titanic-survival-analysis

September 10, 2023

Titanic Passanger Survival Analysis

[1]:

```
from IPython.display import Image
Image(url= "https://static1.squarespace.com/static/5006453fe4b09ef2252ba068/
 ↪5095eabce4b06cb305058603/5095eabce4b02d37bef4c24c/1352002236895/
 ↪100_anniversary_titanic_sinking_by_esai8mellows-d4xbme8.jpg")
```

[1]:

```
<IPython.core.display.Image object>
```

[2]:

```
import pandas as pd
import numpy as np
```

[3]:

```
train = pd.read_csv("input/train.csv")
test = pd.read_csv("input/test.csv")
```

[4]:

```
train.isnull().sum()
print("Train Shape:",train.shape)
test.isnull().sum()
print("Test Shape:",test.shape)
```

```
Train Shape: (891, 12)
Test Shape: (418, 11)
```

[5]:

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId    891 non-null int64
Survived       891 non-null int64
Pclass         891 non-null int64
Name           891 non-null object
Sex            891 non-null object
Age            714 non-null float64
SibSp          891 non-null int64
Parch          891 non-null int64
Ticket         891 non-null object
Fare           891 non-null float64
Cabin          204 non-null object
```

```
Embarked       889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```

[6]:
```
test.info()
```

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

0.0.1 Data Dictionary

- Survived: 0 = No, 1 = Yes
- pclass: Ticket class 1 = 1st, 2 = 2nd, 3 = 3rd
- sibsp: # of siblings / spouses aboard the Titanic
- parch: # of parents / children aboard the Titanic
- ticket: Ticket number
- cabin: Cabin number
- embarked: Port of Embarkation C = Cherbourg, Q = Queenstown, S = Southampton

Total rows and columns

We can see that there are 891 rows and 12 columns in our training dataset.

[7]:
```
train.head(10)
```

[7]:
```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3
5            6         0       3
6            7         0       1
7            8         0       3
8            9         1       3
```

```
9           10          1       2

                                                Name     Sex   Age  SibSp  \
0                            Braund, Mr. Owen Harris    male  22.0      1
1  Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
2                             Heikkinen, Miss. Laina  female  26.0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                           Allen, Mr. William Henry    male  35.0      0
5                                   Moran, Mr. James    male   NaN      0
6                            McCarthy, Mr. Timothy J    male  54.0      0
7                     Palsson, Master. Gosta Leonard    male   2.0      3
8  Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)  female  27.0      0
9                Nasser, Mrs. Nicholas (Adele Achem)  female  14.0      1

   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
5      0            330877   8.4583   NaN        Q
6      0             17463  51.8625   E46        S
7      1            349909  21.0750   NaN        S
8      2            347742  11.1333   NaN        S
9      0            237736  30.0708   NaN        C
```

[8]:
```
train.describe()
```

[8]:
```
       PassengerId    Survived      Pclass         Age       SibSp  \
count   891.000000  891.000000  891.000000  714.000000  891.000000
mean    446.000000    0.383838    2.308642   29.699118    0.523008
std     257.353842    0.486592    0.836071   14.526497    1.102743
min       1.000000    0.000000    1.000000    0.420000    0.000000
25%     223.500000    0.000000    2.000000   20.125000    0.000000
50%     446.000000    0.000000    3.000000   28.000000    0.000000
75%     668.500000    1.000000    3.000000   38.000000    1.000000
max     891.000000    1.000000    3.000000   80.000000    8.000000

            Parch        Fare
count  891.000000  891.000000
mean     0.381594   32.204208
std      0.806057   49.693429
min      0.000000    0.000000
25%      0.000000    7.910400
50%      0.000000   14.454200
75%      0.000000   31.000000
max      6.000000  512.329200
```

[9]:
```
test.describe()
```

[9]:
```
       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
```

[10]:
```
train.isnull().sum()
```

[10]:
```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
```

[11]:
```
test.isnull().sum()
test["Survived"] = ""
test.head()
```

[11]:
```
   PassengerId  Pclass                                          Name     Sex  \
0          892       3                              Kelly, Mr. James    male
1          893       3              Wilkes, Mrs. James (Ellen Needs)  female
2          894       2                     Myles, Mr. Thomas Francis    male
3          895       3                              Wirz, Mr. Albert    male
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female

    Age  SibSp  Parch   Ticket     Fare Cabin Embarked Survived
0  34.5      0      0   330911   7.8292   NaN        Q
1  47.0      1      0   363272   7.0000   NaN        S
2  62.0      0      0   240276   9.6875   NaN        Q
3  27.0      0      0   315154   8.6625   NaN        S
4  22.0      1      1  3101298  12.2875   NaN        S
```

1 Data Visualization using Matplotlib and Seaborn packages.

[12]:

```
import matplotlib.pyplot as plt # Plot the graphes
%matplotlib inline
import seaborn as sns
sns.set() # setting seaborn default for plots
```

2 Bar Chart for Categorical Features

- Pclass
- Sex
- SibSp (# of siblings and spouse)
- Parch (# of parents and children)
- Embarked
- Cabin

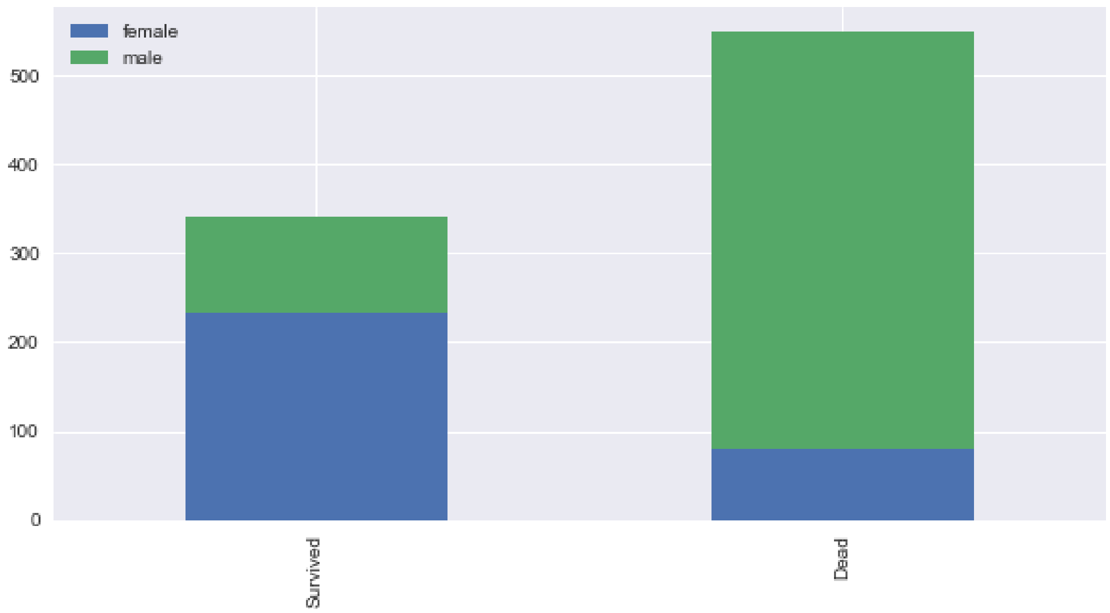
[13]:

```
def bar_chart(feature):
    survived = train[train['Survived']==1][feature].value_counts()
    dead = train[train['Survived']==0][feature].value_counts()
    df = pd.DataFrame([survived,dead])
    df.index = ['Survived','Dead']
    df.plot(kind='bar',stacked=True, figsize=(10,5))
```

[14]:

```
bar_chart('Sex')
print("Survived :\n",train[train['Survived']==1]['Sex'].value_counts())
print("Dead:\n",train[train['Survived']==0]['Sex'].value_counts())
```

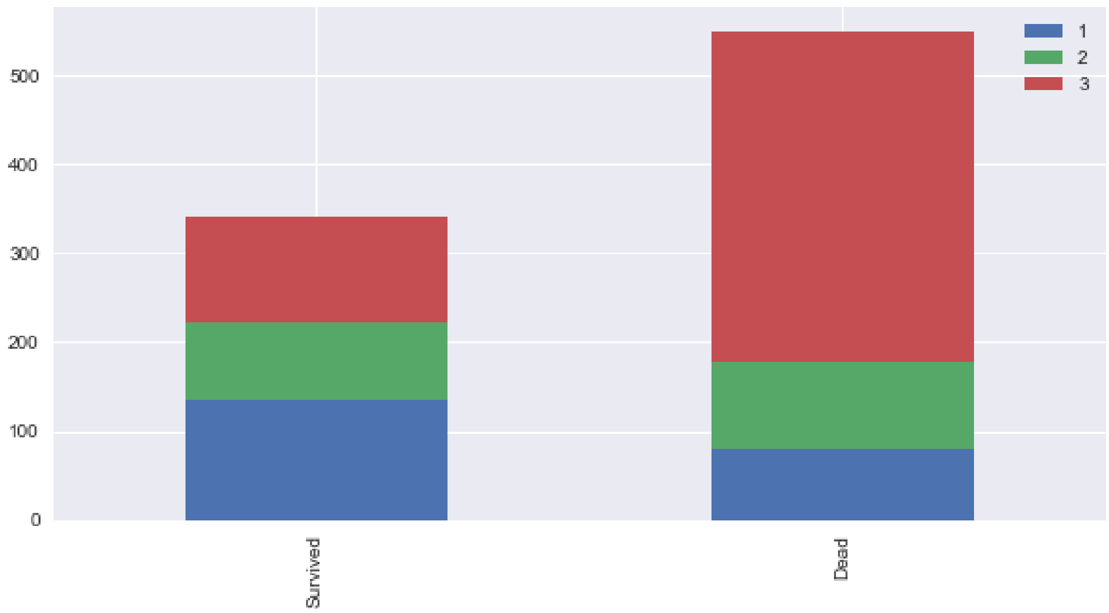
```
Survived :
 female    233
male      109
Name: Sex, dtype: int64
Dead:
 male      468
female     81
Name: Sex, dtype: int64
```



The Chart confirms **Women more likely survivied than Men**.

```
[15]: bar_chart('Pclass')
      print("Survived :\n",train[train['Survived']==1]['Pclass'].value_counts())
      print("Dead:\n",train[train['Survived']==0]['Pclass'].value_counts())
```

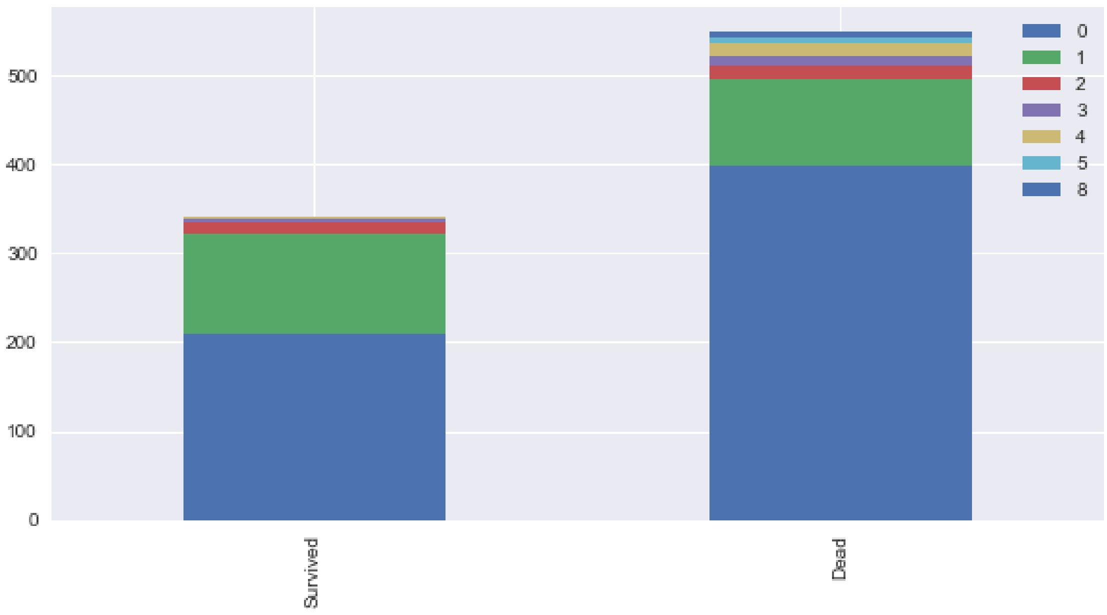
```
Survived :
 1    136
3    119
2     87
Name: Pclass, dtype: int64
Dead:
 3    372
2     97
1     80
Name: Pclass, dtype: int64
```



The Chart confirms **1st class** more likely survivied than **other classes**.
The Chart confirms **3rd class** more likely dead than **other classes**

[16]:
```
bar_chart('SibSp')
print("Survived :\n",train[train['Survived']==1]['SibSp'].value_counts())
print("Dead:\n",train[train['Survived']==0]['SibSp'].value_counts())
```

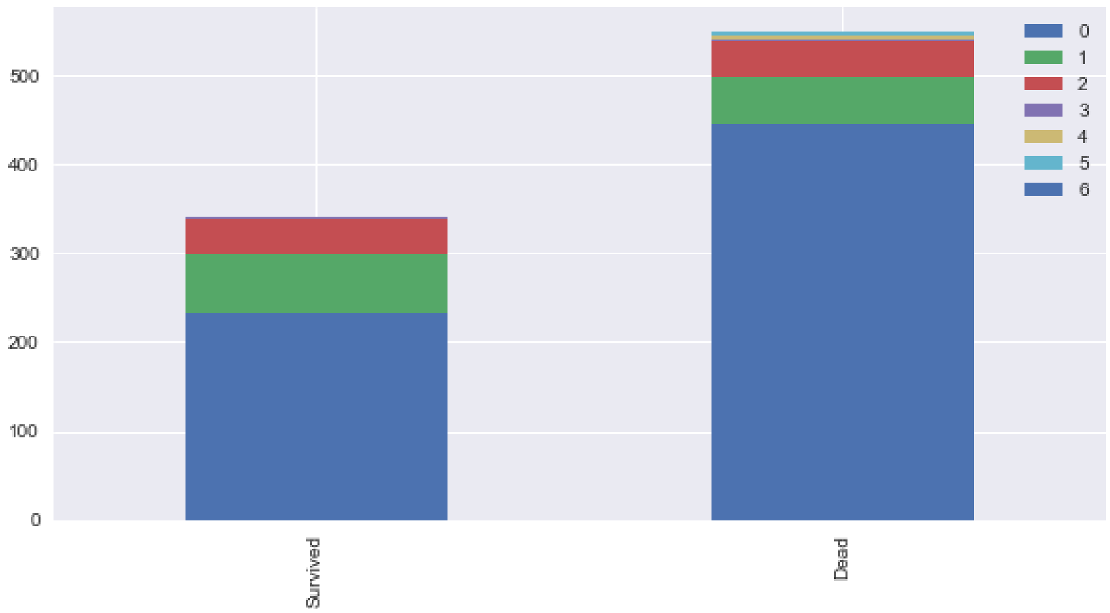
```
Survived :
 0    210
1    112
2     13
3      4
4      3
Name: SibSp, dtype: int64
Dead:
 0    398
1     97
4     15
2     15
3     12
8      7
5      5
Name: SibSp, dtype: int64
```



The Chart confirms a **person aboarded with more than 2 siblings or spouse** more likely survived.
The Chart confirms a **person aboarded without siblings or spouse** more likely dead

[17]:
```
bar_chart('Parch')
print("Survived :\n",train[train['Survived']==1]['Parch'].value_counts())
print("Dead:\n",train[train['Survived']==0]['Parch'].value_counts())
```

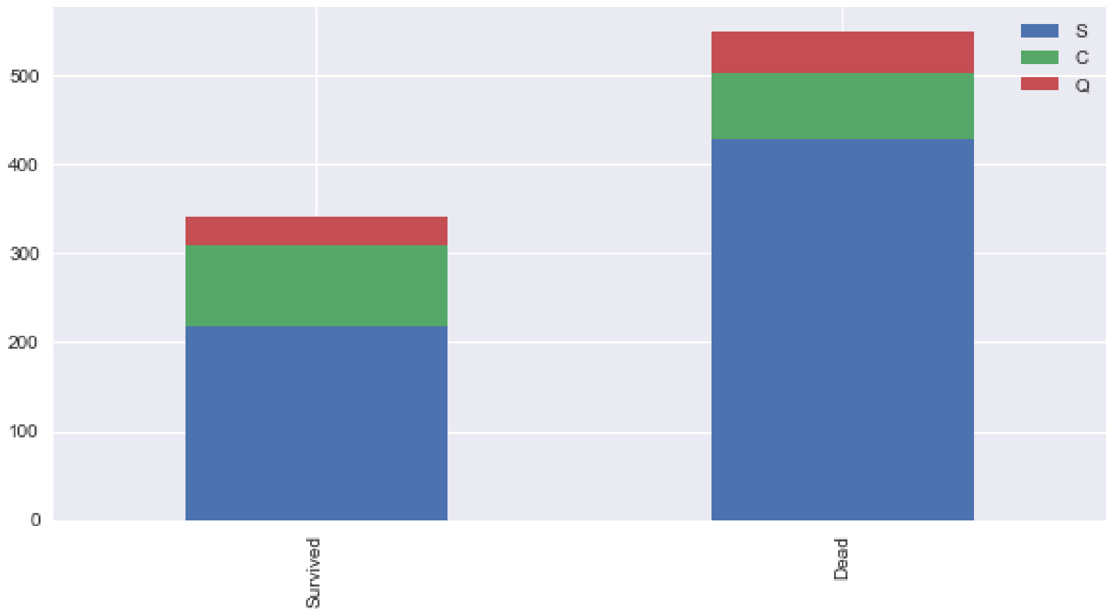
```
Survived :
 0    233
1     65
2     40
3      3
5      1
Name: Parch, dtype: int64
Dead:
 0    445
1     53
2     40
5      4
4      4
3      2
6      1
Name: Parch, dtype: int64
```



The Chart confirms a **person aboarded with more than 2 parents or children more likely survived.**
The Chart confirms a **person aboarded alone more likely dead**

[18]:
```
bar_chart('Embarked')
print("Survived :\n",train[train['Survived']==1]['Embarked'].value_counts())
print("Dead:\n",train[train['Survived']==0]['Embarked'].value_counts())
```

```
Survived :
 S    217
C     93
Q     30
Name: Embarked, dtype: int64
Dead:
 S    427
C     75
Q     47
Name: Embarked, dtype: int64
```



The Chart confirms a **person aboarded from C** slightly more likely survived.
The Chart confirms a **person aboarded from Q** more likely dead.
The Chart confirms a **person aboarded from S** more likely dead.

2.1 4. Feature engineering

Feature engineering is the process of using domain knowledge of the data to create features (**feature vectors**) that make machine learning algorithms work.

feature vector is an n-dimensional vector of numerical features that represent some object. Many algorithms in machine learning require a numerical representation of objects, since such representations facilitate processing and statistical analysis.

```
[19]: train.head()
```

```
[19]:    PassengerId  Survived  Pclass  \
      0            1         0       3
      1            2         1       1
      2            3         1       3
      3            4         1       1
      4            5         0       3

                                                     Name     Sex   Age  SibSp  \
      0                            Braund, Mr. Owen Harris    male  22.0      1
      1  Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
      2                             Heikkinen, Miss. Laina  female  26.0      0
      3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
      4                           Allen, Mr. William Henry    male  35.0      0
```

```
   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
```

4.1 how titanic sank?

```
[20]: Image(url= "https://static1.squarespace.com/static/5006453fe4b09ef2252ba068/t/
       ↪5090b249e4b047ba54dfd258/1351660113175/TItanic-Survival-Infographic.jpg?
       ↪format=1500w")
```

```
[20]: <IPython.core.display.Image object>
```

```
[21]: train.head(10)
```

```
[21]:    PassengerId  Survived  Pclass  \
      0            1         0       3
      1            2         1       1
      2            3         1       3
      3            4         1       1
      4            5         0       3
      5            6         0       3
      6            7         0       1
      7            8         0       3
      8            9         1       3
      9           10         1       2

                                                     Name     Sex   Age  SibSp  \
      0                            Braund, Mr. Owen Harris    male  22.0      1
      1  Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
      2                             Heikkinen, Miss. Laina  female  26.0      0
      3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
      4                           Allen, Mr. William Henry    male  35.0      0
      5                                   Moran, Mr. James    male   NaN      0
      6                            McCarthy, Mr. Timothy J    male  54.0      0
      7                     Palsson, Master. Gosta Leonard    male   2.0      3
      8  Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)  female  27.0      0
      9                Nasser, Mrs. Nicholas (Adele Achem)  female  14.0      1

         Parch            Ticket     Fare Cabin Embarked
      0      0         A/5 21171   7.2500   NaN        S
      1      0          PC 17599  71.2833   C85        C
      2      0  STON/O2. 3101282   7.9250   NaN        S
      3      0            113803  53.1000  C123        S
```

```
4       0             373450   8.0500   NaN         S
5       0             330877   8.4583   NaN         Q
6       0              17463  51.8625   E46         S
7       1             349909  21.0750   NaN         S
8       2             347742  11.1333   NaN         S
9       0             237736  30.0708   NaN         C
```

[22]:
```
train_test_data = [train,test] # combine dataset

for dataset in train_test_data:
    dataset['Title'] = dataset['Name'].str.extract(' ([A-Za-z]+)\.',␣
  ↪expand=False)
```

[23]:
```
train['Title'].value_counts()
```

[23]:
```
Mr          517
Miss        182
Mrs         125
Master       40
Dr            7
Rev           6
Mlle          2
Col           2
Major         2
Lady          1
Sir           1
Mme           1
Ms            1
Don           1
Countess      1
Capt          1
Jonkheer      1
Name: Title, dtype: int64
```

[24]:
```
test['Title'].value_counts()
```

[24]:
```
Mr        240
Miss       78
Mrs        72
Master     21
Rev         2
Col         2
Dr          1
Ms          1
Dona        1
Name: Title, dtype: int64
```

Title Map Mr : 0
Miss : 1
Mrs: 2
Others: 3

[25]:

```
title_mapping = {"Mr": 0, "Miss": 1, "Mrs": 2,
                 "Master": 3, "Dr": 3, "Rev": 3, "Col": 3, "Major": 3, "Mlle":␣
 ↪3,"Countess": 3,
                 "Ms": 3, "Lady": 3, "Jonkheer": 3, "Don": 3, "Dona" : 3, "Mme":
 ↪ 3,"Capt": 3,"Sir": 3 }

for dataset in train_test_data:
    dataset['Title'] = dataset["Title"].map(title_mapping)
```

[26]:

```
dataset.head()
```

[26]:

```
   PassengerId  Pclass                                          Name     Sex  \
0          892       3                              Kelly, Mr. James    male
1          893       3              Wilkes, Mrs. James (Ellen Needs)  female
2          894       2                     Myles, Mr. Thomas Francis    male
3          895       3                              Wirz, Mr. Albert    male
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female

    Age  SibSp  Parch   Ticket     Fare Cabin Embarked Survived  Title
0  34.5      0      0   330911   7.8292   NaN        Q               0
1  47.0      1      0   363272   7.0000   NaN        S               2
2  62.0      0      0   240276   9.6875   NaN        Q               0
3  27.0      0      0   315154   8.6625   NaN        S               0
4  22.0      1      1  3101298  12.2875   NaN        S               2
```

[27]:

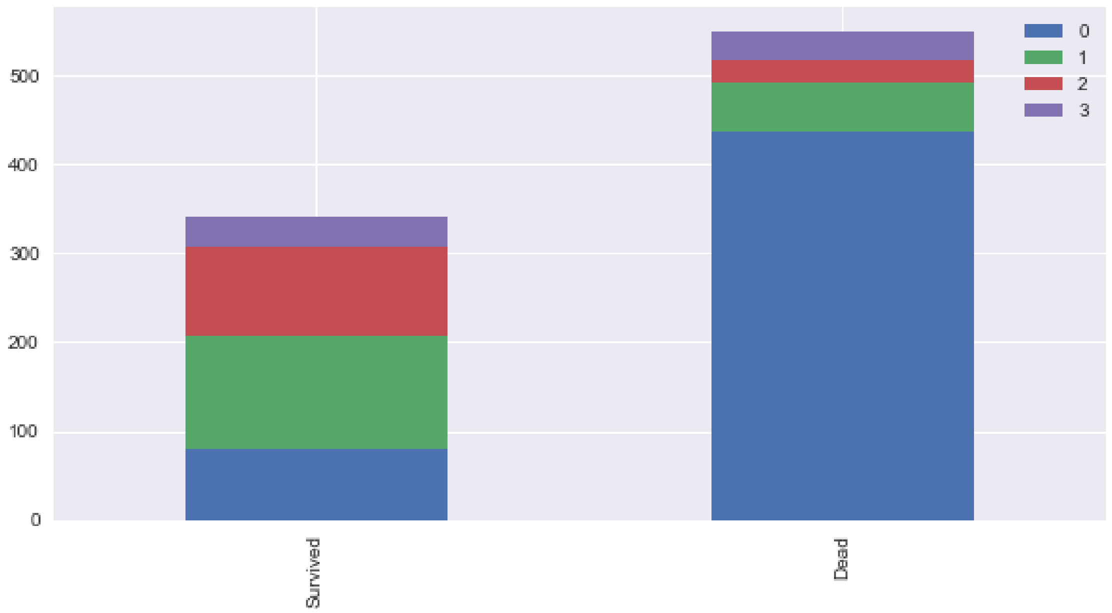
```
test.head()
```

[27]:

```
   PassengerId  Pclass                                          Name     Sex  \
0          892       3                              Kelly, Mr. James    male
1          893       3              Wilkes, Mrs. James (Ellen Needs)  female
2          894       2                     Myles, Mr. Thomas Francis    male
3          895       3                              Wirz, Mr. Albert    male
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female

    Age  SibSp  Parch   Ticket     Fare Cabin Embarked Survived  Title
0  34.5      0      0   330911   7.8292   NaN        Q               0
1  47.0      1      0   363272   7.0000   NaN        S               2
2  62.0      0      0   240276   9.6875   NaN        Q               0
3  27.0      0      0   315154   8.6625   NaN        S               0
4  22.0      1      1  3101298  12.2875   NaN        S               2
```

[28]:

```
bar_chart('Title')
```



[29]:

```
# delete unnecessary feature from dataset
train.drop('Name', axis=1, inplace=True)
test.drop('Name', axis=1, inplace=True)
```

[30]:

```
train.head()
```

[30]:

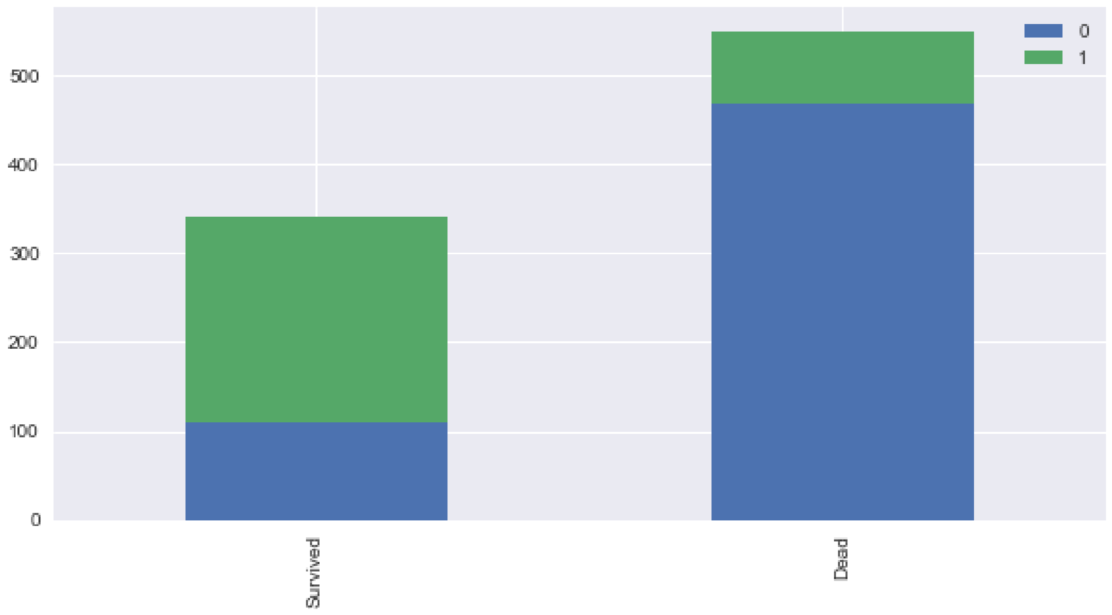
```
   PassengerId  Survived  Pclass     Sex   Age  SibSp  Parch  \
0            1         0       3    male  22.0      1      0
1            2         1       1  female  38.0      1      0
2            3         1       3  female  26.0      0      0
3            4         1       1  female  35.0      1      0
4            5         0       3    male  35.0      0      0

             Ticket     Fare Cabin Embarked  Title
0         A/5 21171   7.2500   NaN        S      0
1          PC 17599  71.2833   C85        C      2
2  STON/O2. 3101282   7.9250   NaN        S      1
3            113803  53.1000  C123        S      2
4            373450   8.0500   NaN        S      0
```

[31]:

```
sex_mapping = {"male": 0, "female": 1}
for dataset in train_test_data:
    dataset['Sex'] = dataset['Sex'].map(sex_mapping)
```

[32]:

```
bar_chart('Sex')
```



[33]:
```
test.head()
```

[33]:
```
   PassengerId  Pclass  Sex   Age  SibSp  Parch   Ticket     Fare Cabin  \
0          892       3    0  34.5      0      0   330911   7.8292   NaN
1          893       3    1  47.0      1      0   363272   7.0000   NaN
2          894       2    0  62.0      0      0   240276   9.6875   NaN
3          895       3    0  27.0      0      0   315154   8.6625   NaN
4          896       3    1  22.0      1      1  3101298  12.2875   NaN

  Embarked Survived  Title
0        Q               0
1        S               2
2        Q               0
3        S               0
4        S               2
```

[34]:
```
train["Age"].fillna(train.groupby("Title")["Age"].transform("median"), inplace=␣
 ↪True)
test["Age"].fillna(test.groupby('Title')['Age'].transform("median"), inplace=␣
 ↪True)
```

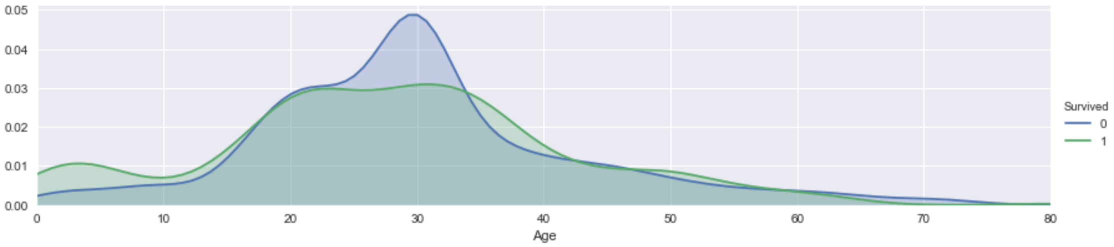
[35]:
```
train.head(30)
#train.groupby("Title")["Age"].transform("median")
```

[35]:
```
    PassengerId  Survived  Pclass  Sex   Age  SibSp  Parch            Ticket  \
0             1         0       3    0  22.0      1      0         A/5 21171
1             2         1       1    1  38.0      1      0          PC 17599
```

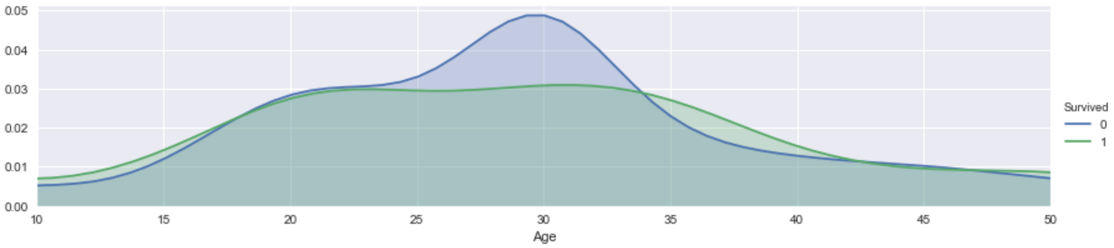
```
2             3         1       3    1  26.0         0       0  STON/O2. 3101282
3             4         1       1    1  35.0         1       0            113803
4             5         0       3    0  35.0         0       0            373450
5             6         0       3    0  30.0         0       0            330877
6             7         0       1    0  54.0         0       0             17463
7             8         0       3    0   2.0         3       1            349909
8             9         1       3    1  27.0         0       2            347742
9            10         1       2    1  14.0         1       0            237736
10           11         1       3    1   4.0         1       1           PP 9549
11           12         1       1    1  58.0         0       0            113783
12           13         0       3    0  20.0         0       0         A/5. 2151
13           14         0       3    0  39.0         1       5            347082
14           15         0       3    1  14.0         0       0            350406
15           16         1       2    1  55.0         0       0            248706
16           17         0       3    0   2.0         4       1            382652
17           18         1       2    0  30.0         0       0            244373
18           19         0       3    1  31.0         1       0            345763
19           20         1       3    1  35.0         0       0              2649
20           21         0       2    0  35.0         0       0            239865
21           22         1       2    0  34.0         0       0            248698
22           23         1       3    1  15.0         0       0            330923
23           24         1       1    0  28.0         0       0            113788
24           25         0       3    1   8.0         3       1            349909
25           26         1       3    1  38.0         1       5            347077
26           27         0       3    0  30.0         0       0              2631
27           28         0       1    0  19.0         3       2             19950
28           29         1       3    1  21.0         0       0            330959
29           30         0       3    0  30.0         0       0            349216

        Fare         Cabin Embarked  Title
0     7.2500           NaN        S      0
1    71.2833           C85        C      2
2     7.9250           NaN        S      1
3    53.1000          C123        S      2
4     8.0500           NaN        S      0
5     8.4583           NaN        Q      0
6    51.8625           E46        S      0
7    21.0750           NaN        S      3
8    11.1333           NaN        S      2
9    30.0708           NaN        C      2
10   16.7000            G6        S      1
11   26.5500          C103        S      1
12    8.0500           NaN        S      0
13   31.2750           NaN        S      0
14    7.8542           NaN        S      1
15   16.0000           NaN        S      2
16   29.1250           NaN        Q      3
```

```
17    13.0000           NaN        S       0
18    18.0000           NaN        S       2
19     7.2250           NaN        C       2
20    26.0000           NaN        S       0
21    13.0000           D56        S       0
22     8.0292           NaN        Q       1
23    35.5000            A6        S       0
24    21.0750           NaN        S       1
25    31.3875           NaN        S       2
26     7.2250           NaN        C       0
27   263.0000   C23 C25 C27        S       0
28     7.8792           NaN        Q       1
29     7.8958           NaN        S       0
```

[36]:
```
facet = sns.FacetGrid(train, hue="Survived",aspect=4)
facet.map(sns.kdeplot,'Age',shade= True)
facet.set(xlim=(0, train['Age'].max()))
facet.add_legend()
plt.show()

facet = sns.FacetGrid(train, hue="Survived",aspect=4)
facet.map(sns.kdeplot,'Age',shade= True)
facet.set(xlim=(0, train['Age'].max()))
facet.add_legend()
plt.xlim(10,50)
```



[36]:
```
(10, 50)
```



Those who were **20 to 30 years old** were **more dead and more survived.**

[37]:

```
train.info()
test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId    891 non-null int64
Survived       891 non-null int64
Pclass         891 non-null int64
Sex            891 non-null int64
Age            891 non-null float64
SibSp          891 non-null int64
Parch          891 non-null int64
Ticket         891 non-null object
Fare           891 non-null float64
Cabin          204 non-null object
Embarked       889 non-null object
Title          891 non-null int64
dtypes: float64(2), int64(7), object(3)
memory usage: 83.6+ KB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 12 columns):
PassengerId    418 non-null int64
Pclass         418 non-null int64
Sex            418 non-null int64
Age            418 non-null float64
SibSp          418 non-null int64
Parch          418 non-null int64
Ticket         418 non-null object
Fare           417 non-null float64
Cabin          91 non-null object
Embarked       418 non-null object
Survived       418 non-null object
Title          418 non-null int64
dtypes: float64(2), int64(6), object(4)
memory usage: 39.3+ KB
```

Binning

Binning/Converting Numerical Age to Categorical Variable

feature vector map: * child: 0 * young: 1 * adult: 2 * mid-age: 3 * senior: 4

[38]:

```
train.head()
```

[38]:

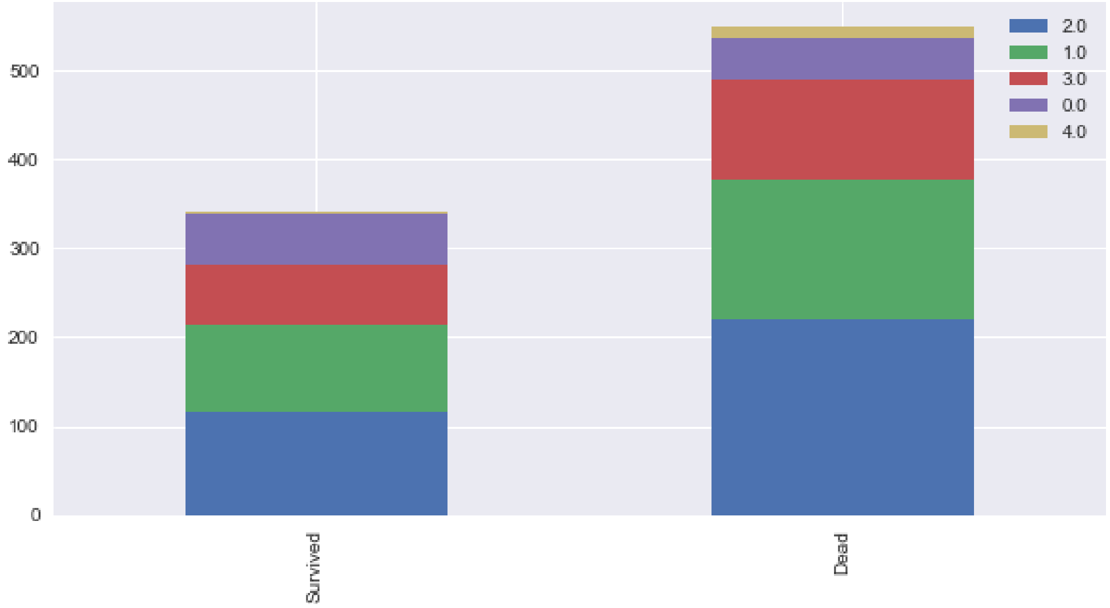
```
   PassengerId  Survived  Pclass  Sex   Age  SibSp  Parch            Ticket  \
0            1         0       3    0  22.0      1      0         A/5 21171
1            2         1       1    1  38.0      1      0          PC 17599
2            3         1       3    1  26.0      0      0  STON/O2. 3101282
3            4         1       1    1  35.0      1      0            113803
4            5         0       3    0  35.0      0      0            373450

      Fare Cabin Embarked  Title
0   7.2500   NaN        S      0
1  71.2833   C85        C      2
2   7.9250   NaN        S      1
3  53.1000  C123        S      2
4   8.0500   NaN        S      0
```

[39]:

```
for dataset in train_test_data:
    dataset.loc[ dataset['Age'] <= 16, 'Age'] = 0,
    dataset.loc[(dataset['Age'] > 16) & (dataset['Age'] <= 26), 'Age'] = 1,
    dataset.loc[(dataset['Age'] > 26) & (dataset['Age'] <= 36), 'Age'] = 2,
    dataset.loc[(dataset['Age'] > 36) & (dataset['Age'] <= 62), 'Age'] = 3,
    dataset.loc[ dataset['Age'] > 62, 'Age'] = 4
# for dataset in train_test_data:
#     dataset.loc[]
#train[train['Age'].isin([23])]
```

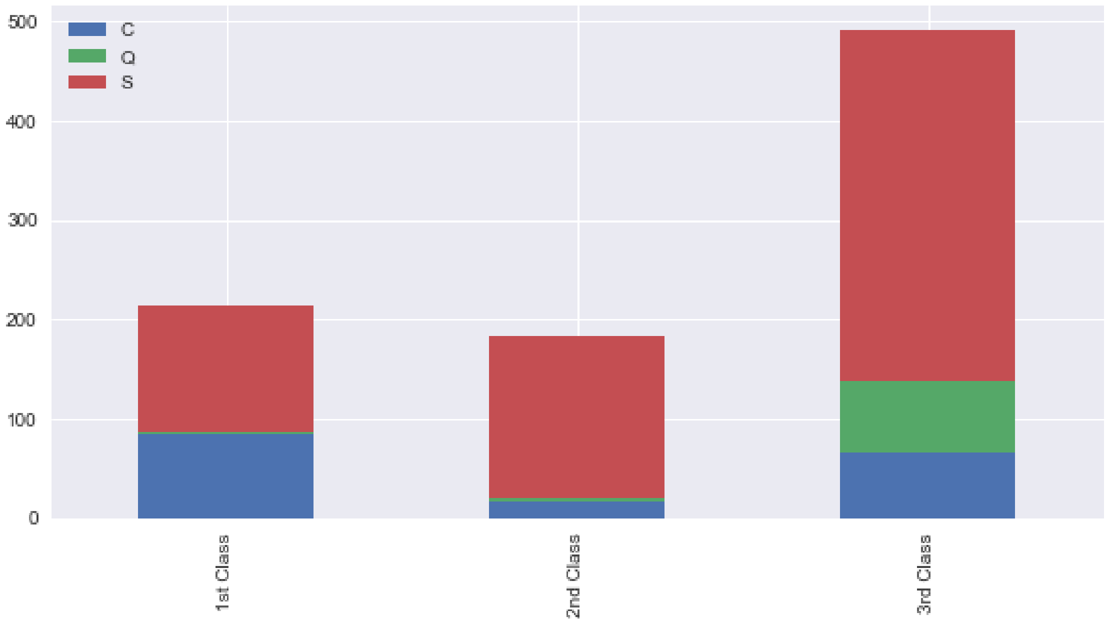
[40]:

```
train.head()
bar_chart('Age')
```



[41]:

```
Pclass1 = train[train['Pclass'] == 1]['Embarked'].value_counts()
Pclass2 = train[train['Pclass'] == 2]['Embarked'].value_counts()
Pclass3 = train[train['Pclass'] == 3]['Embarked'].value_counts()
df = pd.DataFrame([Pclass1,Pclass2,Pclass3])
df.index = ['1st Class','2nd Class','3rd Class']
df.plot(kind = 'bar', stacked =  True, figsize=(10,5))
plt.show()
print("Pclass1:\n",Pclass1)
print("Pclass2:\n",Pclass2)
print("Pclass3:\n",Pclass3)
```



```
Pclass1:
 S    127
C     85
Q      2
Name: Embarked, dtype: int64
Pclass2:
 S    164
C     17
Q      3
Name: Embarked, dtype: int64
Pclass3:
 S    353
Q     72
C     66
Name: Embarked, dtype: int64
```

more than 50 % of 1st class are from S embark.
more than 50 % of 2st class are from S embark.
more than 50 % of 3st class are from S embark.

fill out missing embark with S embark

[42]:
```
for dataset in train_test_data:
    dataset['Embarked'] =  dataset['Embarked'].fillna('S')
```

[43]:
```
train.head()
```

[43]:
```
   PassengerId  Survived  Pclass  Sex  Age  SibSp  Parch            Ticket  \
0            1         0       3    0  1.0      1      0         A/5 21171
1            2         1       1    1  3.0      1      0          PC 17599
2            3         1       3    1  1.0      0      0  STON/O2. 3101282
3            4         1       1    1  2.0      1      0            113803
4            5         0       3    0  2.0      0      0            373450

      Fare Cabin Embarked  Title
0   7.2500   NaN        S      0
1  71.2833   C85        C      2
2   7.9250   NaN        S      1
3  53.1000  C123        S      2
4   8.0500   NaN        S      0
```

[44]:
```
embarked_mapping = {'S':0,'C':1,'Q':2}
for dataset in train_test_data:
    dataset['Embarked'] = dataset['Embarked'].map(embarked_mapping)
```

[45]:
```
# train["Fare"].fillna(train.groupby("Pclass")["Fare"])
# train["Fare"].fillna(train.groupby("Pclass")["Fare"].transform("median"),␣
 ↪inplace = True)
# test["Fare"].fillna(test.groupby("Pclass")["Fare"].transform("median"),␣
 ↪inplace = True)
# train.head(50)


# fill missing Fare with median fare for each Pclass
train["Fare"].fillna(train.groupby("Pclass")["Fare"].transform("median"),␣
 ↪inplace=True)
test["Fare"].fillna(test.groupby("Pclass")["Fare"].transform("median"),␣
 ↪inplace=True)
train.head(50)
```

[45]:
```
    PassengerId  Survived  Pclass  Sex  Age  SibSp  Parch            Ticket  \
0             1         0       3    0  1.0      1      0         A/5 21171
1             2         1       1    1  3.0      1      0          PC 17599
2             3         1       3    1  1.0      0      0  STON/O2. 3101282
```

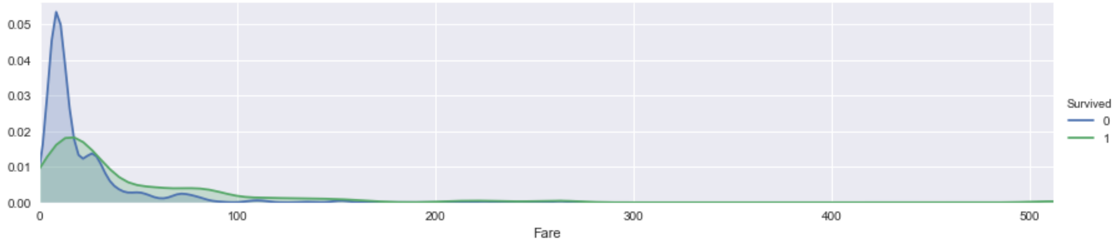
3	4	1	1	1	2.0	1	0	113803
4	5	0	3	0	2.0	0	0	373450
5	6	0	3	0	2.0	0	0	330877
6	7	0	1	0	3.0	0	0	17463
7	8	0	3	0	0.0	3	1	349909
8	9	1	3	1	2.0	0	2	347742
9	10	1	2	1	0.0	1	0	237736
10	11	1	3	1	0.0	1	1	PP 9549
11	12	1	1	1	3.0	0	0	113783
12	13	0	3	0	1.0	0	0	A/5. 2151
13	14	0	3	0	3.0	1	5	347082
14	15	0	3	1	0.0	0	0	350406
15	16	1	2	1	3.0	0	0	248706
16	17	0	3	0	0.0	4	1	382652
17	18	1	2	0	2.0	0	0	244373
18	19	0	3	1	2.0	1	0	345763
19	20	1	3	1	2.0	0	0	2649
20	21	0	2	0	2.0	0	0	239865
21	22	1	2	0	2.0	0	0	248698
22	23	1	3	1	0.0	0	0	330923
23	24	1	1	0	2.0	0	0	113788
24	25	0	3	1	0.0	3	1	349909
25	26	1	3	1	3.0	1	5	347077
26	27	0	3	0	2.0	0	0	2631
27	28	0	1	0	1.0	3	2	19950
28	29	1	3	1	1.0	0	0	330959
29	30	0	3	0	2.0	0	0	349216
30	31	0	1	0	3.0	0	0	PC 17601
31	32	1	1	1	2.0	1	0	PC 17569
32	33	1	3	1	1.0	0	0	335677
33	34	0	2	0	4.0	0	0	C.A. 24579
34	35	0	1	0	2.0	1	0	PC 17604
35	36	0	1	0	3.0	1	0	113789
36	37	1	3	0	2.0	0	0	2677
37	38	0	3	0	1.0	0	0	A./5. 2152
38	39	0	3	1	1.0	2	0	345764
39	40	1	3	1	0.0	1	0	2651
40	41	0	3	1	3.0	1	0	7546
41	42	0	2	1	2.0	1	0	11668
42	43	0	3	0	2.0	0	0	349253
43	44	1	2	1	0.0	1	2	SC/Paris 2123
44	45	1	3	1	1.0	0	0	330958
45	46	0	3	0	2.0	0	0	S.C./A.4. 23567
46	47	0	3	0	2.0	1	0	370371
47	48	1	3	1	1.0	0	0	14311
48	49	0	3	0	2.0	2	0	2662
49	50	0	3	1	1.0	1	0	349237

```
        Fare        Cabin  Embarked  Title
0     7.2500          NaN         0      0
1    71.2833          C85         1      2
2     7.9250          NaN         0      1
3    53.1000         C123         0      2
4     8.0500          NaN         0      0
5     8.4583          NaN         2      0
6    51.8625          E46         0      0
7    21.0750          NaN         0      3
8    11.1333          NaN         0      2
9    30.0708          NaN         1      2
10   16.7000           G6         0      1
11   26.5500         C103         0      1
12    8.0500          NaN         0      0
13   31.2750          NaN         0      0
14    7.8542          NaN         0      1
15   16.0000          NaN         0      2
16   29.1250          NaN         2      3
17   13.0000          NaN         0      0
18   18.0000          NaN         0      2
19    7.2250          NaN         1      2
20   26.0000          NaN         0      0
21   13.0000          D56         0      0
22    8.0292          NaN         2      1
23   35.5000           A6         0      0
24   21.0750          NaN         0      1
25   31.3875          NaN         0      2
26    7.2250          NaN         1      0
27  263.0000  C23 C25 C27         0      0
28    7.8792          NaN         2      1
29    7.8958          NaN         0      0
30   27.7208          NaN         1      3
31  146.5208          B78         1      2
32    7.7500          NaN         2      1
33   10.5000          NaN         0      0
34   82.1708          NaN         1      0
35   52.0000          NaN         0      0
36    7.2292          NaN         1      0
37    8.0500          NaN         0      0
38   18.0000          NaN         0      1
39   11.2417          NaN         1      1
40    9.4750          NaN         0      2
41   21.0000          NaN         0      2
42    7.8958          NaN         1      0
43   41.5792          NaN         1      1
44    7.8792          NaN         2      1
```

```
45    8.0500          NaN         0      0
46   15.5000          NaN         2      0
47    7.7500          NaN         2      1
48   21.6792          NaN         1      0
49   17.8000          NaN         0      2
```

[46]:

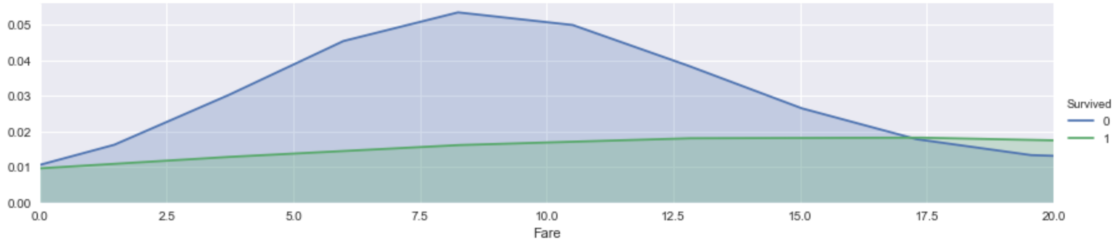
```
facet = sns.FacetGrid(train, hue="Survived",aspect=4 )
facet.map(sns.kdeplot, 'Fare', shade = True)
facet.set(xlim = (0, train['Fare'].max()))
facet.add_legend()
plt.show()
```



[47]:

```
facet = sns.FacetGrid(train, hue="Survived",aspect=4)
facet.map(sns.kdeplot,'Fare',shade= True)
facet.set(xlim=(0, train['Fare'].max()))
facet.add_legend()
plt.xlim(0, 20)
```

[47]: (0, 20)



[48]:

```
for dataset in train_test_data:
    dataset.loc[dataset['Fare'] <= 17, 'Fare'] = 0,
    dataset.loc[(dataset['Fare'] > 17) & (dataset['Fare'] <= 30), 'Fare'] = 1,
    dataset.loc[(dataset['Fare'] > 30) & (dataset['Fare'] <= 100), 'Fare'] = 2,
    dataset.loc[dataset['Fare'] >= 100, 'Fare'] = 3
```

[49]:

```
train.head()
```

[49]:

```
   PassengerId  Survived  Pclass  Sex  Age  SibSp  Parch            Ticket  \
0            1         0       3    0  1.0      1      0         A/5 21171
1            2         1       1    1  3.0      1      0          PC 17599
2            3         1       3    1  1.0      0      0  STON/O2. 3101282
3            4         1       1    1  2.0      1      0            113803
4            5         0       3    0  2.0      0      0            373450

   Fare Cabin  Embarked  Title
0   0.0   NaN         0      0
1   2.0   C85         1      2
2   0.0   NaN         0      1
3   2.0  C123         0      2
4   0.0   NaN         0      0
```

[50]:

```
train.Cabin.value_counts()
```

[50]:

```
B96 B98            4
G6                 4
C23 C25 C27        4
E101               3
C22 C26            3
D                  3
F2                 3
F33                3
B57 B59 B63 B66    2
E24                2
B20                2
B22                2
D17                2
C92                2
E33                2
E67                2
C52                2
F4                 2
B5                 2
B49                2
C65                2
D36                2
C93                2
C78                2
E25                2
B28                2
D33                2
D20                2
D35                2
B18                2
                  ..
```

```
C62 C64            1
B102               1
E46                1
B69                1
E68                1
C50                1
C106               1
D28                1
E50                1
D46                1
B19                1
C47                1
A24                1
C70                1
E36                1
C86                1
A34                1
C111               1
A32                1
D15                1
B101               1
A6                 1
B41                1
B94                1
B50                1
E17                1
C104               1
D56                1
B78                1
C95                1
Name: Cabin, Length: 147, dtype: int64
```

[51]:

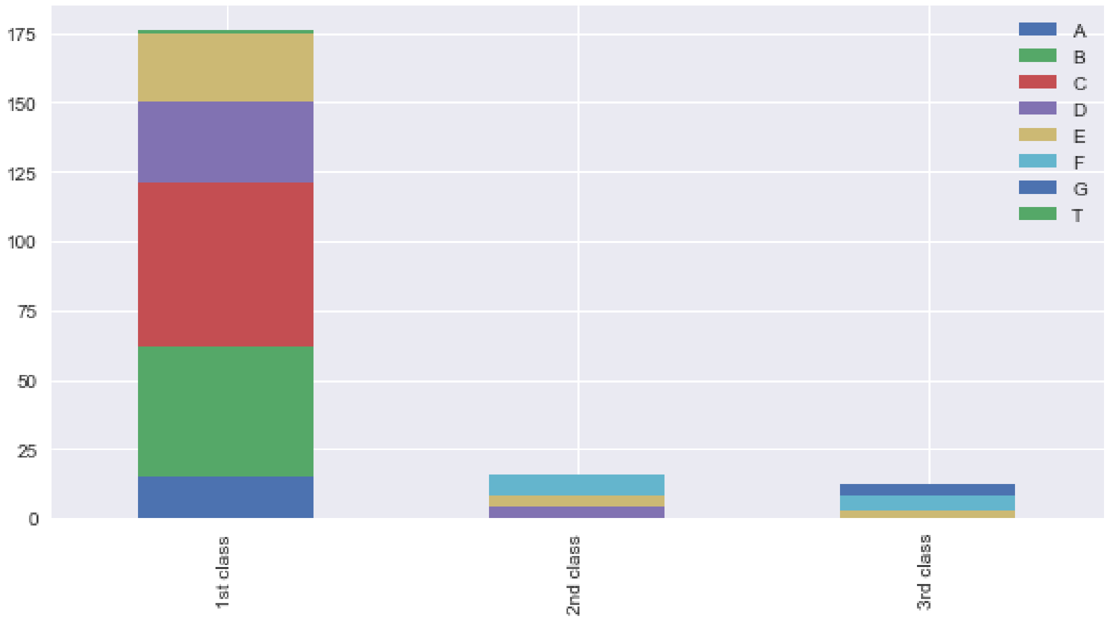
```
for dataset in train_test_data:
    dataset['Cabin'] =  dataset['Cabin'].str[:1]
```

[52]:

```
Pclass1 = train[train['Pclass']==1]['Cabin'].value_counts()
Pclass2 = train[train['Pclass']==2]['Cabin'].value_counts()
Pclass3 = train[train['Pclass']==3]['Cabin'].value_counts()
df = pd.DataFrame([Pclass1, Pclass2, Pclass3])
df.index = ['1st class','2nd class', '3rd class']
df.plot(kind='bar',stacked=True, figsize=(10,5))
```

[52]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2085f6b8748>
```



[53]:
```
cabin_mapping = {"A": 0, "B": 0.4, "C": 0.8, "D": 1.2, "E": 1.6, "F": 2, "G": 2.
 ↪4, "T": 2.8}
for dataset in train_test_data:
    dataset['Cabin'] = dataset['Cabin'].map(cabin_mapping)
```

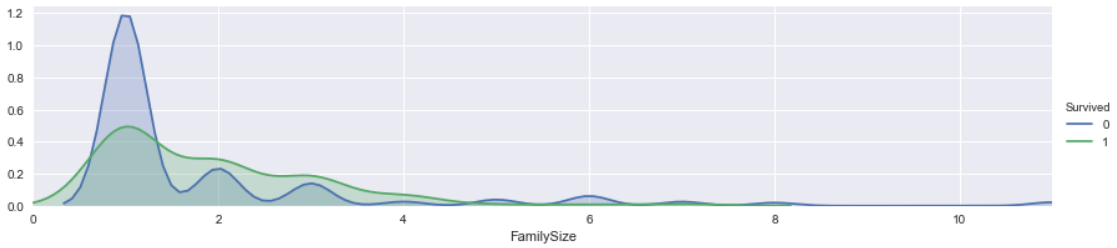
[54]:
```
# fill missing Fare with median fare for each Pclass
train["Cabin"].fillna(train.groupby("Pclass")["Cabin"].transform("median"),␣
 ↪inplace=True)
test["Cabin"].fillna(test.groupby("Pclass")["Cabin"].transform("median"),␣
 ↪inplace=True)
```

family Size

[55]:
```
train["FamilySize"] = train["SibSp"] + train["Parch"] + 1
test["FamilySize"] = test["SibSp"] + test["Parch"] + 1
```

[56]:
```
facet = sns.FacetGrid(train, hue="Survived",aspect=4)
facet.map(sns.kdeplot,'FamilySize',shade= True)
facet.set(xlim=(0, train['FamilySize'].max()))
facet.add_legend()
plt.xlim(0)
```

[56]:
```
(0, 11.0)
```



[57]:
```
family_mapping = {1: 0, 2: 0.4, 3: 0.8, 4: 1.2, 5: 1.6, 6: 2, 7: 2.4, 8: 2.8, 9:
 ↪ 3.2, 10: 3.6, 11: 4}
for dataset in train_test_data:
    dataset['FamilySize'] = dataset['FamilySize'].map(family_mapping)
```

[58]:
```
train.head()
```

[58]:
```
   PassengerId  Survived  Pclass  Sex  Age  SibSp  Parch            Ticket  \
0            1         0       3    0  1.0      1      0         A/5 21171
1            2         1       1    1  3.0      1      0          PC 17599
2            3         1       3    1  1.0      0      0  STON/O2. 3101282
3            4         1       1    1  2.0      1      0            113803
4            5         0       3    0  2.0      0      0            373450

   Fare  Cabin  Embarked  Title  FamilySize
0   0.0    2.0         0      0         0.4
1   2.0    0.8         1      2         0.4
2   0.0    2.0         0      1         0.0
3   2.0    0.8         0      2         0.4
4   0.0    2.0         0      0         0.0
```

[59]:
```
features_drop = ['Ticket','SibSp','Parch']
train = train.drop(features_drop, axis = 1)
test = test.drop(features_drop,axis=1)
train = train.drop(['PassengerId'], axis=1)
```

[60]:
```
train_data = train.drop('Survived', axis = 1)
target = train['Survived']
train_data.shape, target.shape
```

[60]:
```
((891, 8), (891,))
```

[61]:
```
train_data.head(10)
```

[61]:
```
   Pclass  Sex  Age  Fare  Cabin  Embarked  Title  FamilySize
0       3    0  1.0   0.0    2.0         0      0         0.4
1       1    1  3.0   2.0    0.8         1      2         0.4
```

```
2        3    1  1.0    0.0    2.0          0      1          0.0
3        1    1  2.0    2.0    0.8          0      2          0.4
4        3    0  2.0    0.0    2.0          0      0          0.0
5        3    0  2.0    0.0    2.0          2      0          0.0
6        1    0  3.0    2.0    1.6          0      0          0.0
7        3    0  0.0    1.0    2.0          0      3          1.6
8        3    1  2.0    0.0    2.0          0      2          0.8
9        2    1  0.0    2.0    1.8          1      2          0.4
```

3 5. Modelling

[62]:

```
# Importing Classifier Modules
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier,ExtraTreeClassifier
from sklearn.ensemble import␣
 ↪RandomForestClassifier,ExtraTreesClassifier,BaggingClassifier,AdaBoostClassifier,GradientBo
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC

import numpy as np
```

[63]:

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 9 columns):
Survived      891 non-null int64
Pclass        891 non-null int64
Sex           891 non-null int64
Age           891 non-null float64
Fare          891 non-null float64
Cabin         891 non-null float64
Embarked      891 non-null int64
Title         891 non-null int64
FamilySize    891 non-null float64
dtypes: float64(4), int64(5)
memory usage: 62.7 KB
```

4 6.Cross Validation(k-fold)

[64]:

```
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
k_fold = KFold(n_splits=10, shuffle=True, random_state=0)
```

[65]:

```
clf = KNeighborsClassifier(n_neighbors = 13)
scoring = 'accuracy'
score = cross_val_score(clf, train_data, target, cv=k_fold, n_jobs=1,␣
 ↪scoring=scoring)
print(score)
```

```
[0.82222222 0.76404494 0.80898876 0.83146067 0.87640449 0.82022472
 0.85393258 0.79775281 0.84269663 0.84269663]
```

[66]:

```
#learning_rates = [0.05, 0.1, 0.25, 0.5, 0.75, 1]
clf = [KNeighborsClassifier(n_neighbors = 13),DecisionTreeClassifier(),
      ␣
 ↪RandomForestClassifier(n_estimators=13),GaussianNB(),SVC(),ExtraTreeClassifier(),
      GradientBoostingClassifier(n_estimators=10,␣
 ↪learning_rate=1,max_features=3, max_depth =3, random_state =␣
 ↪10),AdaBoostClassifier(),ExtraTreesClassifier()]
def model_fit():
    scoring = 'accuracy'
    for i in range(len(clf)):
        score = cross_val_score(clf[i], train_data, target, cv=k_fold,␣
 ↪n_jobs=1, scoring=scoring)
        print("Score of Model",i,":",round(np.mean(score)*100,2))
#     round(np.mean(score)*100,2)
#     print("Score of :\n",score)
model_fit()
```

```
Score of Model 0 : 82.6
Score of Model 1 : 79.8
Score of Model 2 : 80.92
Score of Model 3 : 78.78
Score of Model 4 : 83.5
Score of Model 5 : 80.02
Score of Model 6 : 81.25
Score of Model 7 : 81.03
Score of Model 8 : 80.7
```

[67]:

```
clf1 = SVC()
clf1.fit(train_data, target)
test
test_data = test.drop(['Survived','PassengerId'], axis=1)
prediction = clf1.predict(test_data)
# test_data
```

[73]:

```
test_data['Survived'] = prediction
submission = pd.DataFrame(test['PassengerId'],test_data['Survived'])
submission.to_csv("Submission.csv")
```

[ ]:

```
```