Import all the required libraries and the data from the excel sheet

In [ ]:

```
import pandas as pd
import numpy as np
from scipy.stats.distributions import chi2
import matplotlib.pyplot as plt
import seaborn as sns
data = pd.read_excel('titanic.xls')
data
```

Out[ ]:

	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	embarked
0	1	1	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	S
1	1	1	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	S
2	1	0	Allison, Miss. Helen Loraine	female	2.0000	1	2	113781	151.5500	S
3	1	0	Allison, Mr. Hudson Joshua Creighton	male	30.0000	1	2	113781	151.5500	S
4	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	25.0000	1	2	113781	151.5500	S
...	...	...	...	...	...	...	...	...	...	...
1304	3	0	Zabour, Miss. Hileni	female	14.5000	1	0	2665	14.4542	C
1305	3	0	Zabour, Miss. Thamine	female	NaN	1	0	2665	14.4542	C
1306	3	0	Zakarian, Mr. Mapriededer	male	26.5000	0	0	2656	7.2250	C
1307	3	0	Zakarian, Mr. Ortin	male	27.0000	0	0	2670	7.2250	C
1308	3	0	Zimmerman, Mr. Leo	male	29.0000	0	0	315082	7.8750	S

1309 rows × 10 columns

Q1: a) Count missing values in each column

In [ ]:

```
def countMissing(data):
    ret = []
    for col in data.columns:
        nulls = 0
        for val in data[col].tolist():
            if pd.isnull(val):
                nulls += 1
        ret.append(nulls)
    return pd.DataFrame(ret, index=data.columns, columns=['nulls'])

countMissing(data)
```

Out[ ]:

	nulls
pclass	0
survived	0
name	0
sex	0
age	263
sibsp	0
parch	0
ticket	0
fare	1
embarked	2

Q1: b) Remove rows/attributes having missing values and calculate the ratio with respect to original data

Part 1: When removing Columns with missing data:

In [ ]:

```
def removeRows(data):
    nul = []
    for col in data.columns:
        for val in data[col].tolist():
            if pd.isnull(val):
                nul.append(col)
                break
    data_copy = data.copy()
    for r in nul:
        data_copy = data_copy.drop(r, axis=1)
    # print ratio of removed columns
    print("Ratio of wrt to original data, when attributes are dropped:", len(data_copy.col
    return data_copy
removeRows(data)
```

```
Ratio of wrt to original data, when attributes are dropped: 0.7
```

Out[ ]:

	pclass	survived	name	sex	sibsp	parch	ticket
0	1	1	Allen, Miss. Elisabeth Walton	female	0	0	24160
1	1	1	Allison, Master. Hudson Trevor	male	1	2	113781
2	1	0	Allison, Miss. Helen Loraine	female	1	2	113781
3	1	0	Allison, Mr. Hudson Joshua Creighton	male	1	2	113781
4	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	1	2	113781
...	...	...	...	...	...	...	...
1304	3	0	Zabour, Miss. Hileni	female	1	0	2665
1305	3	0	Zabour, Miss. Thamine	female	1	0	2665
1306	3	0	Zakarian, Mr. Mapriededer	male	0	0	2656
1307	3	0	Zakarian, Mr. Ortin	male	0	0	2670
1308	3	0	Zimmerman, Mr. Leo	male	0	0	315082

1309 rows × 7 columns

Part 2: When removing Rows with missing data:

In [ ]:

```
def removeCols(data):
    nul = []
    for row in data.itertuples():
        for val in list(row)[1:]:
            if pd.isnull(val):
                nul.append(row[0])
                break
    data_copy = data.copy()
    for r in nul:
        data_copy = data_copy.drop(r, axis=0)
    # print ratio of removed rows
    print("Ratio of wrt to original data, when rows are dropped:", len(data_copy.index)/le
    return data_copy
removeCols(data)
```

```
Ratio of wrt to original data, when rows are dropped: 0.7967914438502673
```

Out[ ]:

	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	embarked
0	1	1	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	S
1	1	1	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	S
2	1	0	Allison, Miss. Helen Loraine	female	2.0000	1	2	113781	151.5500	S
3	1	0	Allison, Mr. Hudson Joshua Creighton	male	30.0000	1	2	113781	151.5500	S
4	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	25.0000	1	2	113781	151.5500	S
...	...	...	...	...	...	...	...	...	...	...
1301	3	0	Youseff, Mr. Gerious	male	45.5000	0	0	2628	7.2250	C
1304	3	0	Zabour, Miss. Hileni	female	14.5000	1	0	2665	14.4542	C
1306	3	0	Zakarian, Mr. Mapriededer	male	26.5000	0	0	2656	7.2250	C
1307	3	0	Zakarian, Mr. Ortin	male	27.0000	0	0	2670	7.2250	C
1308	3	0	Zimmerman, Mr. Leo	male	29.0000	0	0	315082	7.8750	S

1043 rows × 10 columns

Q1: c) Replace missing values (in original file) of age attribute with:

- Mean
- Median

> lets make a generic function which can perform replacing data effectively.

In [ ]:

```
def replace(df, col, property):
    df['filled-'+col] = df[col].fillna(getattr(data[col], property)())
    return df

data = replace(data, 'age', 'mean')
data
```

Out[ ]:

	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	embarked	filled-age
0	1	1	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	S	29.000000
1	1	1	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	S	0.916700
2	1	0	Allison, Miss. Helen Loraine	female	2.0000	1	2	113781	151.5500	S	2.000000
3	1	0	Allison, Mr. Hudson Joshua Creighton	male	30.0000	1	2	113781	151.5500	S	30.000000
4	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	25.0000	1	2	113781	151.5500	S	25.000000
...	...	...	...	...	...	...	...	...	...	...	...
1304	3	0	Zabour, Miss. Hileni	female	14.5000	1	0	2665	14.4542	C	14.500000
1305	3	0	Zabour, Miss. Thamine	female	NaN	1	0	2665	14.4542	C	29.881135
1306	3	0	Zakarian, Mr. Mapriededer	male	26.5000	0	0	2656	7.2250	C	26.500000
1307	3	0	Zakarian, Mr. Ortin	male	27.0000	0	0	2670	7.2250	C	27.000000
1308	3	0	Zimmerman, Mr. Leo	male	29.0000	0	0	315082	7.8750	S	29.000000

1309 rows × 11 columns

In [ ]:

```
replace(data, 'age', 'median')
```

Out[ ]:

	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	embarked	filled-age
0	1	1	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	S	29.0000
1	1	1	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	S	0.9167
2	1	0	Allison, Miss. Helen Loraine	female	2.0000	1	2	113781	151.5500	S	2.0000
3	1	0	Allison, Mr. Hudson Joshua Creighton	male	30.0000	1	2	113781	151.5500	S	30.0000
4	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	25.0000	1	2	113781	151.5500	S	25.0000
...	...	...	...	...	...	...	...	...	...	...	...
1304	3	0	Zabour, Miss. Hileni	female	14.5000	1	0	2665	14.4542	C	14.5000
1305	3	0	Zabour, Miss. Thamine	female	NaN	1	0	2665	14.4542	C	28.0000
1306	3	0	Zakarian, Mr. Mapriededer	male	26.5000	0	0	2656	7.2250	C	26.5000
1307	3	0	Zakarian, Mr. Ortin	male	27.0000	0	0	2670	7.2250	C	27.0000
1308	3	0	Zimmerman, Mr. Leo	male	29.0000	0	0	315082	7.8750	S	29.0000

1309 rows × 11 columns

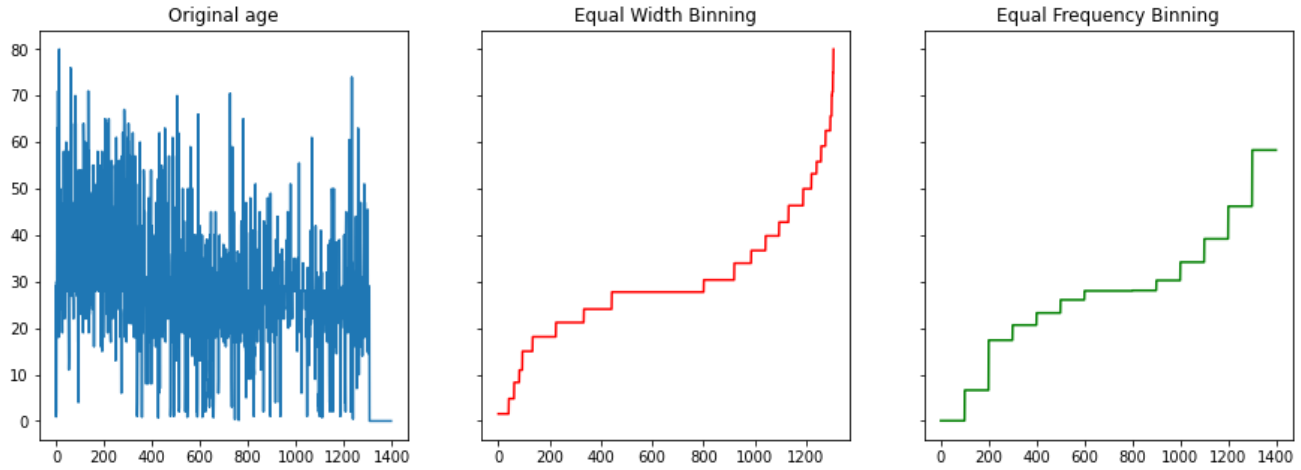
Q2: WAP to perform transformation of data on age attribute of Titanic dataset using Binning

a) With equal width bins using K=25, using mean (you may fill zero value to balance last bin)
b) With equal frequency bins of size 100 using mean (you may fill zero value to balance last bin)

In [ ]:

```
def binningEqualWidth(age, k):
    a = len(age)
    w = (max(age) - min(age))/k
    bins = [min(age) + i*w for i in range(k+1)]
    ret = []
    for i in range(0, k):
        curr = []
        for j in age:
            if j >= bins[i] and j <= bins[i+1]:
```

```
                curr.append(j)
        # mean of curr
        ret+=[np.mean(curr)]*len(curr)
    return ret


def binningEqualFrequency(age, size):
    while len(age) % size != 0:
        age.append(0)
    age = sorted(age)
    ret = []
    for i in range(0, len(age), size):
        ret+=[np.mean(age[i:i+size])]*size
    return ret

def binning(li):
    equalWidth = binningEqualWidth(li, 25)
    equalFrequency = binningEqualFrequency(li, 100)
    fig, axs = plt.subplots(1,3, figsize=(15,5), sharey=True)
    axs[0].plot(li, label = 'Original age')
    axs[0].set_title('Original age')
    axs[1].plot(equalWidth, label = 'Equal Width Binning', color = 'red')
    axs[1].set_title('Equal Width Binning')
    axs[2].plot(equalFrequency, label = 'Equal Frequency Binning', color = 'green')
    axs[2].set_title('Equal Frequency Binning')
    plt.show()

binning(data['filled-age'].tolist())
```



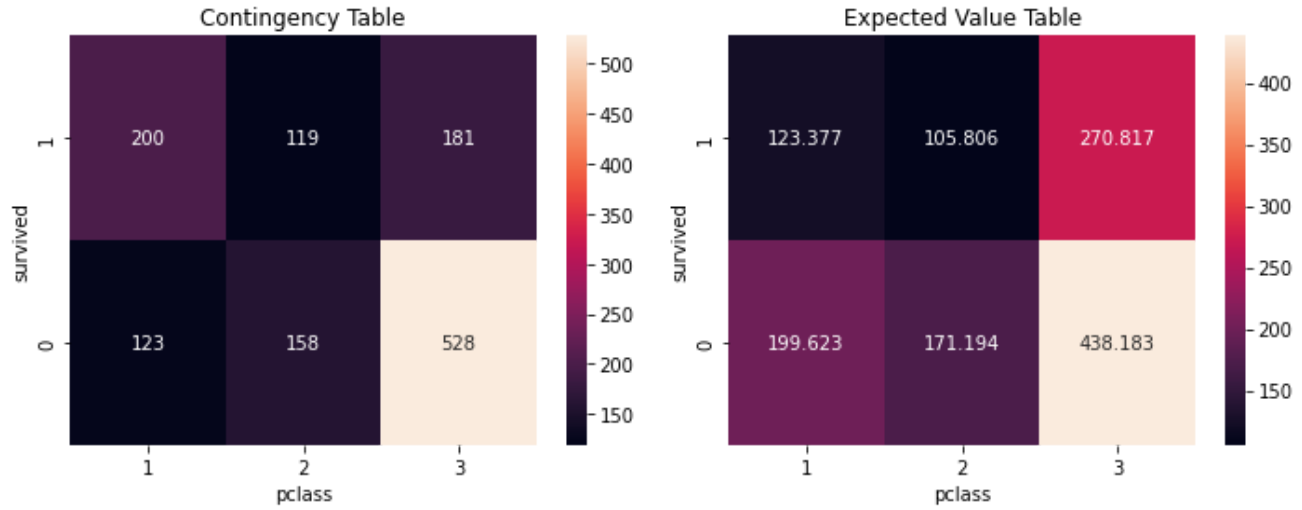
Q3: Perform chi-square test (also show the contingency table)

a) Pclass & Survived (fill missing values with highest frequency category, if any)
b) Pclass & sex (fill missing values with highest frequency category, if any)
c) Plass & embarked (fill missing values with highest frequency category, if any)

In [ ]:

```
def chiSquareCalc(x, y):
    x = x.fillna(x.mode()[0])
    y = y.fillna(y.mode()[0])

    table = {}
    for i in range(len(x)):
        if x[i] in table:
            if y[i] in table[x[i]]:
                table[x[i]][y[i]] += 1
            else:
                table[x[i]][y[i]] = 1
        else:
            table[x[i]] = {}
```

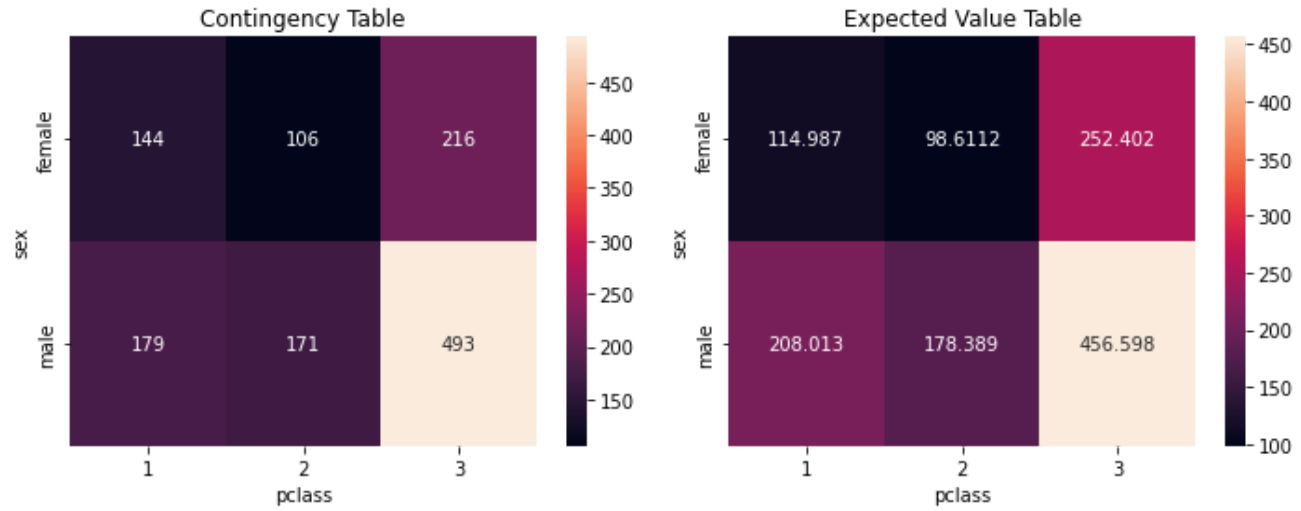
```
            table[x[i]][y[i]] = 1
    df = pd.DataFrame(table)
    df['Sum(row)'] = df.sum(axis=1)
    df.loc['Sum(col)'] = df.sum()
    df.columns.name = x.name
    df.index.name = y.name

    df_exp = df.copy()

    for i in range(len(df.columns)-1):
        df_exp.iloc[i, :-1] = df_exp.iloc[-1,:-1]*df_exp.iloc[i, -1]/df_exp.iloc[-1,-1]

    # Plot everything
    plt.figure(figsize=(10,4))
    plt.subplot(1,2,1)
    sns.heatmap(df.iloc[:-1, :-1], annot=True, fmt='d')
    plt.title('Contingency Table')
    plt.subplot(1,2,2)
    sns.heatmap(df_exp.iloc[:-1, :-1], annot=True, fmt='g')
    plt.title('Expected Value Table')
    plt.tight_layout()
    plt.show()

    chiSq = np.sum(np.sum(((df.iloc[:-1, :-1] - df_exp.iloc[:-1, :-1])**2/df_exp.iloc[:-1,
    print("The chi-square value:", chiSq)
    rows = x.unique()
    cols = y.unique()
    dof = (len(rows)-1)*(len(cols)-1)
    print("The degree of freedom:", dof)
    p = chi2.sf(chiSq, dof)
    print("The p-value:", p)


chiSquareCalc(data['pclass'], data['survived'])
```




```
The chi-square value: 127.85915643930326
The degree of freedom: 2
The p-value: 1.7208259588256175e-28
```

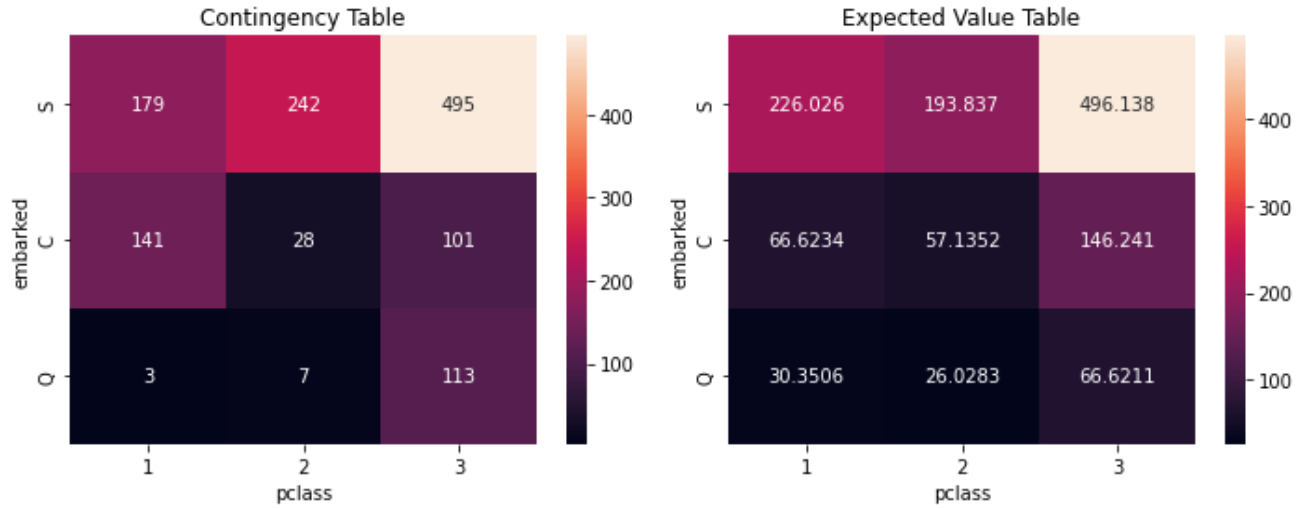
In [ ]:

```
chiSquareCalc(data['pclass'], data['sex'])
```




```
The chi-square value: 20.378781205085584
The degree of freedom: 2
The p-value: 3.7566772719164106e-05
```

In [ ]:
```
chiSquareCalc(data['pclass'], data['embarked'])
```



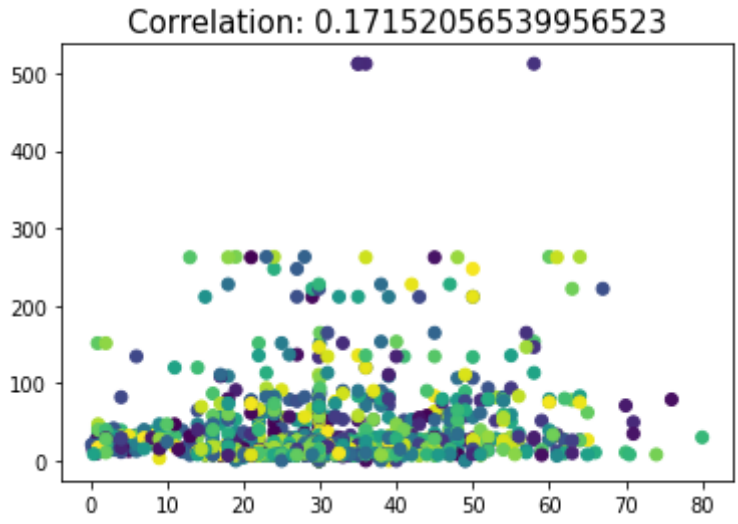

```
The chi-square value: 204.48431967559742
The degree of freedom: 4
The p-value: 4.0799162291284984e-43
```

Q4: Perform correlation analysis

a) Age & Fare (first fill missing values using mean, if any)
b) Age & sibsp (first fill missing values using mean, if any)

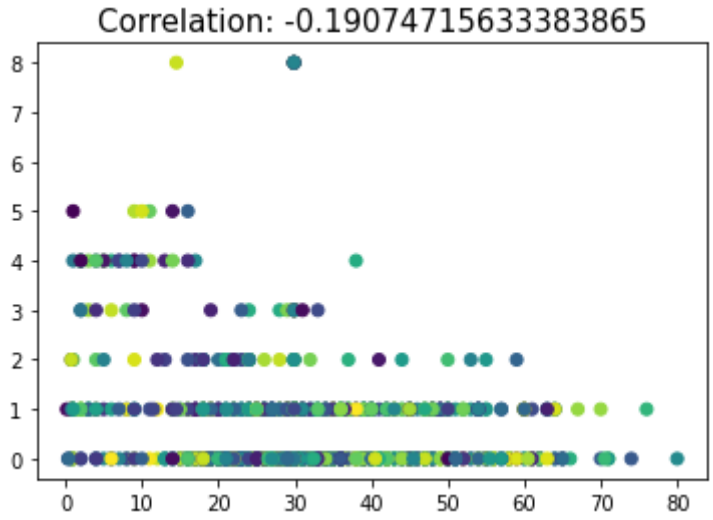
In [ ]:
```
def correlation(x, y):
    x = x.fillna(x.mean())
    y = y.fillna(y.mean())

    r = ((x-x.mean())*(y-y.mean())).sum() / ((x.size-1)*x.std()*y.std())
    plt.scatter(x, y, c=np.random.rand(x.size))
    plt.title("Correlation: "+str(r), fontsize=15)
    plt.show()
```

In [ ]:
```
correlation(data['age'], data['fare'])
```



In [ ]:

```
correlation(data['age'], data['sibsp'])
```



Thank You