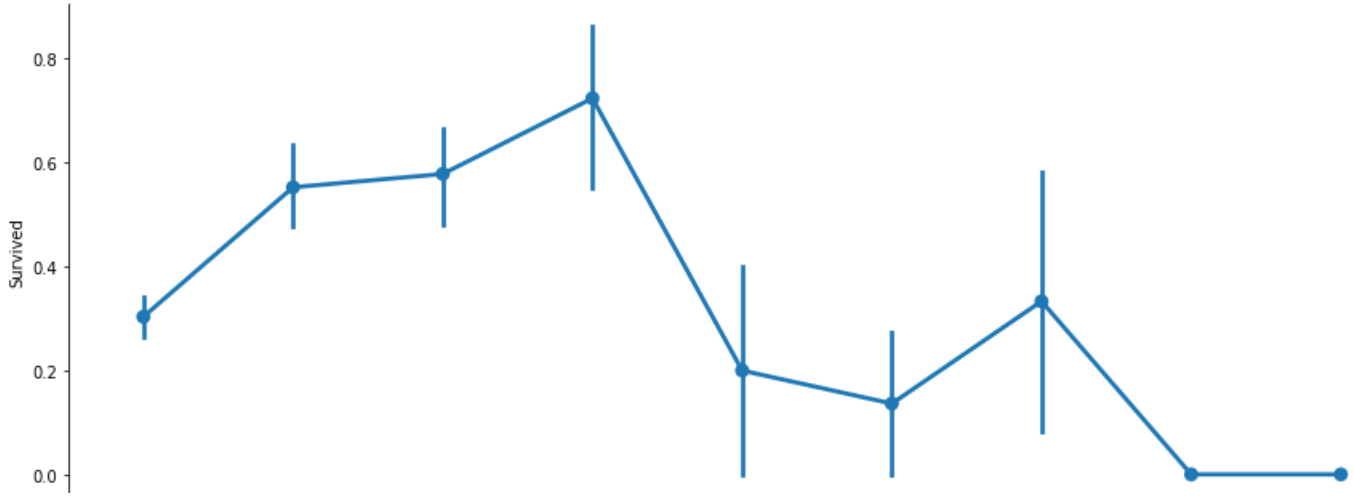

```
grid = snb.FacetGrid(train_df, col='Survived', row='Pclass', size=2.2, aspect=1.6)
grid.map(plt.hist, 'Age', alpha=.5, bins=20)
grid.add_legend();
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning: The `size` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```




```
data = [train_df, test_df]


for dataset in data:
  dataset['relatives'] = dataset['SibSp'] + dataset['Parch']
  dataset.loc[dataset['relatives'] > 0, 'not_alone'] =0
  dataset.loc[dataset['relatives'] == 0, 'not_alone'] = 1
  dataset['not_alone'] =dataset['not_alone'].astype(int)


train_df['not_alone'].value_counts()

    1    537
    0    354
    Name: not_alone, dtype: int64


axes = snb.factorplot('relatives','Survived', data=train_df, aspect = 2.5, )
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/categorical.py:3717: UserWarning: The `factorplot` function has been renamed to `catplot`. The original name will
  warnings.warn(msg)
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only
  FutureWarning
```




```
train_df = train_df.drop(['PassengerId'], axis=1)
```

```
import re
deck = {"A": 1, "B": 2, "C": 3, "D": 4, "E": 5, "F": 6, "G": 7, "U":
8}


data = [train_df, test_df]


for dataset in data:
   dataset['Cabin'] = dataset['Cabin'].fillna("U0")
   dataset['Deck'] = dataset['Cabin'].map(lambda x: re.compile("([azA-Z]+)").search(x).group())
   dataset['Deck'] = dataset['Deck'].map(deck)
   dataset['Deck'] = dataset['Deck'].fillna(0)
   dataset['Deck'] = dataset['Deck'].astype(int)# we can now drop the cabin feature



train_df = train_df.drop(['Cabin'], axis=1)
test_df = test_df.drop(['Cabin'], axis=1)


data = [train_df, test_df]


for dataset in data:
```

```
  mean = train_df["Age"].mean()
  std = test_df["Age"].std()
  is_null = dataset["Age"].isnull().sum()
# compute random numbers between the mean, std and is_null
  rand_age = np.random.randint(mean - std, mean + std, size =
is_null)
# fill NaN values in Age column with random values generated
  age_slice = dataset["Age"].copy()
  age_slice[np.isnan(age_slice)] = rand_age
  dataset["Age"] =age_slice
  dataset["Age"] =train_df["Age"].astype(int)


train_df["Age"].isnull().sum()
```

```
0
```

```
train_df['Embarked'].describe()
```

```
count     889
unique      3
top         S
freq      644
Name: Embarked, dtype: object
```

```
%matplotlib inline
df = pd.read_csv("/content/train.csv")
df['Survived_status']=df['Survived'].apply(lambda x: "No" if x==0 else "Yes")
df.head(4)
```

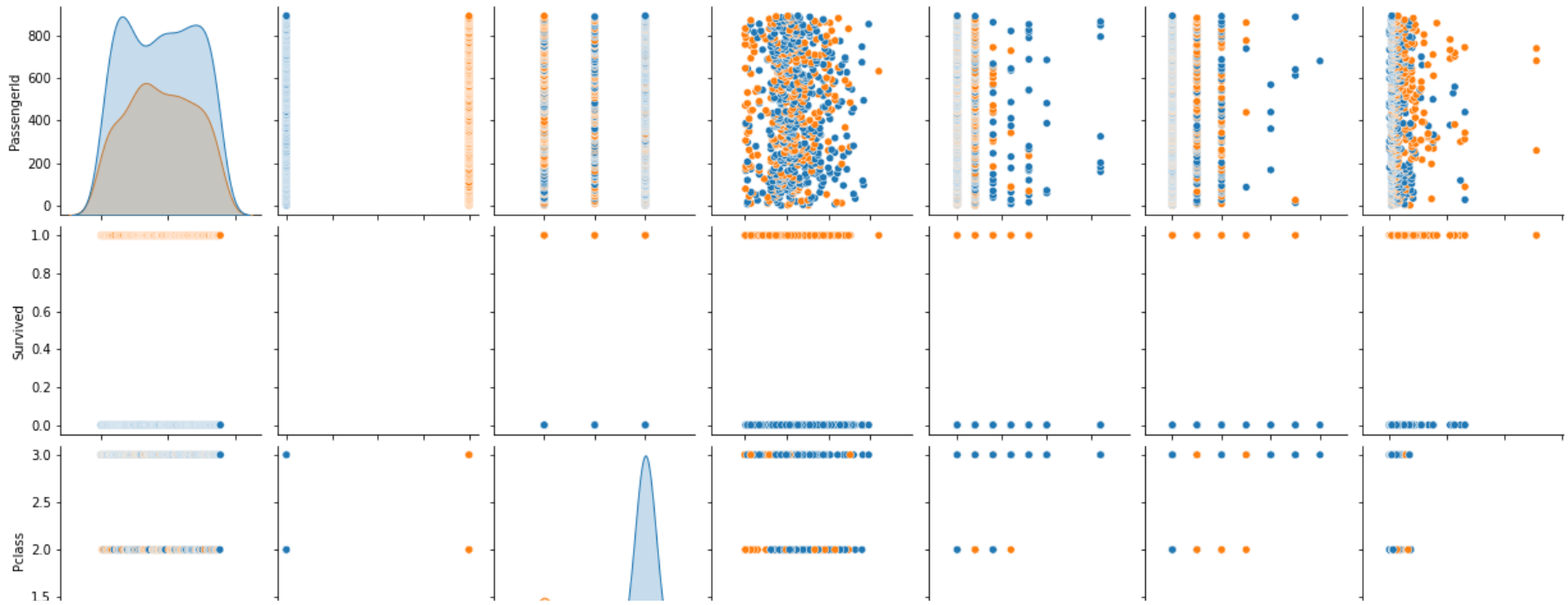
	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	Survived_status
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S	No
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C	Yes
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S	Yes

```
print("Survival Status: \n",df['Survived'].value_counts())
print("Passenger Class: ",*df['Pclass'].unique())
print("Embarked City: ",*df['Embarked'].unique())
print("# of parents / children aboard the Titanic: ",*df['Parch'].unique())
print("# of siblings / spouses aboard the Titanic: ",*df['SibSp'].unique())
```

```
Survival Status:
 0    549
1    342
Name: Survived, dtype: int64
Passenger Class:  3 1 2
Embarked City:  S C Q nan
# of parents / children aboard the Titanic:  0 1 2 5 3 4 6
# of siblings / spouses aboard the Titanic:  1 0 3 4 2 5 8
```

```
import seaborn as sns
sns.pairplot(df,hue='Survived_status')
```

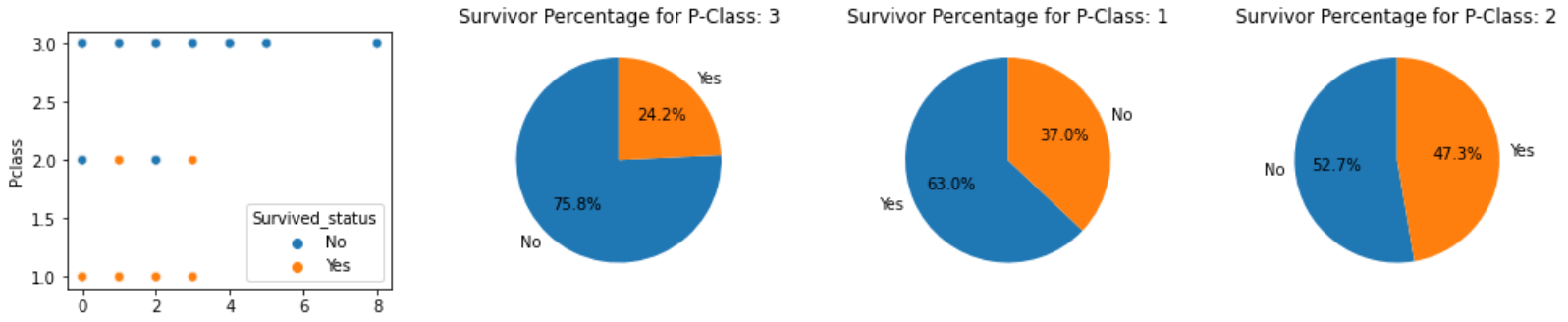
```
<seaborn.axisgrid.PairGrid at 0x7efc30207f90>
```




```
print("Correlation matrix: \n",df.corr())
print("\nHeat Map: \n",sns.heatmap(df.corr(),annot=True))
```

```
Correlation matrix:
             PassengerId  Survived    Pclass       Age     SibSp     Parch  \
PassengerId     1.000000 -0.005007 -0.035144  0.036847 -0.057527 -0.001652
Survived       -0.005007  1.000000 -0.338481 -0.077221 -0.035322  0.081629
Pclass         -0.035144 -0.338481  1.000000 -0.369226  0.083081  0.018443
Age             0.036847 -0.077221 -0.369226  1.000000 -0.308247 -0.189119
SibSp          -0.057527 -0.035322  0.083081 -0.308247  1.000000  0.414838
Parch          -0.001652  0.081629  0.018443 -0.189119  0.414838  1.000000
Fare            0.012658  0.257307 -0.549500  0.096067  0.159651  0.216225

                 Fare
PassengerId  0.012658
Survived     0.257307
Pclass      -0.549500
Age          0.096067
SibSp        0.159651
Parch        0.216225
Fare         1.000000
```

```
fig, axes = plt.subplots(nrows=1, ncols=4, figsize=(17,3))
class_1= df.loc[(df['Pclass']==1) ,:]['Survived_status'].value_counts()
class_2= df.loc[(df['Pclass']==2) ,:]['Survived_status'].value_counts()
class_3= df.loc[(df['Pclass']==3) ,:]['Survived_status'].value_counts()
plt.subplot(1,4,1)
sns.scatterplot(x='SibSp',y='Pclass',data=df,hue='Survived_status').set(title="")
plt.subplot(1,4,2)
plt.pie(class_3.values,labels=class_3.index,autopct='%1.1f%%',startangle = 90)
plt.title("Survivor Percentage for P-Class: 3")
plt.subplot(1,4,3)
plt.pie(class_1.values,labels=class_1.index,autopct='%1.1f%%',startangle = 90)
plt.title("Survivor Percentage for P-Class: 1")
plt.subplot(1,4,4)
plt.pie(class_2.values,labels=class_2.index,autopct='%1.1f%%',startangle = 90)
plt.title("Survivor Percentage for P-Class: 2")
plt.show()
```




```
x = df.copy()
```

```
x['generations'] = df['Age'].apply(lambda x: "young" if x<=20 else "adult" if x<=50 else "old")
pd.DataFrame(x.groupby(['Pclass','Sex','generations','Survived_status'])['Fare'].describe())
```

				count	mean	std	min	25%	50%	75%	max
Pclass	Sex	generations	Survived_status								
1	female	adult	No	2.0	90.131250	86.859229	28.7125	59.421875	90.13125	120.840625	151.5500
			Yes	56.0	113.639659	84.547919	25.9292	57.716700	83.31665	135.633300	512.3292
		old	Yes	22.0	85.552836	33.815546	26.5500	63.362500	78.73335	92.401050	153.4625
		young	No	1.0	151.550000	NaN	151.5500	151.550000	151.55000	151.550000	151.5500
			Yes	13.0	107.540708	78.028584	26.2833	57.000000	86.50000	120.000000	262.3750
	male	adult	No	37.0	64.187381	53.674081	0.0000	29.700000	52.00000	79.200000	247.5208
			Yes	31.0	81.947994	118.470239	26.2875	26.550000	52.55420	76.729200	512.3292
		old	No	37.0	55.215541	59.129922	0.0000	26.550000	32.32080	52.000000	263.0000
			Yes	10.0	35.400000	15.684157	26.5500	29.775000	30.25000	34.250000	79.2000
		young	No	3.0	141.666667	108.718643	53.1000	81.000000	108.90000	185.950000	263.0000

```
pclass_age = pd.DataFrame(df.groupby('Pclass').describe()[['Age','Fare']].reset_index())
print(df.loc[df['Fare']==0.0,:].groupby('Pclass').describe().iloc[:,0])
print(df.loc[df['Fare']==0.0,:].groupby('Sex').describe().iloc[:,0])
pclass_age
```

```
Pclass
1    5.0
2    6.0
3    4.0
Name: (PassengerId, count), dtype: float64
Sex
male    15.0
Name: (PassengerId, count), dtype: float64
```

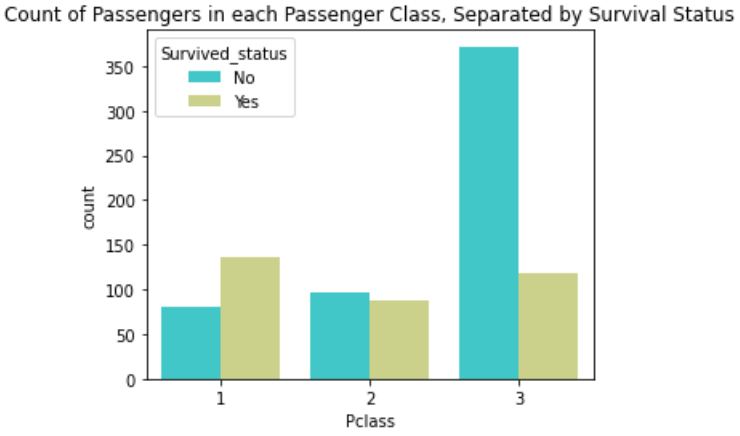
	Pclass	Age							Fare							
		count	mean	std	min	25%	50%	75%	max	count	mean	std	min	25%	50%	75%	max
0	1	186.0	38.233441	14.802856	0.92	27.0	37.0	49.0	80.0	216.0	84.154687	78.380373	0.0	30.92395	60.2875	93.5	512.3292
1	2	173.0	29.877630	14.001077	0.67	23.0	29.0	36.0	70.0	184.0	20.662183	13.417399	0.0	13.00000	14.2500	26.0	73.5000
2	3	355.0	25.140620	12.495398	0.42	18.0	24.0	32.0	74.0	491.0	13.675550	11.778142	0.0	7.75000	8.0500	15.5	69.5500

									Yes	26.0	11.685900	5.854416	7.2250	7.750000	7.85420	15.500000	24.1500

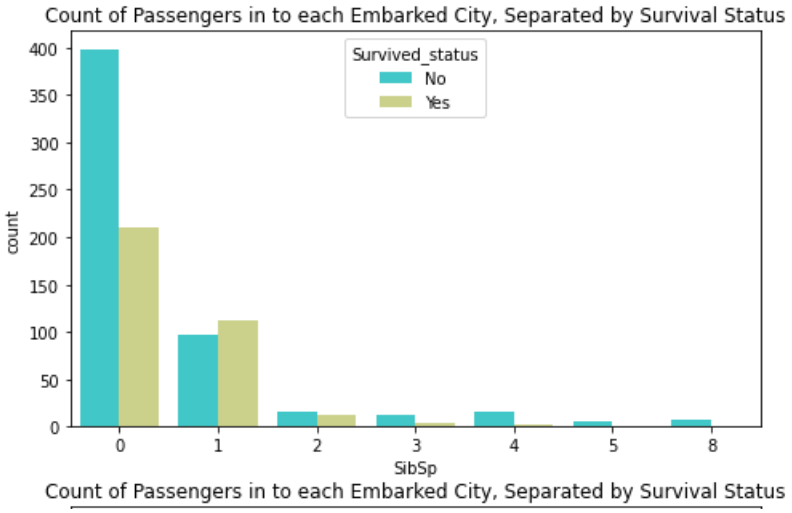
```
pd.DataFrame(df[df['Fare']==0].groupby(['Embarked','Sex','Survived'])['Fare'].describe())
```

			count	mean	std	min	25%	50%	75%	max
Embarked	**Sex**	**Survived**								
S	**male**	**0**	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1	1.0	0.0	NaN	0.0	0.0	0.0	0.0	0.0

```
plt.figure(figsize=(5,4))
sns.countplot(x='Pclass',data=df, palette='rainbow',hue='Survived_status').set(title="Count of Passengers in each Passenger Class, Separated by Survival Status")
plt.show()
```



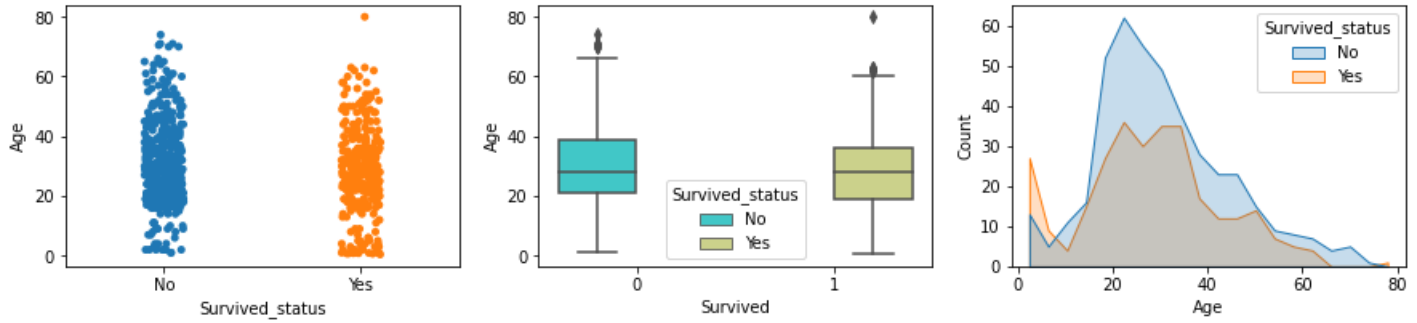

```
fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(17,10))
sns.countplot(x='Embarked',data=df, palette='rainbow',hue='Survived_status',ax=axes[0][0]).set(title="Count of Passengers in to each Embarked City, Separated by Survi
sns.countplot(x='SibSp',data=df, palette='rainbow',hue='Survived_status',ax=axes[0][1]).set(title="Count of Passengers in to each Embarked City, Separated by Survival
sns.countplot(x='Parch',data=df, palette='rainbow',hue='Survived_status',ax=axes[1][0]).set(title="Count of Passengers in to each Embarked City, Separated by Survival
sns.countplot(x='Embarked',data=df, palette='rainbow',hue='Sex',ax=axes[1][1]).set(title="Count of Passengers in to each Embarked City, Separated by Survival Status")
plt.show()
```



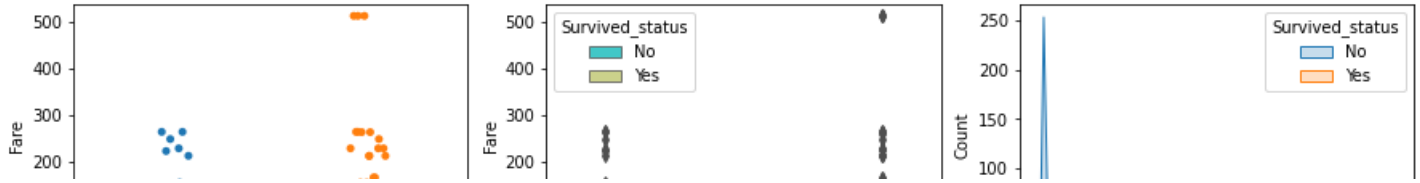
Count of Passengers in to each Embarked City, Separated by Survival Status
Count of Passengers in to each Embarked City, Separated by Survival Status

```
fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(15,3))
sns.stripplot(x='Survived_status', y='Age', data=df,ax=axes[0])
sns.boxplot(x='Survived',y='Age',hue='Survived_status',data=df, palette='rainbow',ax=axes[1])
sns.histplot(data=df,x='Age',ax=axes[2],hue='Survived_status',element="poly")
```

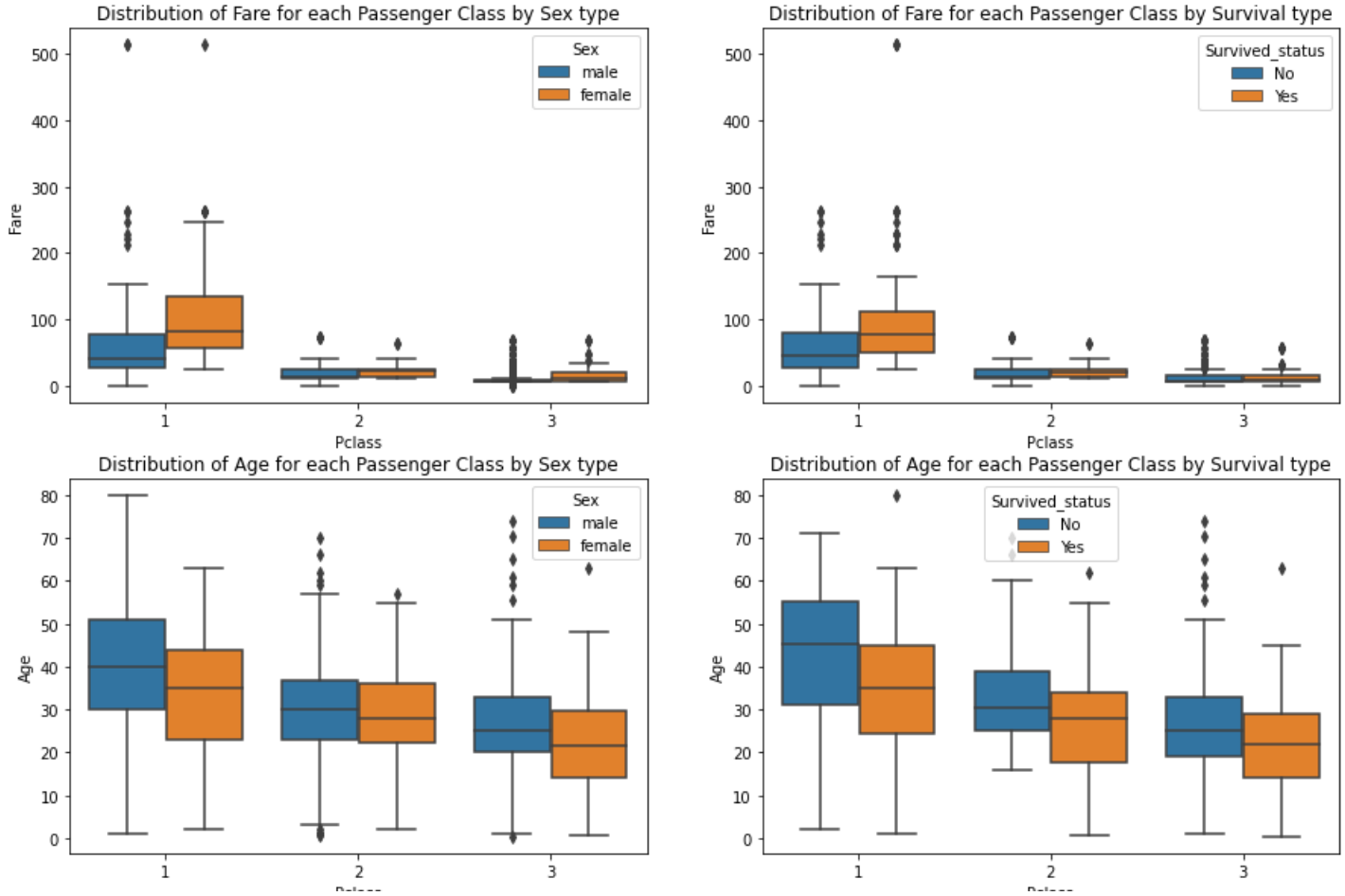
```
<matplotlib.axes._subplots.AxesSubplot at 0x7efc2d0781d0>
```




```
fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(15,3))
sns.stripplot(x='Survived_status', y='Fare', data=df,ax=axes[0])
sns.boxplot(x='Survived_status',y='Fare',hue='Survived_status',data=df, palette='rainbow',ax=axes[1])
sns.histplot(data=df,x='Fare',ax=axes[2],hue='Survived_status',bins=100,kde=True,element='poly')
plt.show()
```

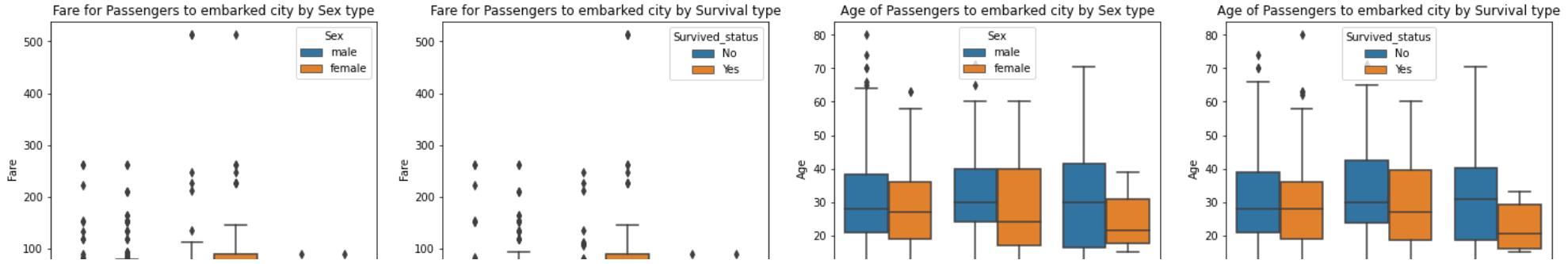



```
fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(15,10))
sns.boxplot(data=df,x='Pclass',y='Fare',hue='Sex',ax=axes[0][0]).set(title="Distribution of Fare for each Passenger Class by Sex type")
sns.boxplot(data=df,x='Pclass',y='Fare',hue='Survived_status',ax=axes[0][1]).set(title="Distribution of Fare for each Passenger Class by Survival type")
sns.boxplot(data=df,x='Pclass',y='Age',hue='Sex',ax=axes[1][0]).set(title="Distribution of Age for each Passenger Class by Sex type")
sns.boxplot(data=df,x='Pclass',y='Age',hue='Survived_status',ax=axes[1][1]).set(title="Distribution of Age for each Passenger Class by Survival type")
plt.show()
```

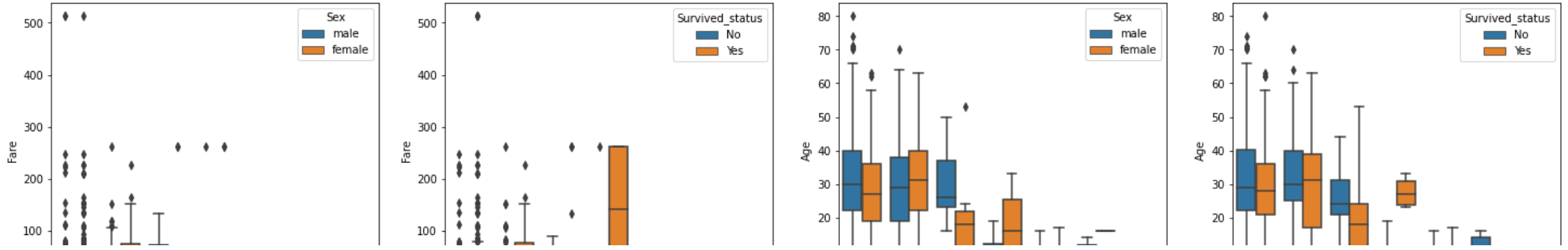



```
fig, axes = plt.subplots(nrows=1, ncols=4, figsize=(25,5))
```

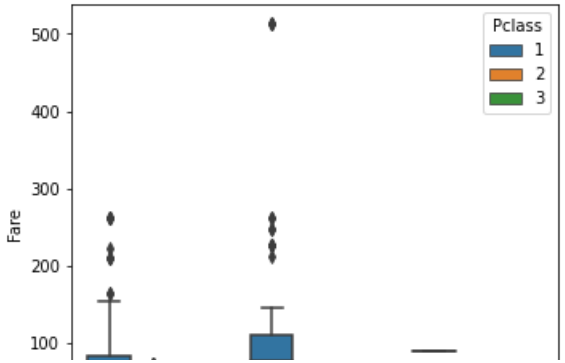
```
sns.boxplot(data=df,x='Embarked',y='Fare',hue='Sex',ax=axes[0]).set(title="Fare for Passengers to embarked city by Sex type")
sns.boxplot(data=df,x='Embarked',y='Fare',hue='Survived_status',ax=axes[1]).set(title="Fare for Passengers to embarked city by Survival type")
sns.boxplot(data=df,x='Embarked',y='Age',hue='Sex',ax=axes[2]).set(title="Age of Passengers to embarked city by Sex type")
sns.boxplot(data=df,x='Embarked',y='Age',hue='Survived_status',ax=axes[3]).set(title="Age of Passengers to embarked city by Survival type")
plt.show()
```

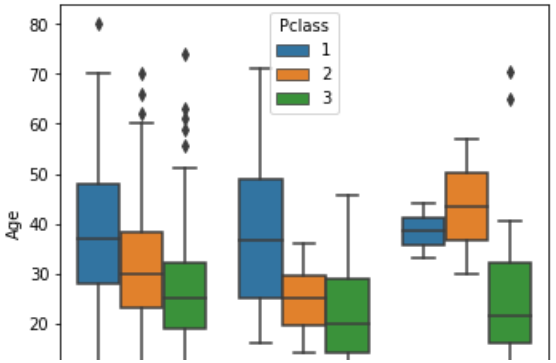



```
fig, axes = plt.subplots(nrows=1, ncols=4, figsize=(25,5))
sns.boxplot(data=df,x='SibSp',y='Fare',hue='Sex',ax=axes[0])
sns.boxplot(data=df,x='SibSp',y='Fare',hue='Survived_status',ax=axes[1])
sns.boxplot(data=df,x='SibSp',y='Age',hue='Sex',ax=axes[2])
sns.boxplot(data=df,x='SibSp',y='Age',hue='Survived_status',ax=axes[3])
plt.show()
```



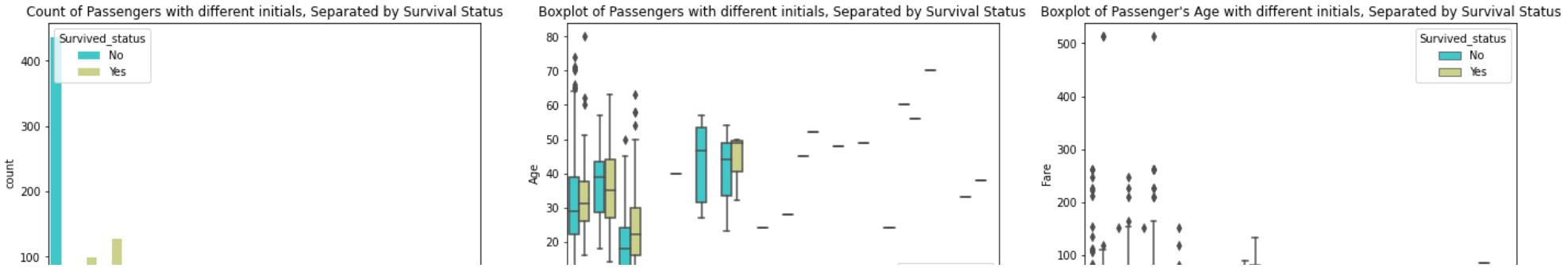

```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(12,5))
sns.boxplot(data=df,x='Embarked',y='Fare',hue='Pclass',ax=axes[0])
sns.boxplot(data=df,x='Embarked',y='Age',hue='Pclass',ax=axes[1])
plt.show()
```






```
df['initials'] = df['Name'].apply(lambda x: x.split(", ")[1].split(".")[0])
```

```
fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(24,5))
sns.countplot(x='initials',data=df, palette='rainbow',hue='Survived_status',ax=axes[0]).set(title="Count of Passengers with different initials, Separated by Survival S
sns.boxplot(x='initials',y='Age',data=df, palette='rainbow',hue='Survived_status',ax=axes[1]).set(title="Boxplot of Passengers with different initials, Separated by Su
sns.boxplot(x='initials',y='Fare',data=df, palette='rainbow',hue='Survived_status',ax=axes[2]).set(title="Boxplot of Passenger's Age with different initials, Separated
plt.show()
```




```
df[df['Cabin']=="G6"]
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	Survived_status	initials
10	11	1	3	Sandstrom, Miss. Marguerite Rut	female	4.0	1	1	PP 9549	16.7000	G6	S	Yes	Miss
205	206	0	3	Strom, Miss. Telma Matilda	female	2.0	0	1	347054	10.4625	G6	S	No	Miss
251	252	0	3	Strom, Mrs. Wilhelm (Elna Matilda Persson)	female	29.0	1	1	347054	10.4625	G6	S	No	Mrs
394	395	1	3	Sandstrom, Mrs. Hjalmar (Agnes Charlotta Bengt...	female	24.0	0	2	PP 9549	16.7000	G6	S	Yes	Mrs

```
df[df['Cabin']=='B28']
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	Survived_status	initials
61	62	1	1	Icard, Miss. Amelie	female	38.0	0	0	113572	80.0	B28	NaN	Yes	Miss
829	830	1	1	Stone, Mrs. George Nelson (Martha Evelyn)	female	62.0	0	0	113572	80.0	B28	NaN	Yes	Mrs

```
df.groupby(['Embarked','Survived_status'])['Fare'].describe()['count']
```

```
Embarked  Survived_status
C         No                 75.0
          Yes                93.0
Q         No                 47.0
          Yes                30.0
S         No                427.0
          Yes               217.0
Name: count, dtype: float64
```

```
cab = df['Cabin'].value_counts()[df['Cabin'].value_counts()>1].index
```

```
multiple_families_cabin = []
for cabin in df['Cabin'].unique():
    families = list(set(df[df['Cabin']==cabin]['Name'].apply(lambda x: x.split(",")[0]).values))
    if len(families)>1:
        multiple_families_cabin.append(cabin)
df['Surname'] = df['Name'].apply(lambda x: x.split(",")[0])
print("Cabin having multiple Families: ",multiple_families_cabin)
df[df['Cabin'].isin(multiple_families_cabin)].groupby(['Cabin','Ticket','Embarked','Surname','Survived_status'])['Fare'].describe()[['count','50%']]
```

```
Cabin having multiple Families:  ['G6', 'C52', 'B28', 'F33', 'F G73', 'E101', 'E33', 'B77', 'C125', 'D', 'C124', 'B35', 'D20', 'E25', 'B51 B53 B55', 'B5', 'E24',
```

					count	50%
Cabin	**Ticket**	**Embarked**	**Surname**	**Survived_status**		
B35	**PC 17477**	**C**	**Aubart**	**Yes**	1.0	69.3000
			Sagesser	**Yes**	1.0	69.3000
B5	**24160**	**S**	**Allen**	**Yes**	1.0	211.3375
			Madill	**Yes**	1.0	211.3375
B51 B53 B55	**695**	**S**	**Carlsson**	**No**	1.0	5.0000
	PC 17755	**C**	**Cardeza**	**Yes**	1.0	512.3292
B77	**110152**	**S**	**Cherry**	**Yes**	1.0	86.5000
			Rothes	**Yes**	1.0	86.5000
C124	**113028**	**S**	**Klaber**	**No**	1.0	26.5500
	113043	**S**	**Partner**	**No**	1.0	28.5000
C125	**PC 17582**	**S**	**Graham**	**Yes**	1.0	153.4625
			Shutes	**Yes**	1.0	153.4625
C52	**110564**	**S**	**Bjornstrom-Steffansson**	**Yes**	1.0	26.5500
	19947	**S**	**Woolner**	**Yes**	1.0	35.5000
D	**28551**	**S**	**Ball**	**Yes**	1.0	13.0000

```
df_pclass1 = df[df['Pclass']==1]

survivor_pclass = pd.DataFrame(df_pclass1['Survived_status'].unique(),columns=['Survived'])
survivor_pclass[['Male','female']] = None
survivor_pclass.loc[survivor_pclass['Survived']=='No','Male']=df_pclass1.loc[(df_pclass1['Survived_status']=='No') & (df_pclass1['Sex']=='male'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='No','female']=df_pclass1.loc[(df_pclass1['Survived_status']=='No') & (df_pclass1['Sex']=='female'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','Male']=df_pclass1.loc[(df_pclass1['Survived_status']=='Yes') & (df_pclass1['Sex']=='male'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','female']=df_pclass1.loc[(df_pclass1['Survived_status']=='Yes') & (df_pclass1['Sex']=='female'),].shape[0]

from scipy.stats import chi2_contingency
def contigency_independence(df):
  return chi2_contingency(np.matrix(df))

print("\nContigency Table for Pclass-1, relation between Survival & Gender\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(survivor_pclass[survivor_pclass.columns[1:]])[1])
```

```
Contigency Table for Pclass-1, relation between Survival & Gender

   Survived Male female
0      Yes   45     91
1       No   77      3

Chi-Square Test for Independence, p-value :  5.603075003861579e-19
```

F G73 348123 S Moen No 1.0 7.6500

```
df_pclass2 = df[df['Pclass']==3]

survivor_pclass = pd.DataFrame(df_pclass2['Survived_status'].unique(),columns=['Survived'])
survivor_pclass[['Male','female']] = None
survivor_pclass.loc[survivor_pclass['Survived']=='No','Male']=df_pclass2.loc[(df_pclass2['Survived_status']=='No') & (df_pclass2['Sex']=='male'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='No','female']=df_pclass2.loc[(df_pclass2['Survived_status']=='No') & (df_pclass2['Sex']=='female'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','Male']=df_pclass2.loc[(df_pclass2['Survived_status']=='Yes') & (df_pclass2['Sex']=='male'),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','female']=df_pclass2.loc[(df_pclass2['Survived_status']=='Yes') & (df_pclass2['Sex']=='female'),].shape[0]

print("\nContigency Table for Pclass-3, relation between Survival & Gender\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(survivor_pclass[survivor_pclass.columns[1:]])[1])


Contigency Table for Pclass-3, relation between Survival & Gender

   Survived Male female
0       No  300     72
1      Yes   47     72

Chi-Square Test for Independence, p-value :  2.52620586012811e-17


survivor_pclass = pd.DataFrame(df['Survived_status'].unique(),columns=['Survived'])
survivor_pclass[['Pclass=1','Pclass=2','Pclass=3']] = None
survivor_pclass.loc[survivor_pclass['Survived']=='No','Pclass=1']=df.loc[(df['Survived_status']=='No') & (df['Pclass']==1),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='No','Pclass=2']=df.loc[(df['Survived_status']=='No') & (df['Pclass']==2),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='No','Pclass=3']=df.loc[(df['Survived_status']=='No') & (df['Pclass']==3),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','Pclass=1']=df.loc[(df['Survived_status']=='Yes') & (df['Pclass']==1),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','Pclass=2']=df.loc[(df['Survived_status']=='Yes') & (df['Pclass']==2),].shape[0]
survivor_pclass.loc[survivor_pclass['Survived']=='Yes','Pclass=3']=df.loc[(df['Survived_status']=='Yes') & (df['Pclass']==3),].shape[0]


print("\nContigency Table : relation between Survival & Pclass\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(survivor_pclass[survivor_pclass.columns[1:]])[1])


Contigency Table : relation between Survival & Pclass

   Survived Pclass=1 Pclass=2 Pclass=3
0       No       80       97      372
```

```
1      Yes      136       87      119

Chi-Square Test for Independence, p-value :  4.549251711298793e-23
```

```
survivor_gender = pd.DataFrame(df['Survived_status'].unique(),columns=['Survived'])
survivor_gender[['female','male']] = None
survivor_gender.loc[survivor_gender['Survived']=='No','female']=df.loc[(df['Survived_status']=='No') & (df['Sex']=='female'),].shape[0]
survivor_gender.loc[survivor_gender['Survived']=='No','male']=df.loc[(df['Survived_status']=='No') & (df['Sex']=='male'),].shape[0]
survivor_gender.loc[survivor_gender['Survived']=='Yes','female']=df.loc[(df['Survived_status']=='Yes') & (df['Sex']=='female'),].shape[0]
survivor_gender.loc[survivor_gender['Survived']=='Yes','male']=df.loc[(df['Survived_status']=='Yes') & (df['Sex']=='male'),].shape[0]
survivor_gender

print("\nContigency Table : relation between Survival & Gender\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(survivor_gender[survivor_gender.columns[1:]])[1])
```

```
Contigency Table : relation between Survival & Gender

   Survived Pclass=1 Pclass=2 Pclass=3
0       No       80       97      372
1      Yes      136       87      119

Chi-Square Test for Independence, p-value :  1.1973570627755645e-58
```

```
sex_pclass = pd.DataFrame(df['Sex'].unique(),columns=['Sex'])
sex_pclass[['Pclass=1','Pclass=2','Pclass=3']] = None
sex_pclass.loc[sex_pclass['Sex']=='male','Pclass=1']=df.loc[(df['Sex']=='male') & (df['Pclass']==1),].shape[0]
sex_pclass.loc[sex_pclass['Sex']=='male','Pclass=2']=df.loc[(df['Sex']=='male') & (df['Pclass']==2),].shape[0]
sex_pclass.loc[sex_pclass['Sex']=='male','Pclass=3']=df.loc[(df['Sex']=='male') & (df['Pclass']==3),].shape[0]
sex_pclass.loc[sex_pclass['Sex']=='female','Pclass=1']=df.loc[(df['Sex']=='female') & (df['Pclass']==1),].shape[0]
sex_pclass.loc[sex_pclass['Sex']=='female','Pclass=2']=df.loc[(df['Sex']=='female') & (df['Pclass']==2),].shape[0]
sex_pclass.loc[sex_pclass['Sex']=='female','Pclass=3']=df.loc[(df['Sex']=='female') & (df['Pclass']==3),].shape[0]

print("\nContigency Table : relation between Survival & Pclass\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(sex_pclass[sex_pclass.columns[1:]])[1])
```

```
Contigency Table : relation between Survival & Pclass

   Survived Pclass=1 Pclass=2 Pclass=3
0       No       80       97      372
1      Yes      136       87      119

Chi-Square Test for Independence, p-value :  0.0002063886434823315
```

```
df_male = df.loc[df['Sex']=='male',:]
```

```
male_survivor_pclass = pd.DataFrame(df_male['Survived_status'].unique(),columns=['Survived'])
male_survivor_pclass[['Pclass=1','Pclass=2','Pclass=3']] = None
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='No','Pclass=1']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==1),].shape[0]
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='No','Pclass=2']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==2),].shape[0]
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='No','Pclass=3']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==3),].shape[0]
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='Yes','Pclass=1']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==1),].shape[0]
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='Yes','Pclass=2']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==2),].shape[0]
male_survivor_pclass.loc[male_survivor_pclass['Survived']=='Yes','Pclass=3']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==3),].shape[0]

print("\nContigency Table for Male: relation between Survival & Pclass\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(male_survivor_pclass[male_survivor_pclass.columns[1:]])[1])
```

```
Contigency Table for Male: relation between Survival & Pclass

   Survived Pclass=1 Pclass=2 Pclass=3
0       No       80       97      372
1      Yes      136       87      119

Chi-Square Test for Independence, p-value :  6.983959431184943e-08
```

```
female_survivor_pclass = pd.DataFrame(df_male['Survived_status'].unique(),columns=['Survived'])
female_survivor_pclass[['Pclass=1','Pclass=2','Pclass=3']] = None
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='No','Pclass=1']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==1),].shape[0]
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='No','Pclass=2']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==2),].shape[0]
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='No','Pclass=3']= df_male.loc[(df_male['Survived_status']=='No') &  (df_male['Pclass']==3),].shape[0]
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='Yes','Pclass=1']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==1),].shape[0]
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='Yes','Pclass=2']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==2),].shape[0]
female_survivor_pclass.loc[female_survivor_pclass['Survived']=='Yes','Pclass=3']=df_male.loc[(df_male['Survived_status']=='Yes') & (df_male['Pclass']==3),].shape[0]

print("\nContigency Table for Female: relation between Survival & Pclass\n\n",survivor_pclass)
print("\nChi-Square Test for Independence, p-value : ",contigency_independence(female_survivor_pclass[female_survivor_pclass.columns[1:]])[1])
```

```
Contigency Table for Female: relation between Survival & Pclass

   Survived Pclass=1 Pclass=2 Pclass=3
0       No       80       97      372
1      Yes      136       87      119

Chi-Square Test for Independence, p-value :  6.983959431184943e-08
```

```
print("--------Percentage of data missing from Variables: --------")
(df.isna().sum()/len(df)*100).apply(lambda x: str(((x*100)//1)/100)+"%")
```

```
--------Percentage of data missing from Variables: --------
PassengerId          0.0%
Survived             0.0%
```

```
Pclass              0.0%
Name                0.0%
Sex                 0.0%
Age                19.86%
SibSp               0.0%
Parch               0.0%
Ticket              0.0%
Fare                0.0%
Cabin               77.1%
Embarked            0.22%
Survived_status     0.0%
initials            0.0%
Surname             0.0%
dtype: object
```

```
pclass_age = pd.DataFrame(df.groupby('Pclass').describe()['Age'].reset_index())
pclass_age['% missing data'] = pclass_age['Pclass'].apply(lambda x: str(((100*df[df['Pclass']==x].isna().sum()['Age']/df['Age'].isna().sum())*100//1)/100)+"%")
pclass_age['Correlation with Fare'] = pclass_age['Pclass'].apply(lambda x: df[df['Pclass']==x][['Age','Fare']].corr().iloc[0,1] )
pclass_age
```

	Pclass	count	mean	std	min	25%	50%	75%	max	% missing data	Correlation with Fare
0	1	186.0	38.233441	14.802856	0.92	27.0	37.0	49.0	80.0	16.94%	-0.218611
1	2	173.0	29.877630	14.001077	0.67	23.0	29.0	36.0	70.0	6.21%	-0.197038
2	3	355.0	25.140620	12.495398	0.42	18.0	24.0	32.0	74.0	76.83%	-0.260315

```
survivor_age = pd.DataFrame(df.groupby('Survived_status').describe()['Age'].reset_index())
survivor_age['% missing data'] = survivor_age['Survived_status'].apply(lambda x: str(((100*100*df[df['Survived_status']==x].isna().sum()['Age']/df['Age'].isna().sum()
survivor_age['Correlation with Fare'] = survivor_age['Survived_status'].apply(lambda x: df[df['Survived_status']==x][['Age','Fare']].corr().iloc[0,1] )
survivor_age
```

	Survived_status	count	mean	std	min	25%	50%	75%	max	% missing data	Correlation with Fare
0	No	424.0	30.626179	14.172110	1.00	21.0	28.0	39.0	74.0	70.62%	0.076852
1	Yes	290.0	28.343690	14.950952	0.42	19.0	28.0	36.0	80.0	29.37%	0.162648

```
embark_age = pd.DataFrame(df.groupby('Embarked').describe()['Age'].reset_index())
embark_age['% missing data'] = embark_age['Embarked'].apply(lambda x: str(((100*df[df['Embarked']==x].isna().sum()['Age']/df['Age'].isna().sum())*100//1)/100)+"%")
embark_age['Correlation with Fare'] = embark_age['Embarked'].apply(lambda x: df[df['Embarked']==x][['Age','Fare']].corr().iloc[0,1] )
embark_age
```

	Embarked	count	mean	std	min	25%	50%	75%	max	% missing data	Correlation with Fare
0	C	130.0	30.814769	15.434860	0.42	21.25	29.0	40.0	71.0	21.46%	0.160451
1	Q	28.0	28.089286	16.915396	2.00	17.50	27.0	34.5	70.5	27.68%	0.027276
2	S	554.0	29.445397	14.143192	0.67	21.00	28.0	38.0	80.0	50.84%	0.052419

```
survivor_age = pd.DataFrame(df.groupby('Sex').describe()['Age'].reset_index())
survivor_age['% missing data'] = survivor_age['Sex'].apply(lambda x: str(((100*100*df[df['Sex']==x].isna().sum()['Age']/df['Age'].isna().sum())//1)/100)+"%")
survivor_age['Correlation with Fare'] = survivor_age['Sex'].apply(lambda x: df[df['Sex']==x][['Age','Fare']].corr().iloc[0,1] )
survivor_age
```

	Sex	count	mean	std	min	25%	50%	75%	max	% missing data	Correlation with Fare
0	female	261.0	27.915709	14.110146	0.75	18.0	27.0	37.0	63.0	29.94%	0.171468
1	male	453.0	30.726645	14.678201	0.42	21.0	29.0	39.0	80.0	70.05%	0.077331

```
import itertools
listOLists = [df['Pclass'].unique(), df['Sex'].unique(), df['Survived_status'].unique()]
sequence = pd.DataFrame(columns=['Pclass','Sex','Survived_status','mean_Age','median_age','% of Age missing'])
for l in itertools.product(*listOLists):
    a=df[(df['Pclass']==l[0]) & (df['Sex']==l[1]) & (df['Survived_status']==l[2])]['Age'].mean()
    b=df[(df['Pclass']==l[0]) & (df['Sex']==l[1]) & (df['Survived_status']==l[2])]['Age'].median()
    c=str((100*df[(df['Pclass']==l[0]) & (df['Sex']==l[1]) & (df['Survived_status']==l[2])]['Age'].isna().sum()/df['Age'].isna().sum())*100//1/100)+"%"
    sequence.loc[len(sequence),:] = [*list(l),a,b,c]
sequence
```

	Pclass	Sex	Survived_status	mean_Age	median_age	% of Age missing
0	3	male	No	27.255814	25.0	48.02%
1	3	male	Yes	22.274211	25.0	5.08%
2	3	female	No	23.818182	22.0	9.6%
3	3	female	Yes	19.329787	19.0	14.12%

```
for l in itertools.product(*listOLists):
  df.loc[(df['Pclass']==l[0]) & (df['Sex']==l[1]) & (df['Survived_status']==l[2]) & (df['Age'].isnull()),'Age'] = df.loc[(df['Pclass']==l[0]) & (df['Sex']==l[1]) & (d
```

```
print(df['Embarked'].isna().sum())
df['Embarked'].fillna(df['Embarked'].mode()[0],inplace=True)
print(df['Embarked'].isna().sum())
```

```
2
0
```

```
dff = df.copy()
dff['Sex']=dff['Sex'].apply(lambda x: 1 if x=="female" else 0)
dff['pclass=1'] = (dff['Pclass']==1).astype('int')
dff['pclass=2'] = (dff['Pclass']==2).astype('int')
dff['pclass=3'] = (dff['Pclass']==3).astype('int')
dff['Embarked=S'] = (dff['Embarked']=='S').astype('int')
dff['Embarked=C'] = (dff['Embarked']=='C').astype('int')
dff['Embarked=Q'] = (dff['Embarked']=='Q').astype('int')
dff.head(3)
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	...	Embarked	Survived_status	initials	Surname	pclass=1	pclass=2	pc
				Braund,														

```
df['initials'].value_counts()
```

```
Mr              517
Miss            182
Mrs             125
Master           40
Dr                7
Rev               6
Mlle              2
Major             2
Col               2
the Countess      1
Capt              1
Ms                1
Sir               1
Lady              1
Mme               1
Don               1
Jonkheer          1
Name: initials, dtype: int64
```

```
dff['initials=Master'] = (dff['initials']=='Master').astype('int')
dff['initials=Mr'] = (dff['initials']=='Mr').astype('int')
dff['initials=Miss'] = (dff['initials']=='Miss').astype('int')
dff['initials=Mrs'] = (dff['initials']=='Mrs').astype('int')
print(dff.columns)
dff.head(3)
```

```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked', 'Survived_status',
       'initials', 'Surname', 'pclass=1', 'pclass=2', 'pclass=3', 'Embarked=S',
       'Embarked=C', 'Embarked=Q', 'initials=Master', 'initials=Mr',
       'initials=Miss', 'initials=Mrs'],
      dtype='object')
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	...	pclass=1	pclass=2	pclass=3	Embarked=S	Embarked=C	Embarked=Q	ini
0	1	0	3	Braund, Mr. Owen	0	22.0	1	0	A/5 21171	7.2500	...	0	0	1	1	0	0	

```
dff.drop(['PassengerId','Pclass','Name','Ticket','Cabin','Embarked','Survived_status','SibSp','Parch','initials','Surname'],axis=1,inplace=True)
```

```
dff.head(3)
```

	Survived	Sex	Age	Fare	pclass=1	pclass=2	pclass=3	Embarked=S	Embarked=C	Embarked=Q	initials=Master	initials=Mr	initials=Miss	initials=Mrs
0	0	0	22.0	7.2500	0	0	1	1	0	0	0	1	0	0
1	1	1	38.0	71.2833	1	0	0	0	1	0	0	0	0	1
2	1	1	26.0	7.9250	0	0	1	1	0	0	0	0	1	0

```
from sklearn.preprocessing import StandardScaler
sc_x = StandardScaler()
x=dff[[col for col in list(dff.columns) if col!='Survived']]
x = sc_x.fit_transform(x)
y=dff['Survived']


from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix
x_train, x_cv, y_train, y_cv = train_test_split(
    x,
    y,
    test_size=0.25,
    random_state=0
)


model = LogisticRegression()
model.fit(x_train,y_train)
```

```
LogisticRegression()
```

```
y_pred = model.predict(x_cv)
y_pred
```

```
array([0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1,
       0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0,
       1, 0, 1, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0,
       1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1,
       0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
       0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0,
       1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0,
       1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1,
       0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1,
       0, 1, 1])
```

```
print("Accuracy of Logistic Model: ",sum([y_pred==y_cv][0].values)/len(y_cv))
```

```
Accuracy of Logistic Model:  0.7982062780269058
```

```
print("Overall Accuracy of Logistic Model on CV dataset: ",sum([y_pred==y_cv][0].values)/len(y_cv))
print("Overall Accuracy of Logistic Model on Train dataset: ",sum([model.predict(x_train)==y_train][0].values)/len(y_train))
```

```
Overall Accuracy of Logistic Model on CV dataset:  0.7982062780269058
Overall Accuracy of Logistic Model on Train dataset:  0.8188622754491018
```

```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_cv, y_pred)

true_pos_rate = len(y_pred[(y_cv==y_pred) & (y_pred==1)])/sum(y_cv==1)
true_neg_rate = len(y_pred[(y_cv==y_pred) & (y_pred==0)])/sum(y_cv==0)
false_pos_rate = len(y_pred[(y_cv!=y_pred) & (y_pred==1)])/(len(y_pred[(y_cv!=y_pred) & (y_pred==1)]) + len(y_pred[(y_cv==y_pred) & (y_pred==0)]))
false_neg_rate = len(y_pred[(y_cv!=y_pred) & (y_pred==0)])/(len(y_pred[(y_cv!=y_pred) & (y_pred==0)]) + len(y_pred[(y_cv==y_pred) & (y_pred==1)]))
```

```
confusion_matrix(y_cv, y_pred)
```

```
array([[115,  24],
       [ 21,  63]])
```

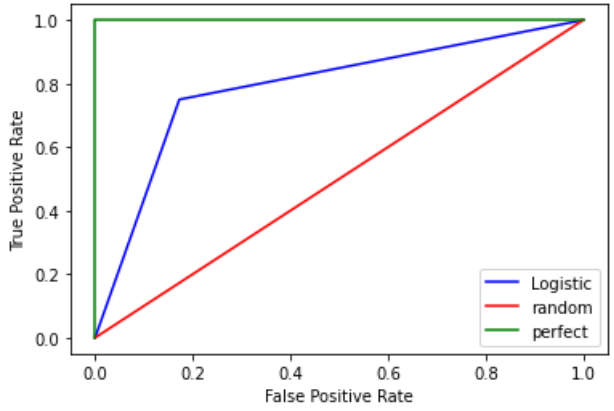
```
print(false_neg_rate, false_pos_rate, true_neg_rate, true_pos_rate)
```

```
0.25 0.17266187050359713 0.8273381294964028 0.75
```

```
from sklearn.metrics import precision_score,recall_score,f1_score

print("Recall: TP/(TP+FN) is := ",len(y_pred[(y_cv==y_pred) & (y_pred==1)])/( len(y_pred[(y_cv==y_pred) & (y_pred==1)]) + len(y_pred[(y_cv!=y_pred) & (y_pred==0)])))
print("Precision: TP/(TP+FP) is := ", len(y_pred[(y_cv==y_pred) & (y_pred==1)]) / ( len(y_pred[(y_cv==y_pred) & (y_pred==1)]) + len(y_pred[(y_cv!=y_pred) & (y_pred==1)
print("F1 Score: 2/(1/recall + 1/precision) is := ", 2/((1/recall_score(y_cv, y_pred)) + (1/precision_score(y_cv, y_pred))) )
```

```
Recall: TP/(TP+FN) is :=  0.75
Precision: TP/(TP+FP) is :=  0.7241379310344828
F1 Score: 2/(1/recall + 1/precision) is :=  0.7368421052631579
```

```
from sklearn.metrics import roc_curve
fpr, tpr, thresholds = roc_curve(y_cv, y_pred)

plt.plot(fpr,tpr,'b-', label= 'Logistic')
plt.plot([0,1],[0,1],'r-',label='random')
plt.plot([0,0,1,1],[0,1,1,1],'g-',label='perfect')
plt.legend()
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.show()
```




```
from sklearn.metrics import roc_auc_score
print("AUC Score := ", roc_auc_score(y_cv, y_pred))
```

```
AUC Score :=  0.7886690647482014
```

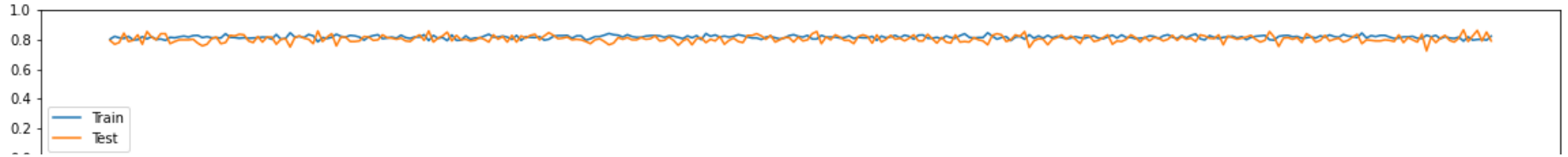
```
x=dff[[col for col in list(dff.columns) if col!='Survived']]
x = sc_x.fit_transform(x)
y=dff['Survived']
```

```
train_x,test_x,train_y,test_y=[None]*4
num_shuffles=300
shuffled = pd.DataFrame(columns=['Shuffle No','train_accuracy','cv_accuracy','train_recall','cv_recall','train_precision','cv_precision','train_f1score','cv_f1score',
for i in range(num_shuffles):
  train_x,test_x,train_y,test_y = train_test_split(x,y,random_state=None,test_size=0.3,shuffle=True)
  model.fit(train_x,train_y)

  y_pred = model.predict(train_x)
  accuracy_train = sum([y_pred==train_y][0].values)/len(train_y)

  tr_precision = precision_score(train_y, y_pred)
  tr_recall = recall_score(train_y, y_pred)
  tr_f1score = f1_score(train_y, y_pred)
  tr_auc = roc_auc_score(train_y, y_pred)

  y_pred = model.predict(test_x)
  accuracy_cv = sum([y_pred==test_y][0].values)/len(test_y)

  cv_precision = precision_score(test_y, y_pred)
  cv_recall = recall_score(test_y, y_pred)
  cv_f1score = f1_score(test_y, y_pred)
  cv_auc = roc_auc_score(test_y, y_pred)

  shuffled.loc[len(shuffled.index)]=[int(i+1), accuracy_train, accuracy_cv, tr_recall, cv_recall, tr_precision, cv_precision, tr_f1score, cv_f1score, tr_auc, cv_auc]
shuffled.head(5)
```

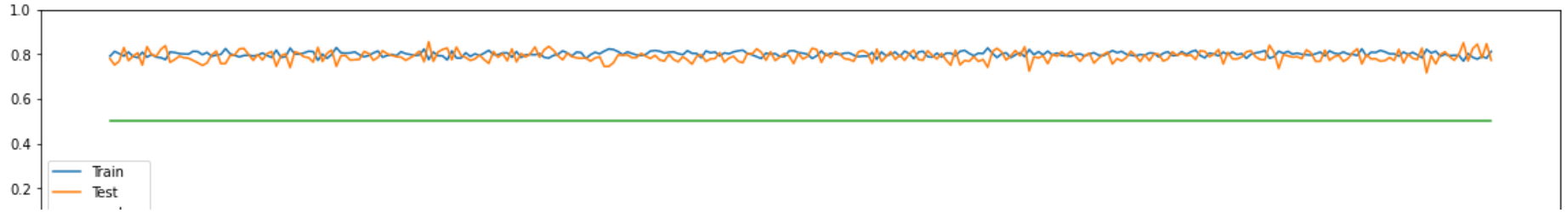
	Shuffle No	train_accuracy	cv_accuracy	train_recall	cv_recall	train_precision	cv_precision	train_f1score	cv_f1score	train_auc	cv_auc
0	1.0	0.802568	0.794776	0.737705	0.724490	0.753138	0.717172	0.745342	0.720812	0.791016	0.779892
1	2.0	0.821830	0.768657	0.769547	0.686869	0.772727	0.686869	0.771134	0.686869	0.812405	0.751718
2	3.0	0.812199	0.779851	0.756098	0.729167	0.765432	0.679612	0.760736	0.703518	0.802452	0.768653
3	4.0	0.807384	0.843284	0.720165	0.777778	0.770925	0.793814	0.744681	0.785714	0.791661	0.829717
4	5.0	0.821830	0.787313	0.751020	0.711340	0.786325	0.704082	0.768267	0.707692	0.809373	0.770875

```
fig = plt.figure(figsize =(20, 2))
plt.plot(shuffled['Shuffle No'],shuffled['train_accuracy'], label='Train')
plt.plot(shuffled['Shuffle No'],shuffled['cv_accuracy'], label='Test')
```

```
plt.legend()
plt.ylim((0,1))
plt.show()
```




```
fig = plt.figure(figsize =(20, 3))
plt.plot(shuffled['Shuffle No'],shuffled['train_auc'], label='Train')
plt.plot(shuffled['Shuffle No'],shuffled['cv_auc'], label='Test')
plt.plot(shuffled['Shuffle No'],[0.5]*len(shuffled['Shuffle No']),label="random")
plt.legend()
plt.ylim((0,1))
plt.show()
```




```
from sklearn.linear_model import LogisticRegression
import scipy.stats

def do_lreg(df):
    sample = df.sample(df.shape[0], replace=True)
    X_tr = sample[[c for c in sample.columns if c != 'y']]
    y_tr = sample.y
    lr = LogisticRegression(penalty='l2', solver='liblinear')
    lr.fit(X_tr, y_tr)
    params = [lr.intercept_[0]] +  list(lr.coef_[0])
    return params

def get_se(X, y):
    lr = LogisticRegression(penalty='l2', solver='liblinear')
    lr.fit(X, y)
    df = pd.DataFrame(X)
    df['y'] = y
    r_df = pd.DataFrame([do_lreg(df) for _ in range(100)])
```

```
    w = [lr.intercept_[0]] + list(lr.coef_[0])
    se = r_df.std()
    dof = X.shape[0] - X.shape[1] - 1
    summary = pd.DataFrame({
        'coeff': w,
        'se': se,
        'z': w / se,
        '.025': w - se,
        '.975': w + se,
        'df': [dof for _ in range(len(w))]
    })
    summary['P>|z|'] = scipy.stats.t.sf(abs(summary.z), df=summary.df)
    return summary

x = np.array(dff[[col for col in list(dff.columns) if col!='Survived']])
y = np.array(dff['Survived'].values)
logistic_coeff_summary = get_se(x, y)
logistic_coeff_summary['features'] = ['intercept']+list(dff.columns)[1:]
logistic_coeff_summary
```

	coeff	se	z	.025	.975	df	P>|z|	features
0	0.171722	0.208735	0.822678	-0.037013	0.380457	877	2.054573e-01	intercept
1	1.827700	0.242517	7.536389	1.585184	2.070217	877	6.018766e-14	Sex
2	-0.031898	0.007969	-4.002810	-0.039867	-0.023929	877	3.394351e-05	Age
3	-0.000420	0.002580	-0.162973	-0.003000	0.002159	877	4.352885e-01	Fare
4	1.261647	0.214684	5.876772	1.046963	1.476331	877	2.969547e-09	pclass=1
5	0.104146	0.147572	0.705729	-0.043426	0.251717	877	2.402719e-01	pclass=2
6	-1.194071	0.141127	-8.460943	-1.335198	-1.052944	877	5.513446e-17	pclass=3
7	-0.281580	0.129520	-2.174029	-0.411100	-0.152060	877	1.498488e-02	Embarked=S
8	0.254789	0.181846	1.401129	0.072944	0.436635	877	8.076459e-02	Embarked=C
9	0.198512	0.201077	0.987245	-0.002565	0.399589	877	1.618974e-01	Embarked=Q
10	1.182146	0.390478	3.027430	0.791667	1.572624	877	1.269289e-03	initials=Master
11	-0.505332	0.292833	-1.725663	-0.798165	-0.212498	877	4.238019e-02	initials=Mr
12	0.138866	0.190603	0.728564	-0.051736	0.329469	877	2.332313e-01	initials=Miss
13	0.774522	0.222947	3.474019	0.551575	0.997469	877	2.689173e-04	initials=Mrs

```
drop_feat_pval = logistic_coeff_summary[logistic_coeff_summary['P>|z|']>0.05]['features']
drop_feat_pval.values
```

```
array(['intercept', 'Fare', 'pclass=2', 'Embarked=C', 'Embarked=Q',
       'initials=Miss'], dtype=object)
```

```
dff.drop(['Fare','Embarked=Q','Embarked=C','Embarked=S','pclass=2','initials=Miss'],axis=1,inplace=True)
x_new = np.array(dff[[col for col in list(dff.columns) if col!='Survived']])
y_new = np.array(dff['Survived'])
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.metrics import roc_auc_score
x_train, x_cv, y_train, y_cv = train_test_split(
    x_new,
    y,
    test_size=0.25,
    random_state=0
)
model_new = LogisticRegression(penalty='l2', solver='liblinear')
model_new.fit(x_train,y_train)
y_pred = model_new.predict(x_cv)
print("Overall Accuracy of Logistic Model on CV dataset: ",sum([y_pred==y_cv][0])/len(y_cv))
print("Overall Accuracy of Logistic Model on Train dataset: ",sum([model_new.predict(x_train)==y_train][0])/len(y_train))
print("Recall on CV dataset: TP/(TP+FN) is := ",len(y_pred[(y_cv==y_pred) & (y_pred==1)])/( len(y_pred[(y_cv==y_pred) & (y_pred==1)]) + len(y_pred[(y_cv!=y_pred) & (y_
print("Precision on CV dataset: TP/(TP+FP) is := ", len(y_pred[(y_cv==y_pred) & (y_pred==1)]) / ( len(y_pred[(y_cv==y_pred) & (y_pred==1)]) + len(y_pred[(y_cv!=y_pred)
print("F1 Score on CV dataset: 2/(1/recall + 1/precision) is := ", 2/((1/recall_score(y_cv, y_pred)) + (1/precision_score(y_cv, y_pred))) )
print("AUC Score on CV dataset:= ", roc_auc_score(y_cv, y_pred))
```

```
Overall Accuracy of Logistic Model on CV dataset:  0.7668161434977578
Overall Accuracy of Logistic Model on Train dataset:  0.8053892215568862
Recall on CV dataset: TP/(TP+FN) is :=  0.7142857142857143
Precision on CV dataset: TP/(TP+FP) is :=  0.6818181818181818
F1 Score on CV dataset: 2/(1/recall + 1/precision) is :=  0.6976744186046512
AUC Score on CV dataset:=  0.7564234326824255
```

```
y = np.array(dff['Survived'])
x = np.array(dff[[col for col in list(dff.columns) if col!='Survived']])
y_pred = model_new.predict(x)
print("Overall Accuracy of Logistic Model on dataset: ",sum([y_pred==y][0])/len(y))
print("Recall on dataset: TP/(TP+FN) is := ",len(y_pred[(y==y_pred) & (y_pred==1)])/( len(y_pred[(y==y_pred) & (y_pred==1)]) + len(y_pred[(y!=y_pred) & (y_pred==0)])))
print("Precision on dataset: TP/(TP+FP) is := ", len(y_pred[(y==y_pred) & (y_pred==1)]) / ( len(y_pred[(y==y_pred) & (y_pred==1)]) + len(y_pred[(y!=y_pred) & (y_pred==
print("F1 Score on dataset: 2/(1/recall + 1/precision) is := ", 2/((1/recall_score(y, y_pred)) + (1/precision_score(y, y_pred))) )
print("AUC Score on dataset:= ", roc_auc_score(y, y_pred))
print("Features used in Final model: ",[col for col in list(dff.columns) if col!='Survived'])
```

```
Overall Accuracy of Logistic Model on dataset:  0.7957351290684624
Recall on dataset: TP/(TP+FN) is :=  0.7192982456140351
Precision on dataset: TP/(TP+FP) is :=  0.7409638554216867
F1 Score on dataset: 2/(1/recall + 1/precision) is :=  0.7299703264094956
AUC Score on dataset:=  0.7813248969418081
Features used in Final model:  ['Sex', 'Age', 'pclass=1', 'pclass=3', 'initials=Master', 'initials=Mr', 'initials=Mrs']
```

```
df_test = pd.read_csv("/content/test.csv")
df_test.head(3)
```

	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

```
df_test.isna().sum()[df_test.isna().sum()>0]
```

```
Age       86
Fare       1
Cabin    327
dtype: int64
```

```
import itertools
listOLists = [df_test['Pclass'].unique(), df_test['Sex'].unique()]
sequence = pd.DataFrame(columns=['Pclass','Sex','mean_Age','median_age','% of Age missing'])
for l in itertools.product(*listOLists):
    a=df_test[(df_test['Pclass']==l[0]) & (df_test['Sex']==l[1]) ]['Age'].mean()
    b=df_test[(df_test['Pclass']==l[0]) & (df_test['Sex']==l[1]) ]['Age'].median()
    c=str((100*df_test[(df_test['Pclass']==l[0]) & (df_test['Sex']==l[1]) ]['Age'].isna().sum()/df_test['Age'].isna().sum())*100//1/100)+"%"
    sequence.loc[len(sequence),:] = [*list(l),a,b,c]
sequence
```

	Pclass	Sex	mean_Age	median_age	% of Age missing
0	3	male	24.525104	24.0	58.13%

```
for l in itertools.product(*listOLists):
  df_test.loc[(df_test['Pclass']==l[0]) & (df_test['Sex']==l[1]) & (df_test['Age'].isnull()),'Age'] = df_test.loc[(df_test['Pclass']==l[0]) & (df_test['Sex']==l[1]) ,
```

```
df_test.isna().sum()[df_test.isna().sum()>0]
```

```
Fare       1
Cabin    327
dtype: int64
```

```
dff_test = df_test.copy()
dff_test['Sex']=dff_test['Sex'].apply(lambda x: 1 if x=="female" else 0)
dff_test['pclass=1'] = (dff_test['Pclass']==1).astype('int')
dff_test['pclass=3'] = (dff_test['Pclass']==3).astype('int')
dff_test['initials'] = dff_test['Name'].apply(lambda x: x.split(", ")[1].split(".")[0])
dff_test['initials=Master'] = (dff_test['initials']=='Master').astype('int')
dff_test['initials=Mr'] = (dff_test['initials']=='Mr').astype('int')
dff_test['initials=Mrs'] = (dff_test['initials']=='Mrs').astype('int')
dff_test.head(3)
```

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	pclass=1	pclass=3	initials	initials=Master	initials=Mr	initials=Mrs
0	892	3	Kelly, Mr. James	0	34.5	0	0	330911	7.8292	NaN	Q	0	1	Mr	0	1	0
1	893	3	Wilkes, Mrs. James (Ellen Needs)	1	47.0	1	0	363272	7.0000	NaN	S	0	1	Mrs	0	0	1
2	894	2	Myles, Mr. Thomas Francis	0	62.0	0	0	240276	9.6875	NaN	Q	0	0	Mr	0	1	0

```
dfff = dff_test.copy()
dfff.drop(['PassengerId','Pclass','Name','SibSp','initials','Parch','Ticket','Fare','Cabin','Embarked'],axis=1,inplace=True)
```

```
dfff.head(2)
```

	Sex	Age	pclass=1	pclass=3	initials=Master	initials=Mr	initials=Mrs
0	0	34.5	0	1	0	1	0
1	1	47.0	0	1	0	0	1

```
model = LogisticRegression(penalty='l2', solver='liblinear')
x = np.array(dff[[col for col in list(dff.columns) if col!='Survived']])
y = np.array(dff['Survived'])
model.fit(x,y)

x_test = np.array(dfff[[col for col in list(dfff.columns) if col!='Survived']])
y_pred = model_new.predict(x_test)
dfff['Survived'] = y_pred
dff_test['Survived'] = y_pred
```

```
dff_test.head(2)
```

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	pclass=1	pclass=3	initials	initials=Master	initials=Mr	initials=Mrs
0	892	3	Kelly, Mr. James	0	34.5	0	0	330911	7.8292	NaN	Q	0	1	Mr	0	1	0
1	893	3	Wilkes, Mrs. James (Ellen Needs)	1	47.0	1	0	363272	7.0000	NaN	S	0	1	Mrs	0	0	1

```
submission = dff_test.loc[:,['PassengerId','Survived']]
```


```
submission = dff_test.loc[:,['PassengerId','Survived']]
```

✓ 0s completed at 11:16 AM