Haverman's Survival DataSet

[2]:
```python
# importing packages
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

1. Data fetching

[4]:
```python
# Here I'm fetching data from 'haberman.csv' file
suv_data = pd.read_csv('habermans.csv', names=['age', 'operation_year', 'axillary_nodes', 'survived_5_years'], header = None)
print(suv_data.head())
```

```
   age  operation_year  axillary_nodes  survived_5_years
0   30              64               1                 1
1   30              62               3                 1
2   30              65               0                 1
3   31              59               2                 1
4   31              65               4                 1
```

2. Data Preparation

[5]:
```python
suv_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 306 entries, 0 to 305
Data columns (total 4 columns):
age                 306 non-null int64
operation_year      306 non-null int64
axillary_nodes      306 non-null int64
survived_5_years    306 non-null int64
dtypes: int64(4)
memory usage: 9.6 KB
```

[6]:
```python
# Assigning 'yes' to 1 and 'no' to 0 in column 'survived_5_years'.
suv_data['survived_5_years'] = suv_data['survived_5_years'].apply(lambda x: 'yes' if x == 1 else 'no')
# Converting data type to category
suv_data['survived_5_years'] = suv_data['survived_5_years'].astype('category')
# Reading top 5 recors of dataset
print(suv_data.head())
```

```
   age  operation_year  axillary_nodes survived_5_years
0   30              64               1              yes
1   30              62               3              yes
2   30              65               0              yes
3   31              59               2              yes
4   31              65               4              yes
```

[8]:
```python
suv_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 306 entries, 0 to 305
Data columns (total 4 columns):
age                 306 non-null int64
operation_year      306 non-null int64
axillary_nodes      306 non-null int64
survived_5_years    306 non-null category
dtypes: category(1), int64(3)
memory usage: 7.6 KB
```

Observation :

1.There are four colums in this dataset three of them are integer and one is category type.

2.The column 'survived_5_years' have 2 classes they are : 'yes' and 'no'. These two signifies that the patient is alive or not after five years

3. High level statistics

[9]:
```python
print("No. of points : ",suv_data.shape[0])
print("No. of features : ",suv_data.shape[1])
print("No. of classes : ", suv_data['survived_5_years'].describe().unique()[1])
```

```
No. of points :  306
No. of features :  4
No. of classes :  2
```

[10]:
```python
print("Data points per class : ")
print(suv_data['survived_5_years'].value_counts())
print("\nData point distribution percentage per class:")
print(suv_data['survived_5_years'].value_counts(normalize=True))
```

```
Data points per class :
yes    225
no      81
Name: survived_5_years, dtype: int64

Data point distribution percentage per class:
yes    0.735294
no     0.264706
Name: survived_5_years, dtype: float64
```

[11]:
```python
suv_data.describe()
```

[11]:

	age	operation_year	axillary_nodes
count	306.000000	306.000000	306.000000
mean	52.457516	62.852941	4.026144
std	10.803452	3.249405	7.189654
min	30.000000	58.000000	0.000000
25%	44.000000	60.000000	0.000000
50%	52.000000	63.000000	1.000000
75%	60.750000	65.750000	4.000000
max	83.000000	69.000000	52.000000

Observarion :

1.This dataset contains medical record of 306 patients.

2.These patients age vary from 30 to 83.

3.There are higher chances of breast cancer to women in their 50's (i.e. more precisely in age of 52).

4.Approximately 75% of patients have less than 5 positive lymph nodes and nearly 25% of the patients have no positive lymph nodes.

5.After the 5 years of the operation 225 people are alive and 81 people have died.

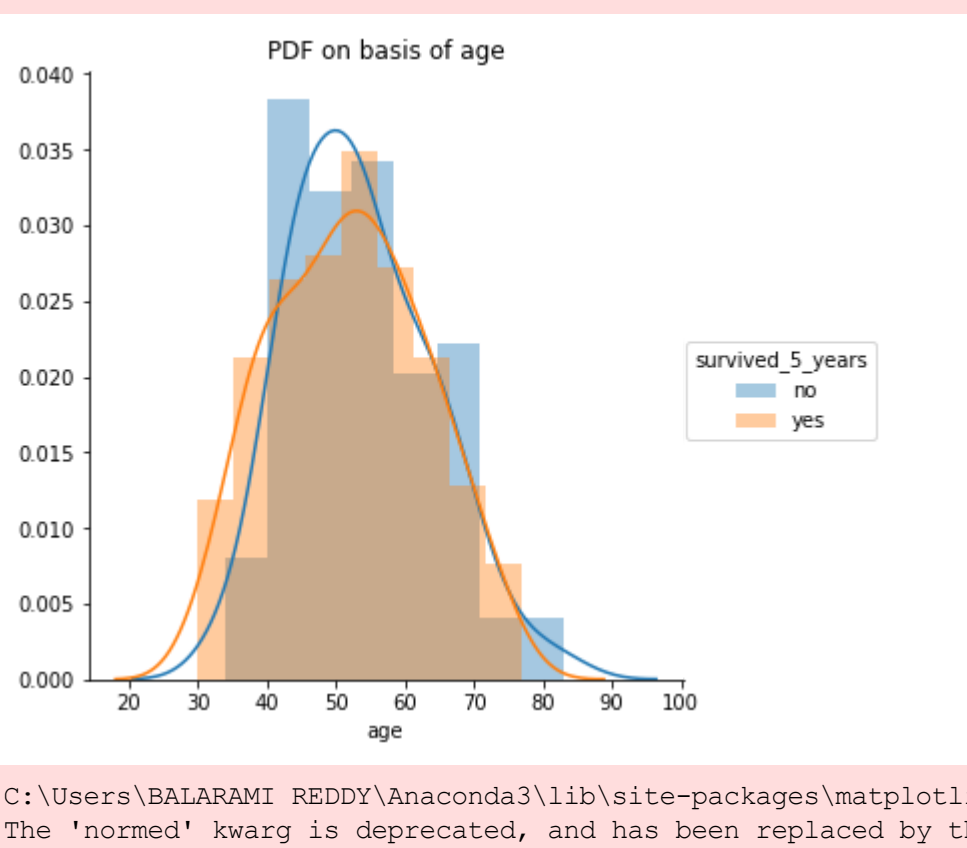
6.This dataset is a imbalanced dataset because 73% people belongs to the surviver class.

4. Univariate Analysis

[13]:
```python
# Histogram/Density Plot and PDF# Histog
import seaborn as sb

for feature in list(suv_data.columns[:-1]):
    sb.FacetGrid(suv_data, hue='survived_5_years', size=5)\
    .map(sb.distplot, feature)\
    .add_legend()
    plt.title('PDF on basis of '+feature)
    plt.show()
```

```
C:\Users\BALARAMI REDDY\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
C:\Users\BALARAMI REDDY\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```




```
C:\Users\BALARAMI REDDY\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
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  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```

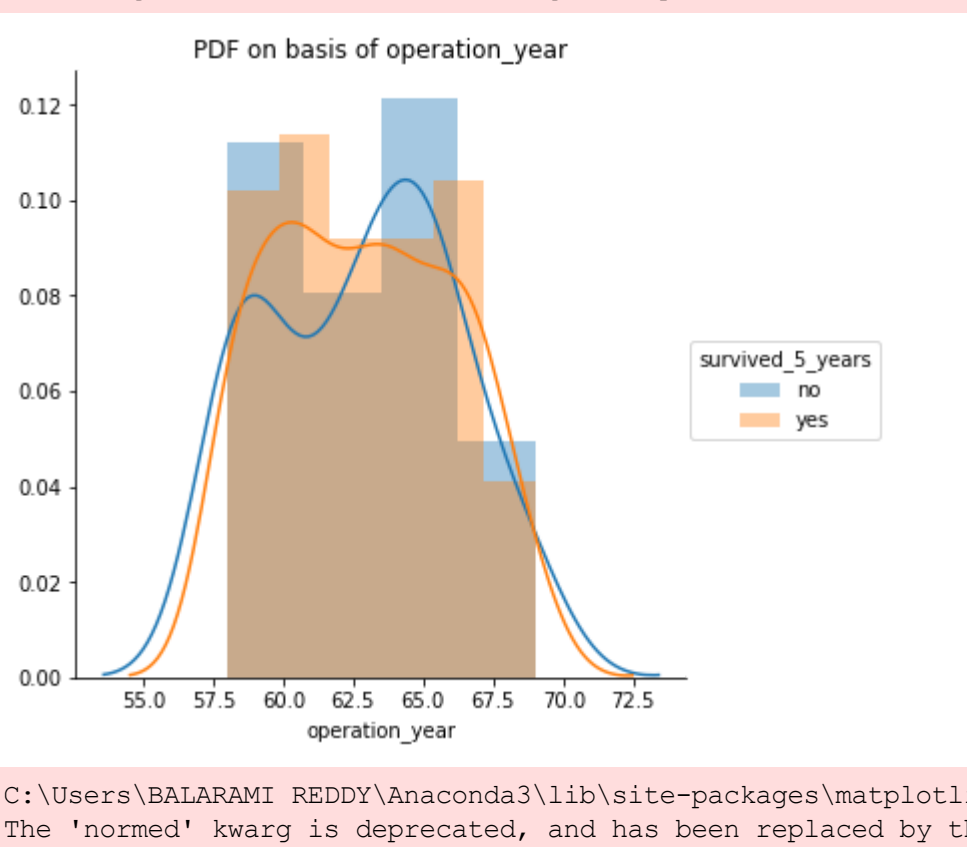


```
C:\Users\BALARAMI REDDY\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
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C:\Users\BALARAMI REDDY\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```
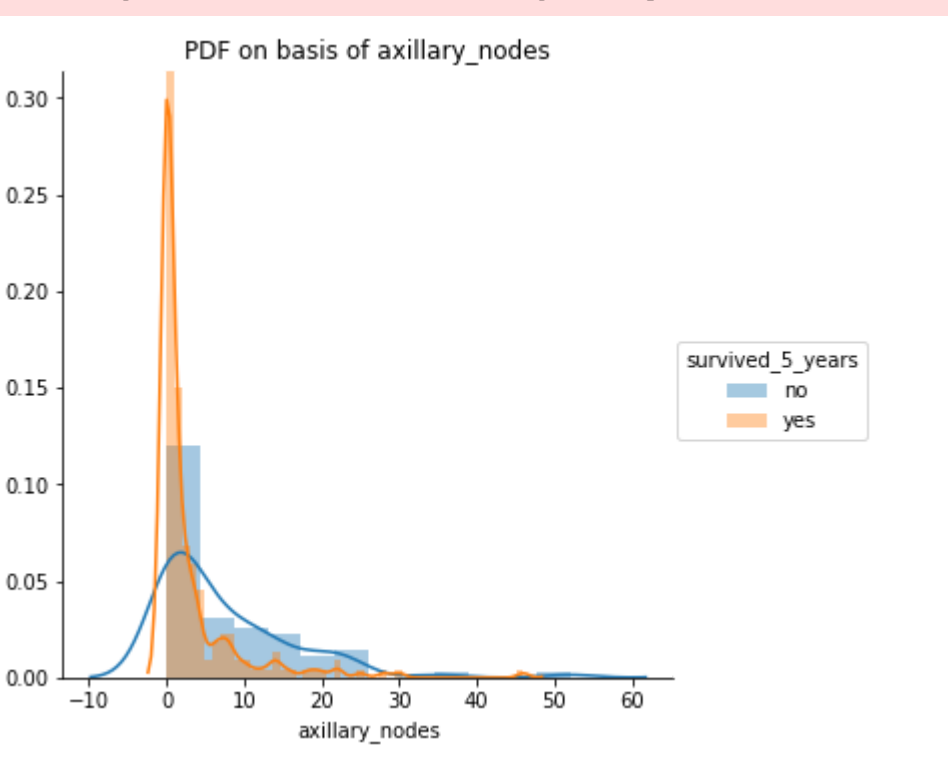
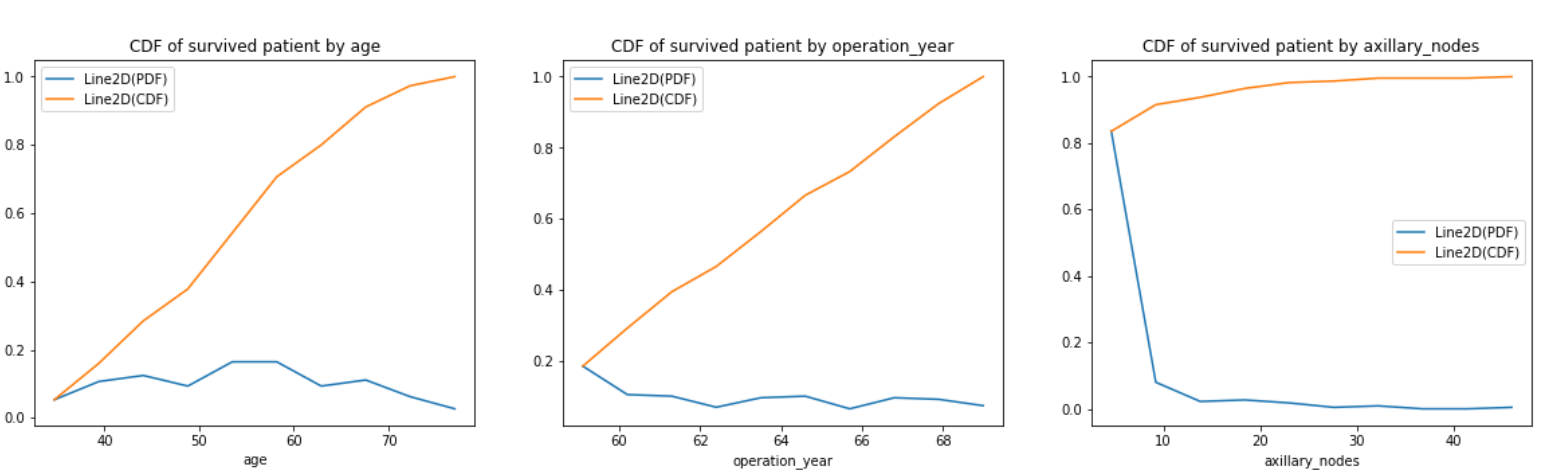
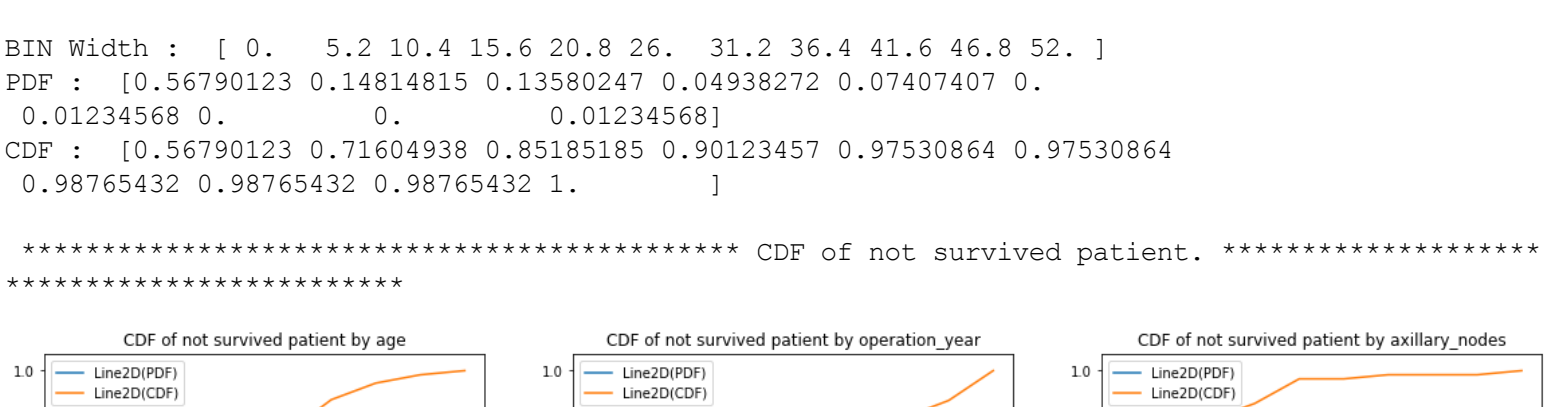



[14]:
```python
plt.close()# This line of code releses the memory that have been occupied by previous plot.

# CDF plot
"""
CDF is the integration of PDF
"""
# This list stores the data of patients who are alive.
surv_yes = suv_data.loc[suv_data["survived_5_years"] == "yes"];
# This list stores the data of patients who are dead.
surv_no = suv_data.loc[suv_data["survived_5_years"] == "no"];

# CDF plot for all features from list of alive patients.
plt.figure(figsize=(20,5))
for index, feature in enumerate(list(suv_data.columns[:-1])):
    plt.subplot(1, 3, index+1)
    counts, bin_edges = np.histogram(surv_yes[feature],\
                                     bins=10, density = True)
    pdf = counts/(sum(counts))
    print("\n",feature,":\n")
    print("BIN Width : ",bin_edges);
    print("PDF : ",pdf);
    cdf = np.cumsum(pdf)
    print("CDF : ",cdf);
    pdf, = plt.plot(bin_edges[1:],pdf,label='PDF')
    cdf, = plt.plot(bin_edges[1:], cdf,label='CDF')
    plt.xlabel(feature)
    plt.legend([pdf, cdf])
    plt.title('CDF of survived patient by '+feature)
print("\n","*"*45,"CDF of survived patient.","*"*45)
plt.show()

# CDF plot for all features from list of dead patients.
plt.figure(figsize=(20,5))
for index, feature in enumerate(list(suv_data.columns[:-1])):
    plt.subplot(1, 3, index+1)
    counts, bin_edges = np.histogram(surv_no[feature],\
                                     bins=10, density = True)
    pdf = counts/(sum(counts))
    print("\n",feature,":\n")
    print("BIN Width : ",bin_edges);
    print("PDF : ",pdf);
    cdf = np.cumsum(pdf)
    print("CDF : ",cdf);
    pdf, = plt.plot(bin_edges[1:],pdf,label='PDF')
    cdf, = plt.plot(bin_edges[1:], cdf,label='CDF')
    plt.xlabel(feature)
    plt.legend([pdf, cdf])
    plt.title('CDF of not survived patient by '+feature)
print("\n","*"*45,"CDF of not survived patient.","*"*45)
plt.show()
```

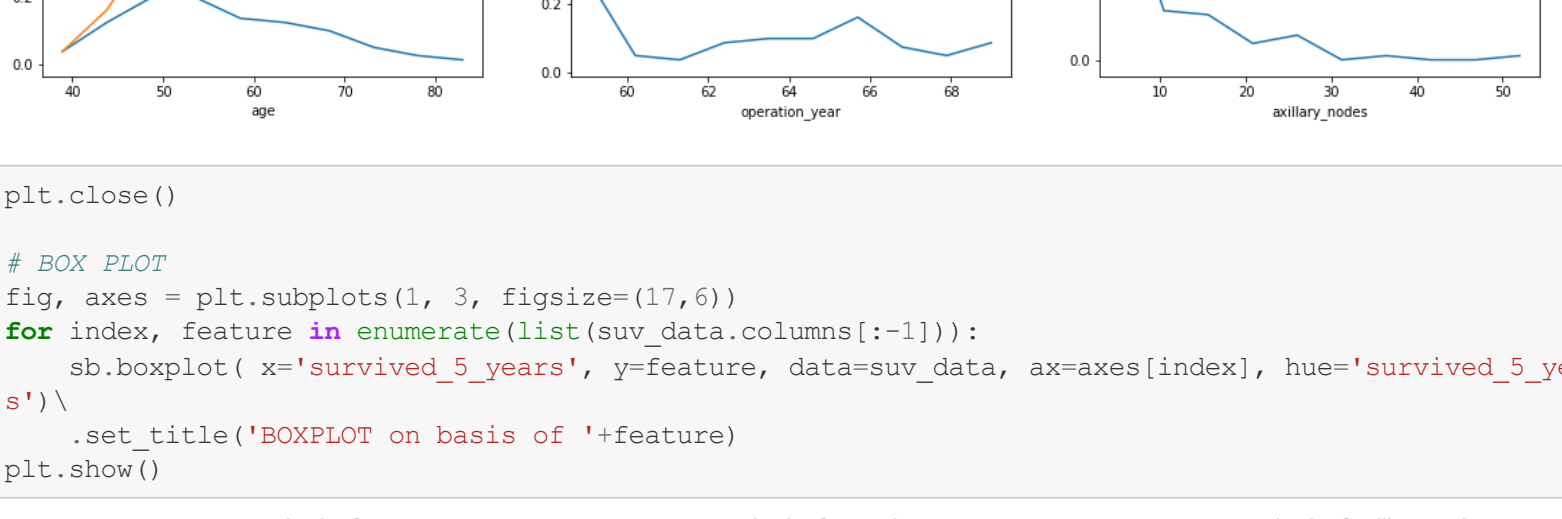
```
 age :

BIN Width :  [30.  34.7 39.4 44.1 48.8 53.5 58.2 62.9 67.6 72.3 77. ]
PDF :  [0.05333333 0.10666667 0.12444444 0.09333333 0.16444444 0.16444444
 0.09333333 0.11111111 0.06222222 0.02666667]
CDF :  [0.05333333 0.16       0.28444444 0.37777778 0.54222222 0.70666667
 0.8        0.91111111 0.97333333 1.        ]

 operation_year :

BIN Width :  [58.  59.1 60.2 61.3 62.4 63.5 64.6 65.7 66.8 67.9 69. ]
PDF :  [0.18666667 0.10666667 0.10222222 0.07111111 0.09777778 0.10222222
 0.06666667 0.09777778 0.09333333 0.07555556]
CDF :  [0.18666667 0.29333333 0.39555556 0.46666667 0.56444444 0.66666667
 0.73333333 0.83111111 0.92444444 1.        ]

 axillary_nodes :

BIN Width :  [ 0.   4.6  9.2 13.8 18.4 23.  27.6 32.2 36.8 41.4 46. ]
PDF :  [0.83555556 0.08       0.02222222 0.02666667 0.01777778 0.00444444
 0.00888889 0.         0.         0.00444444]
CDF :  [0.83555556 0.91555556 0.93777778 0.96444444 0.98222222 0.98666667
 0.99555556 0.99555556 0.99555556 1.        ]

 ********************************************* CDF of survived patient. *********************************************
```




```
 age :

BIN Width :  [34.  38.9 43.8 48.7 53.6 58.5 63.4 68.3 73.2 78.1 83. ]
PDF :  [0.03703704 0.12345679 0.19753086 0.19753086 0.13580247 0.12345679
 0.09876543 0.04938272 0.02469136 0.01234568]
CDF :  [0.03703704 0.16049383 0.35802469 0.55555556 0.69135802 0.81481481
 0.91358025 0.96296296 0.98765432 1.        ]

 operation_year :

BIN Width :  [58.  59.1 60.2 61.3 62.4 63.5 64.6 65.7 66.8 67.9 69. ]
PDF :  [0.25925926 0.04938272 0.03703704 0.08641975 0.09876543 0.09876543
 0.16049383 0.07407407 0.04938272 0.08641975]
CDF :  [0.25925926 0.30864198 0.34567901 0.43209877 0.5308642  0.62962963
 0.79012346 0.86419753 0.91358025 1.        ]

 axillary_nodes :

BIN Width :  [ 0.   5.2 10.4 15.6 20.8 26.  31.2 36.4 41.6 46.8 52. ]
PDF :  [0.56790123 0.14814815 0.13580247 0.04938272 0.07407407 0.
 0.01234568 0.         0.         0.01234568]
CDF :  [0.56790123 0.71604938 0.85185185 0.90123457 0.97530864 0.97530864
 0.98765432 0.98765432 0.98765432 1.        ]

 ********************************************* CDF of not survived patient. *********************************************
```



[15]:
```python
plt.close()

# BOX PLOT
fig, axes = plt.subplots(1, 3, figsize=(17,6))
for index, feature in enumerate(list(suv_data.columns[:-1])):
    sb.boxplot( x='survived_5_years', y=feature, data=suv_data, ax=axes[index], hue='survived_5_years')\
    .set_title('BOXPLOT on basis of '+feature)
plt.show()
```



Observation :

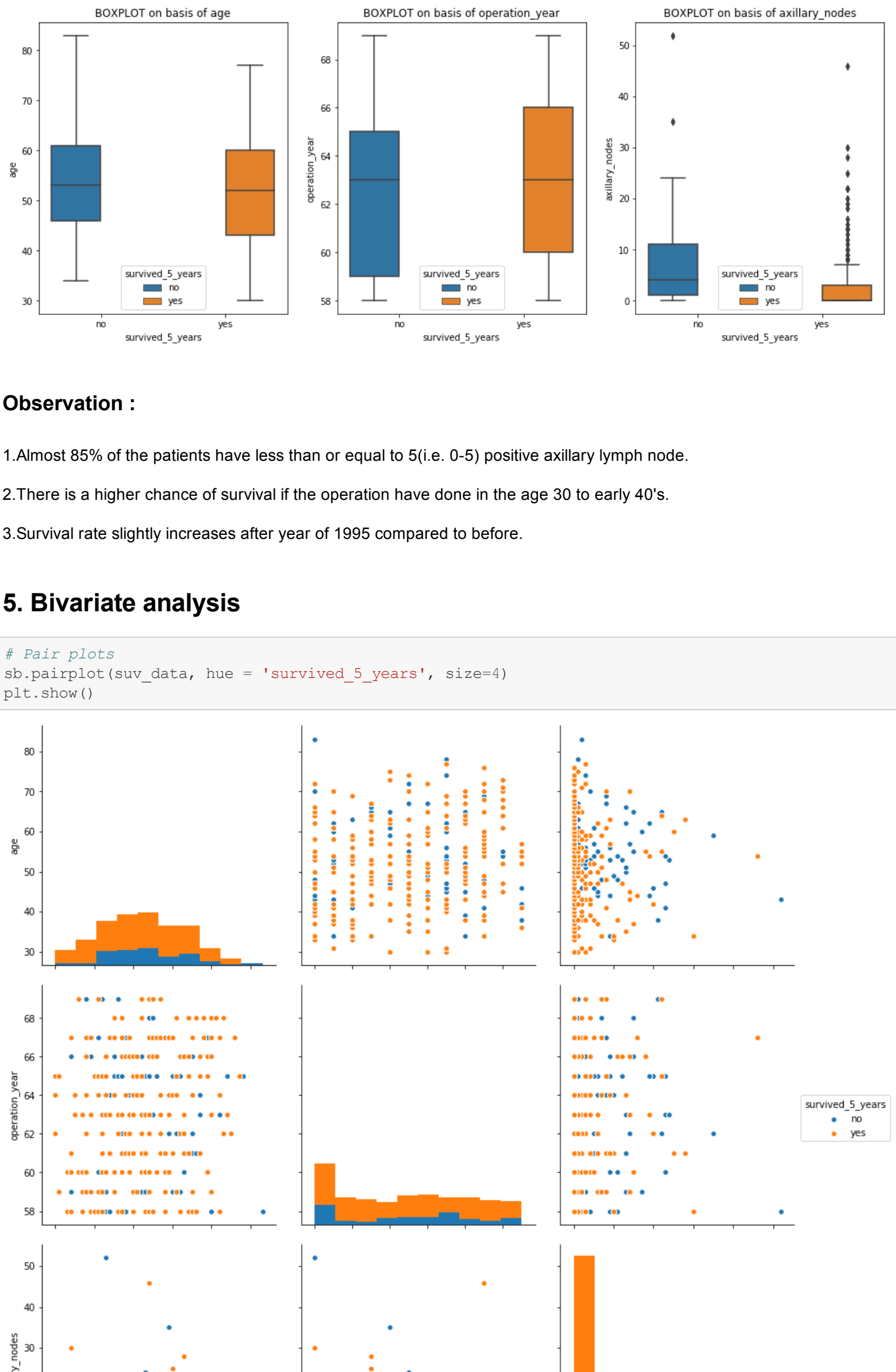
1.Almost 85% of the patients have less than or equal to 5(i.e. 0-5) positive axillary lymph node.

2.There is a higher chance of survival if the operation have done in the age 30 to early 40's.

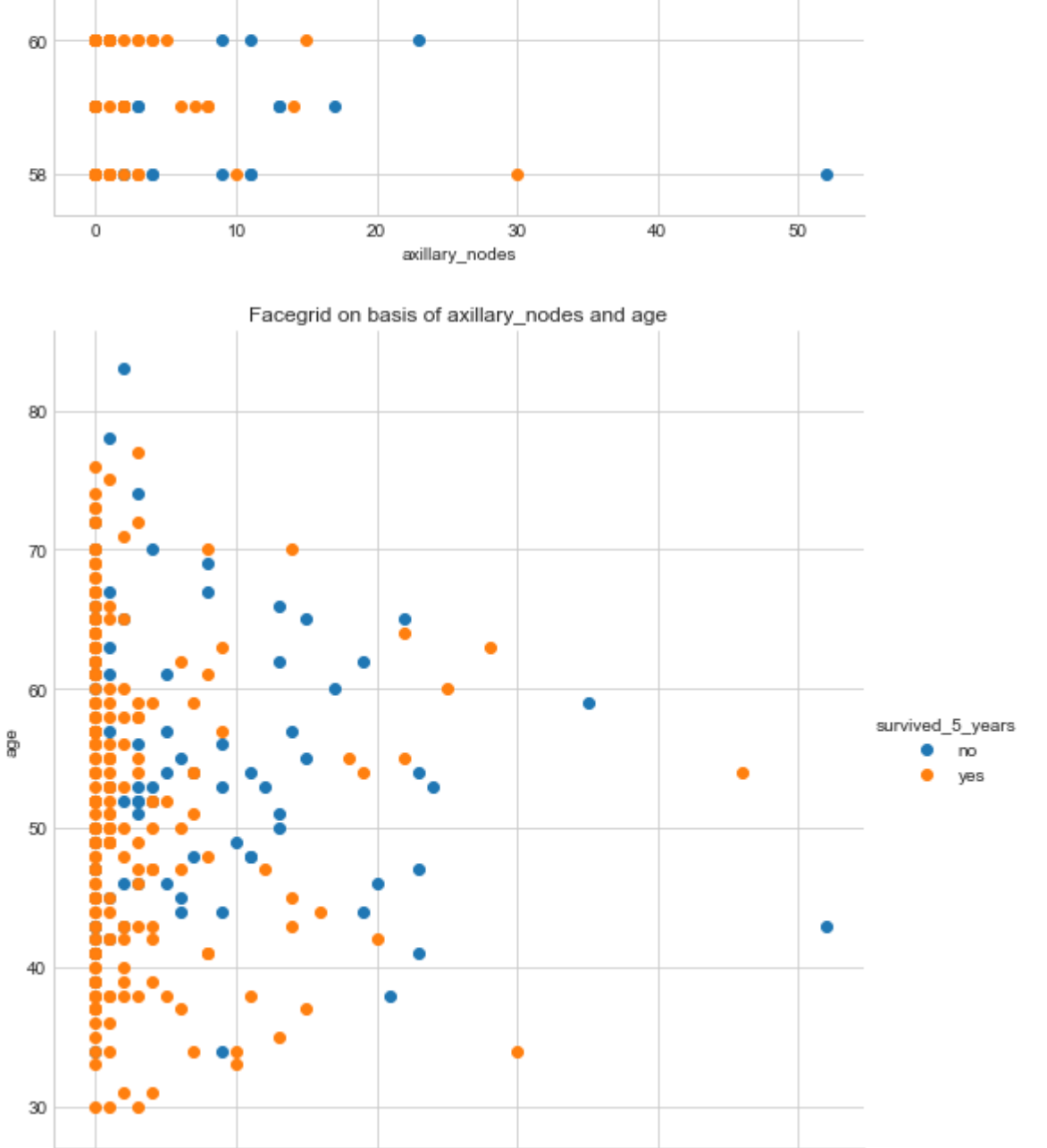
3.Survival rate slightly increases after year of 1995 compared to before.

5. Bivariate analysis

[16]:
```python
# Pair plots
sb.pairplot(suv_data, hue = 'survived_5_years', size=4)
plt.show()
```



[17]:
```python
# SCATTERPLOT for features for better classification

sb.set_style("whitegrid")
sb.FacetGrid(suv_data, hue="survived_5_years", size=7) \
   .map(plt.scatter, "axillary_nodes", "operation_year") \
   .add_legend()
plt.title('Facegrid on basis of axillary_nodes and operation_year')

sb.FacetGrid(suv_data, hue="survived_5_years", size=7) \
   .map(plt.scatter, "axillary_nodes", "age") \
   .add_legend()
plt.title('Facegrid on basis of axillary_nodes and age')
plt.show()
```



Conclusion :

By scattering the data points between {operation_year, axillary_nodes} and {age, axillary_nodes}, we can see the better classification between the two clases than other scatter plots.