** Data Visualization I**

1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data.
2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram

In [ ]:

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import chi2_contingency
%matplotlib inline
%config InlineBackend.figure_format = 'retina'
plt.style.use('seaborn-ticks')

SMALL_SIZE = 13
MEDIUM_SIZE = 14
BIGGER_SIZE = 16

plt.rc('font', size=SMALL_SIZE)          # controls default text sizes
plt.rc('axes', titlesize=SMALL_SIZE)     # fontsize of the axes title
plt.rc('axes', labelsize=MEDIUM_SIZE)    # fontsize of the x and y labels
plt.rc('xtick', labelsize=MEDIUM_SIZE)    # fontsize of the tick labels
plt.rc('ytick', labelsize=MEDIUM_SIZE)    # fontsize of the tick labels
plt.rc('legend', fontsize=SMALL_SIZE)    # legend fontsize
```

In [3]:
```
titanic_data = pd.read_csv('/home/mca01/Downloads/titanic-data.csv')
```

In [4]:
```
titanic_data.head(5)
```

Out[4]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Tic
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	21
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/ 3101
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373

In [5]:
```
titanic_data.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
```

Drop the unwanted columns

In [6]:
```
n_titanic_data=titanic_data.drop(['Cabin','Ticket','Name',
                                  'Fare','PassengerId'],axis=1)
```

In [7]:
```
n_titanic_data.head()
```

Out[7]:

	Survived	Pclass	Sex	Age	SibSp	Parch	Embarked
0	0	3	male	22.0	1	0	S
1	1	1	female	38.0	1	0	C
2	1	3	female	26.0	0	0	S
3	1	1	female	35.0	1	0	S
4	0	3	male	35.0	0	0	S

In [8]:
```
n_titanic_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Survived  891 non-null    int64
 1   Pclass    891 non-null    int64
 2   Sex       891 non-null    object
 3   Age       714 non-null    float64
 4   SibSp     891 non-null    int64
 5   Parch     891 non-null    int64
 6   Embarked  889 non-null    object
dtypes: float64(1), int64(4), object(2)
memory usage: 48.9+ KB
```

We have only 714 Age values out of 891 of the entries and 2 values missing from the Embarked Variable. We will have to decide whether to omit these or impute them with some values when we model relationships based on Age or Embarked.

In [ ]:
```
```

Further Exploration - Visualizations

We will change the keys to make them better readable and explore the initial composition of the passengers.

Make another copy of the new dataframe

Change the embarked keys to better readable ones

And the survived keys

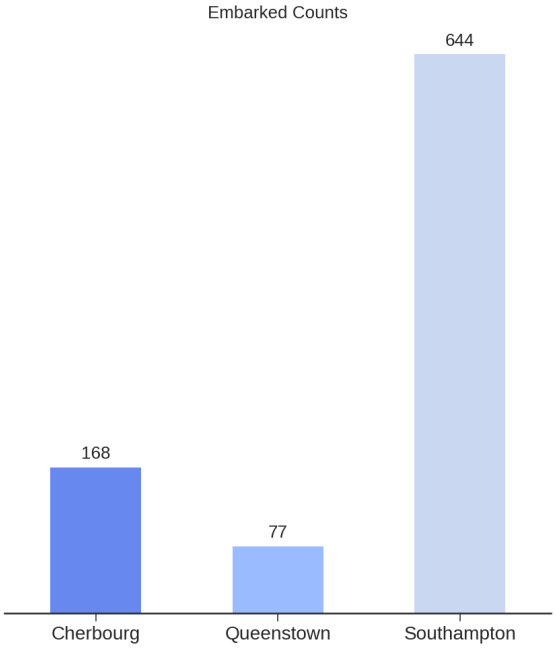
In [9]:
```
descript = n_titanic_data.copy()

descript.loc[:,'Embarked'].replace(['C','S','Q'],
                                   ['Cherbourg','Southampton','Queenstown'],
                                   inplace=True)

descript.loc[:,'Survived'].replace([0,1],['No','Yes'],inplace=True)
```

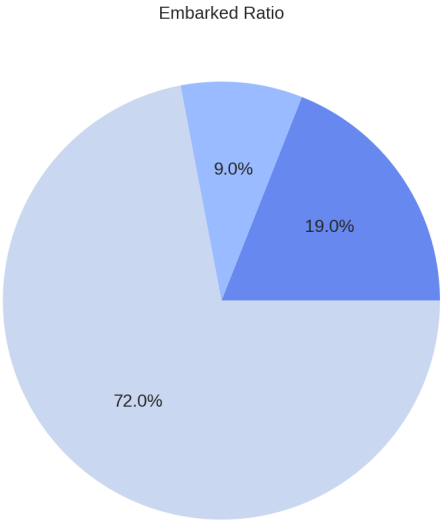
In [10]:
```
# Make a function to get the composition of the variables per number of pass
def Groupby_OneCol_comp_plot(df, col, plt_style = 'seaborn-ticks', color_pal
    '''
    Group by col1, sort by size , return and plot the dataframe with a bar a
    '''
    gr=pd.DataFrame()
    gr['{} No'.format(col)] = df.groupby(col).size()
    gr['{} Ratio'.format(col)] = np.round(gr['{} No'.format(col)].divide(gr[

    print ('Total No. of {}:{}'.format(col,gr['{} No'.format(col)].sum()))

    plt.style.use(plt_style)
    sns.set_palette(sns.color_palette(color_palette))

    fig=plt.figure()
    plt.axis('off')

    fig.add_subplot(121)

    ax=gr['{} No'.format(col)].plot(kind='bar', title='{} Counts'.format(col
    _ = plt.setp(ax.get_xticklabels(), rotation=0)
    for p in ax.patches: ax.annotate(np.round(p.get_height(),decimals=2),
                                     (p.get_x()+p.get_width()/2., p.get_heig
                                     ha='center', va='center', xytext=(0, 10
    ax.get_yaxis().set_ticks([])
    plt.xlabel('')

    fig.add_subplot(122)
    plt.axis('off')
    gr.loc[:,'{} Ratio'.format(col)].plot(kind= 'pie',
                                     autopct='%1.1f%%',shadow=False,
                                     title='{} Ratio'.format(col), legend=Fa
    sns.despine(top=True, right=True, left=True, bottom=False);
```

Analysis of the Embarked variable.

In [11]:
```
Groupby_OneCol_comp_plot(descript, 'Embarked')
```

```
Total No. of Embarked:889
```





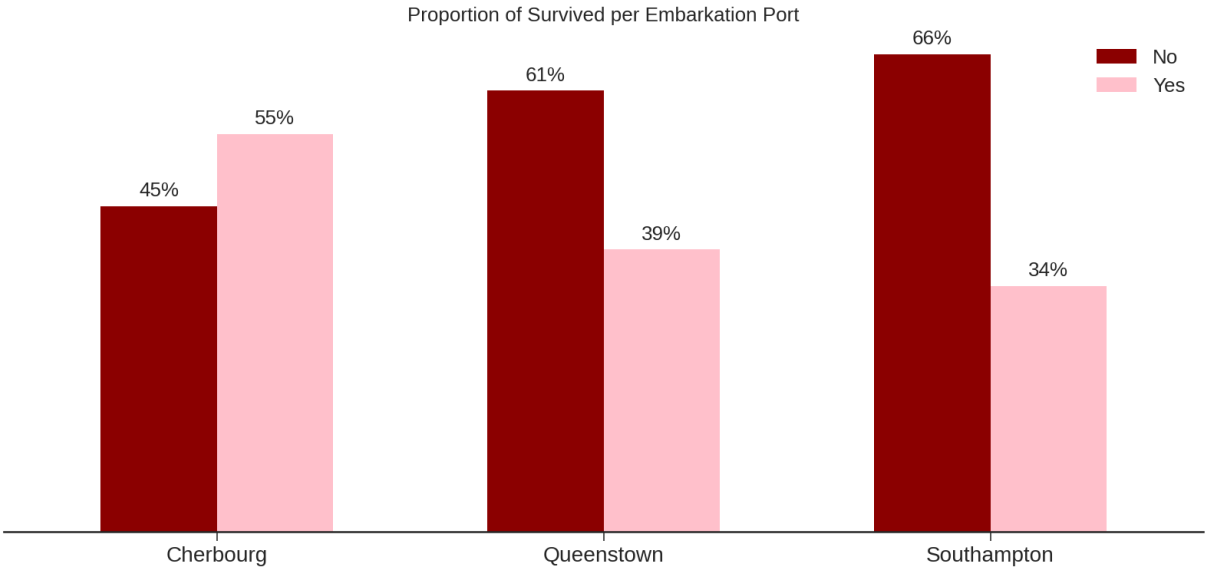
Correlation of Survived with Embarked

.

In [12]:
```
def plot(table, legloc='upper right',
                                    plt_style = 'seaborn-ticks',
                                    color_palette="dark",sorter=None, stacke
                                    kind = 'bar', percentage = True,
                                custom_title=None, minimal=True, figsize=(19,
    grouped = table

    #Tranform to percentages
    if percentage == True:
        grouped = np.round(grouped.divide(grouped['Total'],axis=0)*100,0)
    try:
        del grouped['Total']
    except:
        pass

    # rearrange the columns
    if sorter:
        grouped = grouped[sorter]

    plt.style.use(plt_style)
    sns.set_palette(sns.color_palette(color_palette))
    ax = grouped.plot(kind=kind,stacked=stacked, figsize=figsize, width=widt
    _ = plt.setp(ax.get_xticklabels(), rotation=0)  # Rotate labels
    plt.legend(loc=legloc) # plot the legend normally

    #annotate the bars
    if percentage == True:
      for p in ax.patches:
            ax.annotate('{}%'.format(int(np.round(p.get_height(),decimals=2)
                                         (p.get_x()+p.get_width()/2.,
```

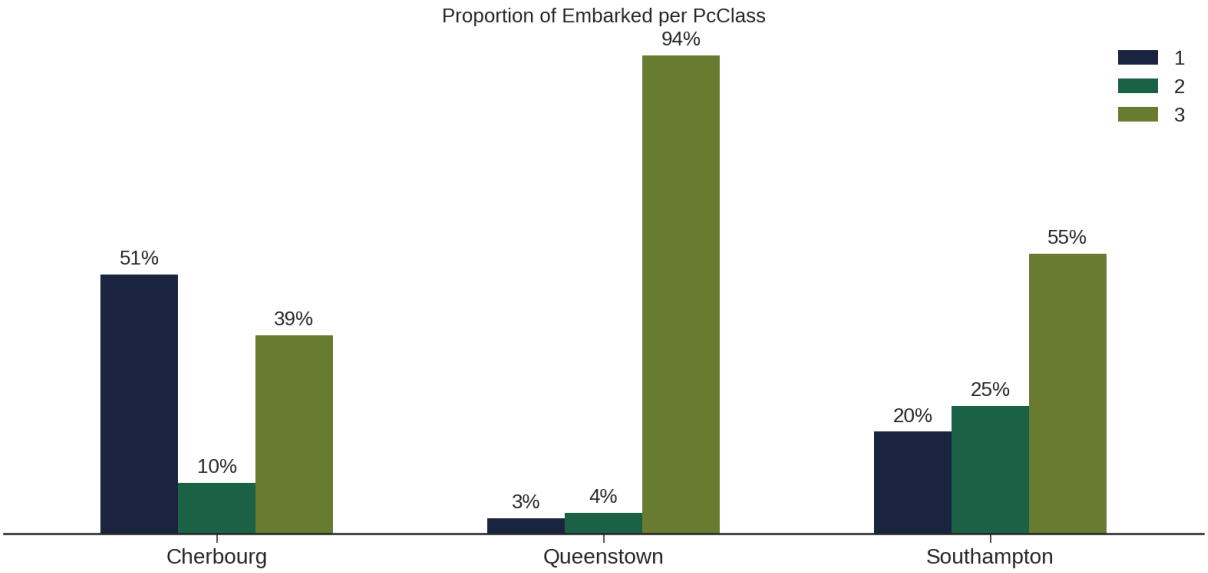
```
                                          p.get_height()), ha='center', va='
                                        xytext=(0, 10), textcoords='offset p
    else:
      for p in ax.patches:
            ax.annotate(np.round(p.get_height(),decimals=2),
                                         (p.get_x()+p.get_width()/2.,
                                          p.get_height()), ha='center', va='
                                        xytext=(0, 10), textcoords='offset p
    if minimal == True:
        ax.get_yaxis().set_ticks([])
        plt.xlabel('')
        sns.despine(top=True, right=True, left=True, bottom=False);
    else:
        pass
    # set custom title
    plt.title(custom_title)

def Groupby_TwoCol_Plot(df, col1, col2, legloc='upper right',
                                    plt_style = 'ggplot',
                                    color_palette="dark",sorter=None, stacke
                                    kind = 'bar', percentage = True,
                                custom_title=None, minimal=True, figsize=(14,

    #Group by Placement and Representative and unstack by Placement
    grouped = df.groupby([col2,col1]).size().unstack(col2)

    #Make a totals column sort and delete after
    grouped['Total'] = grouped.sum(axis=1)
    #grouped = grouped.sort_values('Total', ascending = False)

    plot(grouped, legloc=legloc,
                                    plt_style = plt_style,
                                    color_palette=color_palette,sorter=sorte
                                    kind = kind , percentage = percentage,
                                custom_title=custom_title, minimal=minimal, f
```

In [13]:
```
Groupby_TwoCol_Plot(descript,'Embarked', 'Survived', color_palette=('darkred
                    plt_style = 'seaborn-ticks', custom_title='Proportion of
```



Correlation of Embarked with Pclass

In [14]:
```
#Calculate percentages of port passengers per Class
Groupby_TwoCol_Plot(descript,'Embarked', 'Pclass', color_palette=('cubehelix
                    plt_style = 'seaborn-ticks', custom_title='Proportion of
```

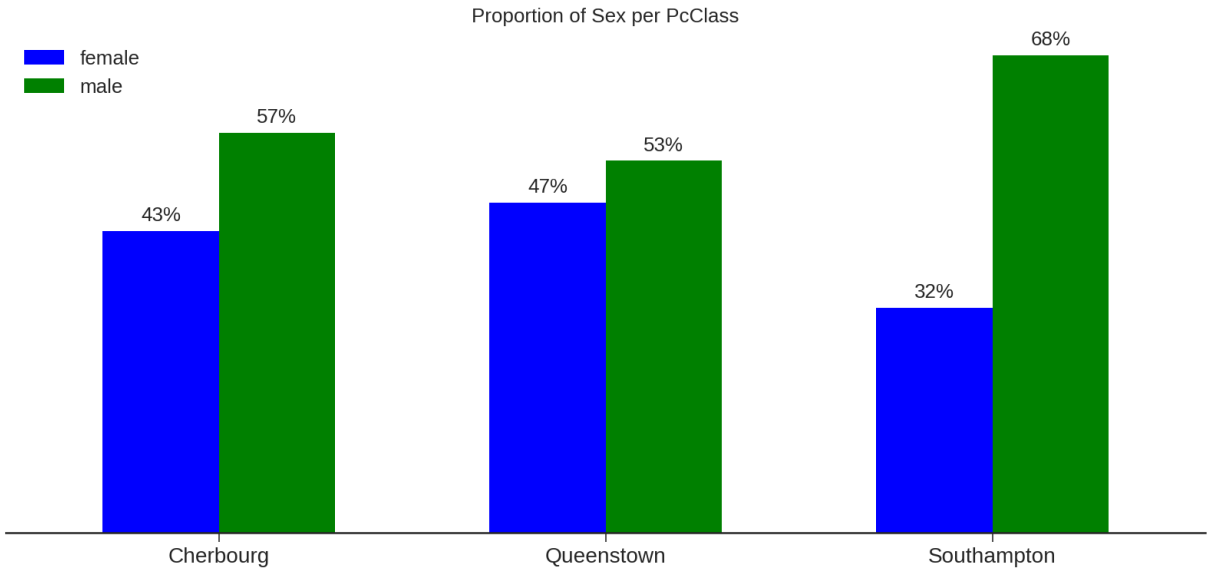


Data Visualization II

1. Use the inbuilt dataset 'titanic' as used in the above problem. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age')
2. Write observations on the inference from the above statistics

Correlation of Embarked with Sex.

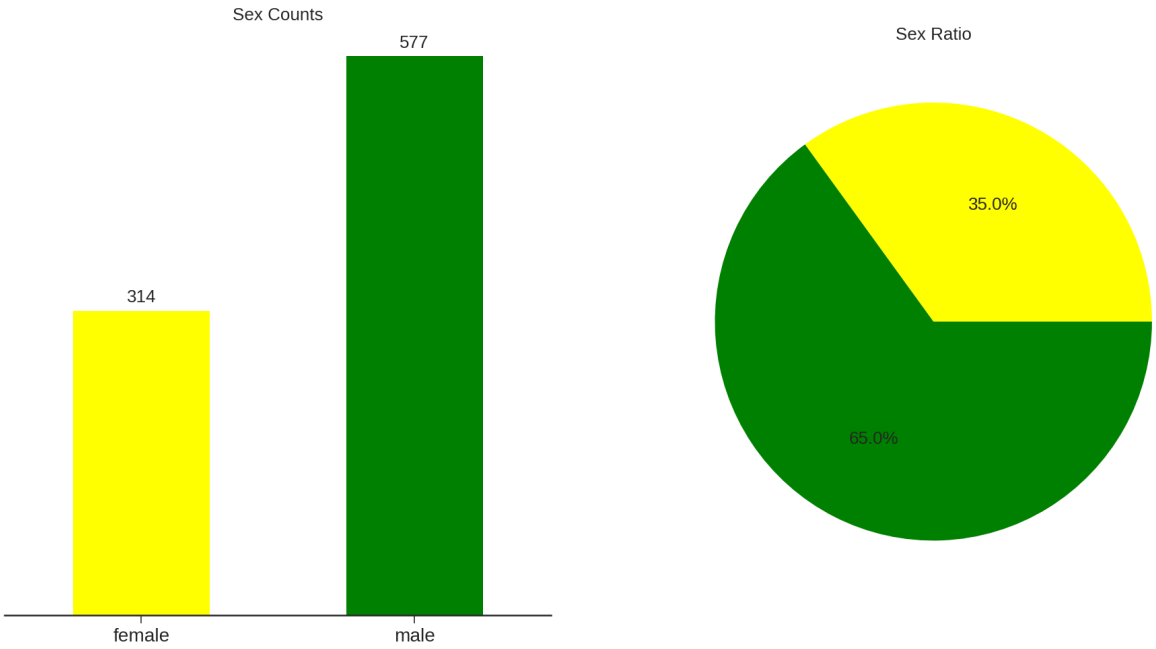
In [15]:
```
#Calculate percentages of port passengers per Sex
Groupby_TwoCol_Plot(descript,'Embarked', 'Sex', color_palette=('blue','green
                    plt_style = 'seaborn-ticks', custom_title='Proportion of
                   legloc='upper left')
```



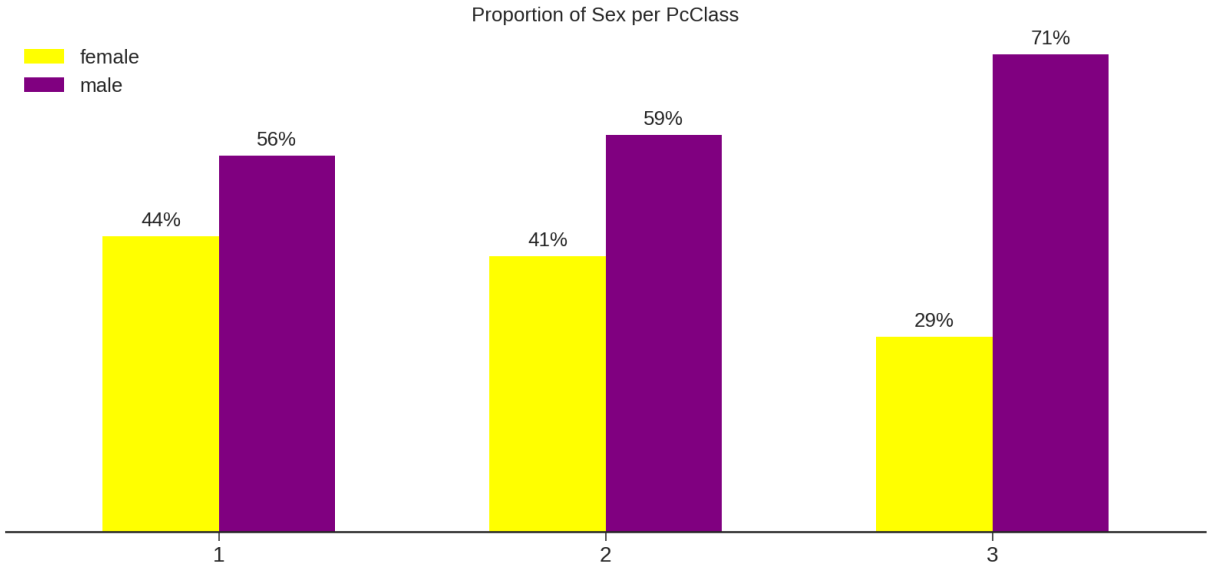
Analysis of the Sex variable

In [16]:
```
Groupby_OneCol_comp_plot(descript, 'Sex', color_palette = ('yellow','green')
```

```
Total No. of Sex:891
```

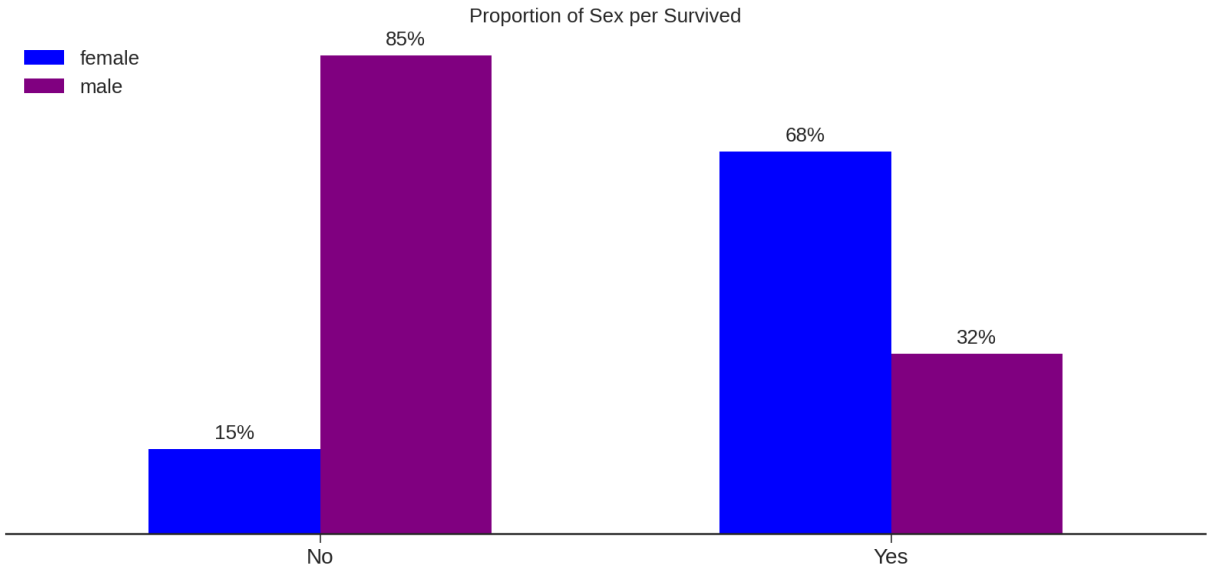


In [17]:
```
#Calculate percentages of Pclass per Sex
Groupby_TwoCol_Plot(descript,'Pclass', 'Sex', color_palette=('yellow','purpl
                    plt_style = 'seaborn-ticks', custom_title='Proportion of
                   legloc='upper left')
```



Correlation of Sex with Survived

In [18]:
```
Groupby_TwoCol_Plot(descript,'Survived', 'Sex', color_palette=('blue','purpl
                    plt_style = 'seaborn-ticks', custom_title='Proportion of
                   legloc='upper left')
```



Analysis of the Age variable

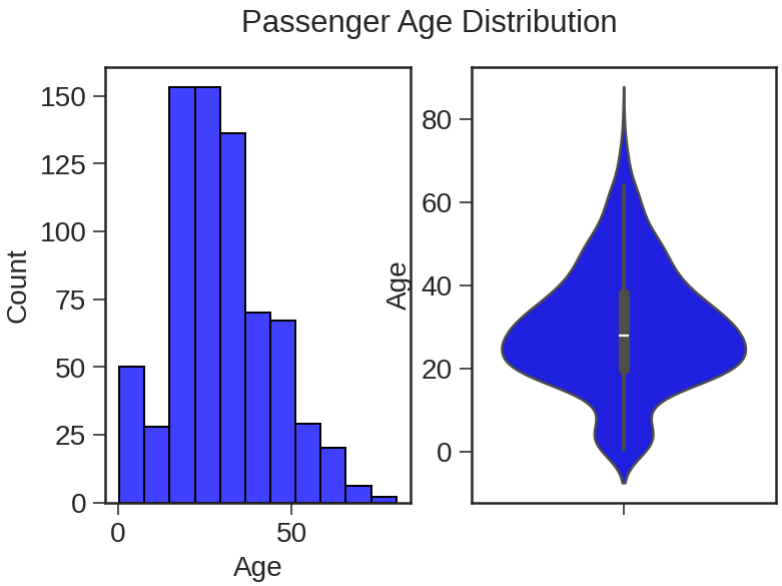
In [19]:
```
#Make a dataframe for non missing 'Age'values
not_missing = n_titanic_data[(n_titanic_data['Age'].notnull())]

#And replace the survived keys
not_missing.loc[:,'Survived'].replace([0,1],['No','Yes'],inplace=True)
```

```
/usr/lib/python3/dist-packages/pandas/core/generic.py:6619: SettingWithCopyW
arning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  return self._update_inplace(result)
```

In [20]:
```
print ('No. of Passengers with not missing Age Values:{}'.format(len(not_mis
```

```
No. of Passengers with not missing Age Values:714
```

In [22]:
```
ax=plt.figure()
plt.suptitle('Passenger Age Distribution')
ax.add_subplot(121)
sns.histplot(not_missing['Age'],bins=11)
ax.add_subplot(122)
sns.violinplot(not_missing['Age']);
```



In [23]:
```
# Get summary descriptive statistics
v= pd.DataFrame(not_missing['Age'].describe())

#Change the index labels and round the values reported
v.index = ['Population Size', 'Mean', 'Std. Deviation', 'Min', '25% Qt', 'Me
               '75% Qt', 'Max']
v = v.round(decimals=3)
v
```

Out[23]:

	Age
Population Size	714.000
Mean	29.699
Std. Deviation	14.526
Min	0.420
25% Qt	20.125
Median	28.000
75% Qt	38.000
Max	80.000

We observe that the percentage of children below 10 that survived was significantly higher and almost nobody over 70 year's old survived. We would like to examine if this was by luck or by some other underlying reason (like the 'Women and Children first' rule).

In [24]:
```
#Make a datframe with the sample populations
age = pd.DataFrame()
age['all'] = not_missing['Age']
not_survived = age['Not-survived'] = not_missing['Age'][not_missing['Survive
survived = age['Survived'] = not_missing['Age'][not_missing['Survived']=='Ye

#Get the summary statistics
var = age.describe()

#Change the index labels and round the values reported
var.index = ['Sample Size', 'Mean', 'Std. Deviation', 'Min', '25% Qt', 'Medi
             '75% Qt', 'Max']
var = var.round(decimals=3)
```

In [25]:
```
var.loc[:,['Not-survived','Survived']]
```

Out[25]:

	Not-survived	Survived
Sample Size	424.000	290.000
Mean	30.626	28.344
Std. Deviation	14.172	14.951
Min	1.000	0.420
25% Qt	21.000	19.000
Median	28.000	28.000
75% Qt	39.000	36.000
Max	74.000	80.000

Survived- Age Statistical Chi-SquaredTest

We will test the following hypotheses:

H0 : The Null Hypothesis, that there is no relationship between the Survived and Age variables (independent) →Oi≠Ei

H1 : The Alternative Hypothesis, that there is a relationship between the Survived and Age variables (dependent) →Oi=Ei

In [26]:
```
#Create age-groups
age_labels = ['0-9', '10-19', '20-29', '30-39', '40-49', '50-59', '60-69',
              '70-80']
age_group_values = pd.cut(not_missing.Age, range(0,81,10),
                                    right=False, labels=age_labels)
not_missing.loc[:,'age-groups'] = age_group_values

#Set the value for the one 80-year old outside the bins
#chi-squared is notvalid for no of observations below 5
not_missing.loc[not_missing['Age']>=80, 'age-groups'] = '70-80'

#Make an observed-table for chi-squared test
obs_table = pd.crosstab([not_missing['Survived']],[not_missing['age-groups']
```

```
/usr/lib/python3/dist-packages/pandas/core/indexing.py:1667: SettingWithCopy
Warning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  self.obj[key] = value
/usr/lib/python3/dist-packages/pandas/core/indexing.py:1817: SettingWithCopy
Warning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  self._setitem_single_column(loc, value, pi)
```

In [27]:
```
obs_table
```

Out[27]:

age-groups	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-80
Survived								
No	24	61	143	94	55	28	13	6
Yes	38	41	77	73	34	20	6	1

In [28]:
```
#Compute Chi-square statistic
chi2, p, dof, expected = chi2_contingency(obs_table)

#report results
print('chi2:{}\ndof:{}\np:{}'.format(chi2,dof,p))
```

```
chi2:17.42772160585894
dof:7
p:0.014836878112813482
```

For a=.05 and 7 degrees of freedom, p is smaller than 0.05 and we therefore reject the Null-Hypothesis and accept that Survived and Age are dependent variables and that there is indeed a relationship between age and survivabilit

In [ ]:
```

```