In [295]:
```
#importing modules

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

df=pd.read_csv('./habermans-survival-data-set/haberman.csv')
```

In [296]:
```
df.head()
```

Out[296]:

	30	64	1	1.1
0	30	62	3	1
1	30	65	0	1
2	31	59	2	1
3	31	65	4	1
4	33	58	10	1

In [297]:
```
df.columns
```

Out[297]:
```
Index(['30', '64', '1', '1.1'], dtype='object')
```

Attribute Information:

- 30 - Age of patient at time of operation (numerical)
- 64 - Patient's year of operation (year - 1900, numerical)
- 1 - Number of positive axillary nodes detected (numerical)
- 1.1 - Survival status (class attribute) 1 = the patient survived 5 years or longer 2 = the patient died within 5 year

OBSERVATION :

- 1. No. of features are 3 i.e '30','64','1'.
- 2. label- '1.1'

In [298]:
```
df.columns=['age','year_of_operation','axillary_nodes','survival_status']
```

In [299]:
```
df=df.sort_values('age',axis=0)
df.head()
```

Out[299]:

	age	year_of_operation	axillary_nodes	survival_status
0	30	62	3	1
1	30	65	0	1
2	31	59	2	1
3	31	65	4	1
4	33	58	10	1

In [300]:
```
df['survival_status'].unique()
```

Out[300]:
```
array([1, 2], dtype=int64)
```

OBJECTIVE -

- It has finite number of classes .So it is ***Binary classification*** problem

In [301]:
```
df['survival_status'].replace(1,'survived',inplace=True)
df['survival_status'].replace(2,'not_survived',inplace=True)
```

In [302]:
```
df.head()
```

Out[302]:

	age	year_of_operation	axillary_nodes	survival_status
0	30	62	3	survived
1	30	65	0	survived
2	31	59	2	survived
3	31	65	4	survived
4	33	58	10	survived

In [303]:
```
1 df.shape
```

Out[303]: (305, 4)

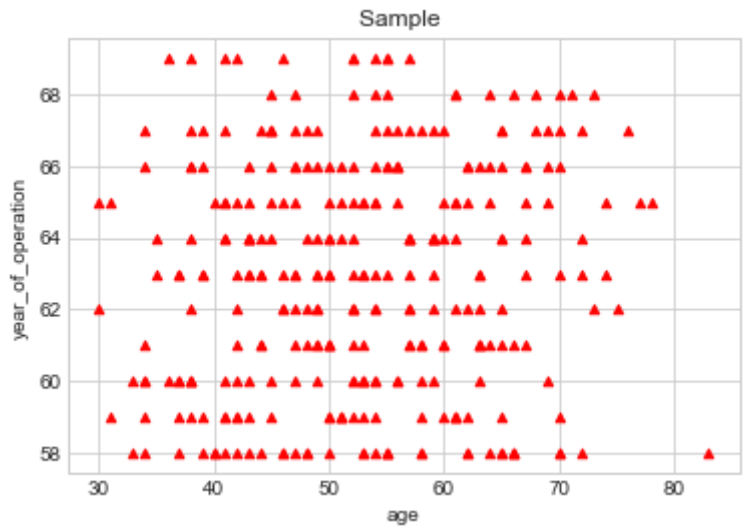
In [304]:
```
1 df['survival_status'].value_counts()
```

Out[304]:
```
survived        224
not_survived     81
Name: survival_status, dtype: int64
```

OBSERVATION :

- Imbalanced dataset
- 224 people Survived from 305.
- 81 people non survived from 305.

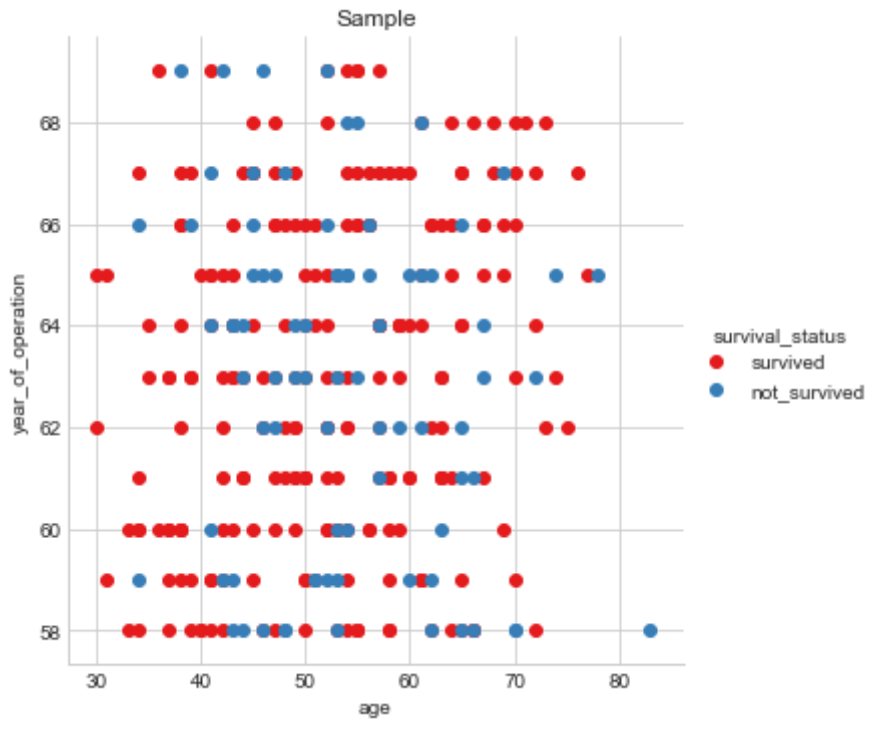
In [305]:
```
1 df.plot(kind='scatter',x='age',y='year_of_operation',color='red',marker='^')
2 plt.title('Sample ')
3 plt.show()
4
```



OBSERVATION :

No information found

In [306]:
```
1 sns.set_style('whitegrid')
2 sns.FacetGrid(df,hue='survival_status',size=5,palette='Set1')\
3    .map(plt.scatter,'age','year_of_operation')\
4    .add_legend()
5
6 plt.title('Sample')
7 plt.show();
```



OBSERVATION :

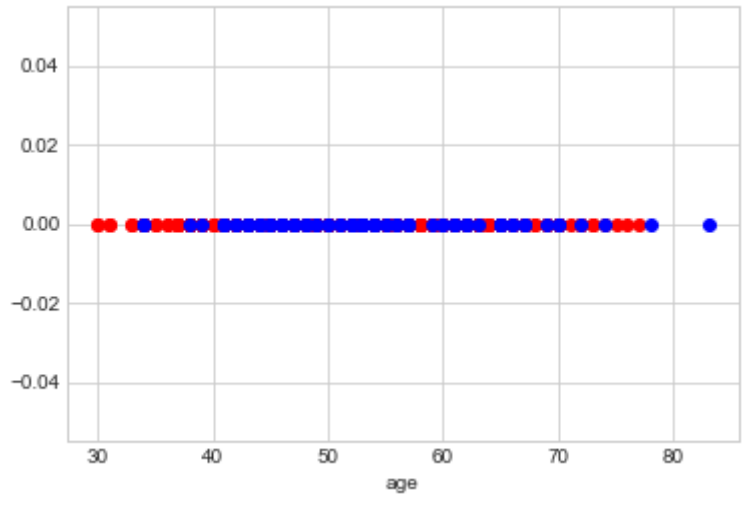
- NO information Found. Randomly distributed

In [307]:
```
1 sns.set_style('whitegrid')
2 sns.pairplot(df,hue='survival_status',size=4,palette='Set2')
3 plt.show()
```

OBSERVATION :

- All plots are very complex.
- No information found

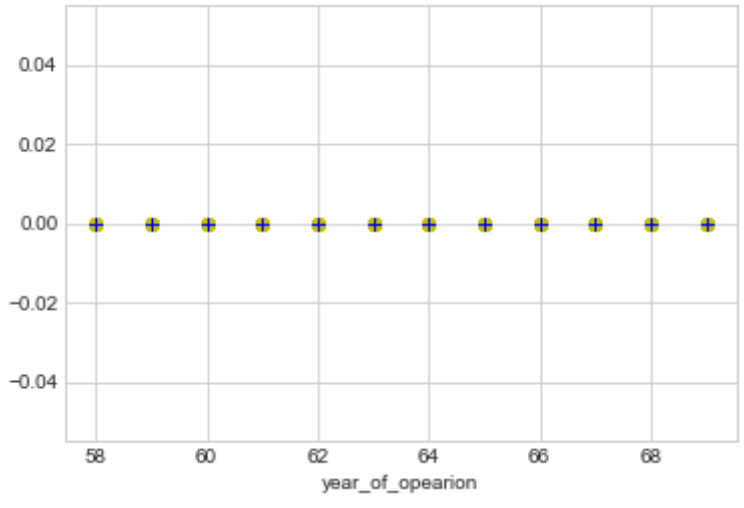
In [308]:
```
1 survived=df[df['survival_status']=='survived']
2 not_survived=df[df['survival_status']=='not_survived']
3
4 r=plt.plot(survived['age'],np.zeros_like(survived['age']),'ro')
5 s=plt.plot(not_survived['age'],np.zeros_like(not_survived['age']),'bo')
6 plt.xlabel('age')
7 plt.show();
```



OBSERVATION :

- Overlapping is there .No information found in age feature

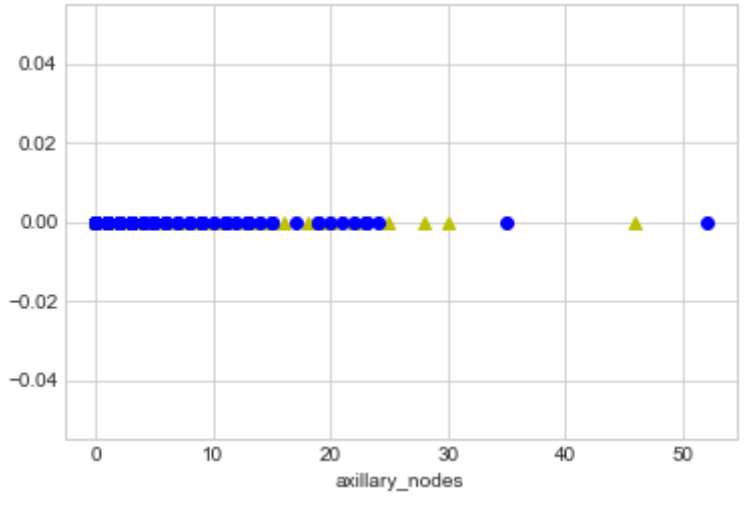
In [309]:
```
plt.plot(survived['year_of_operation'],np.zeros_like(survived['year_of_operation']),'yo')
plt.plot(not_survived['year_of_operation'],np.zeros_like(not_survived['year_of_operation']),'b+');
plt.xlabel('year_of_opearion')
plt.show();
```



OBSERVATION :

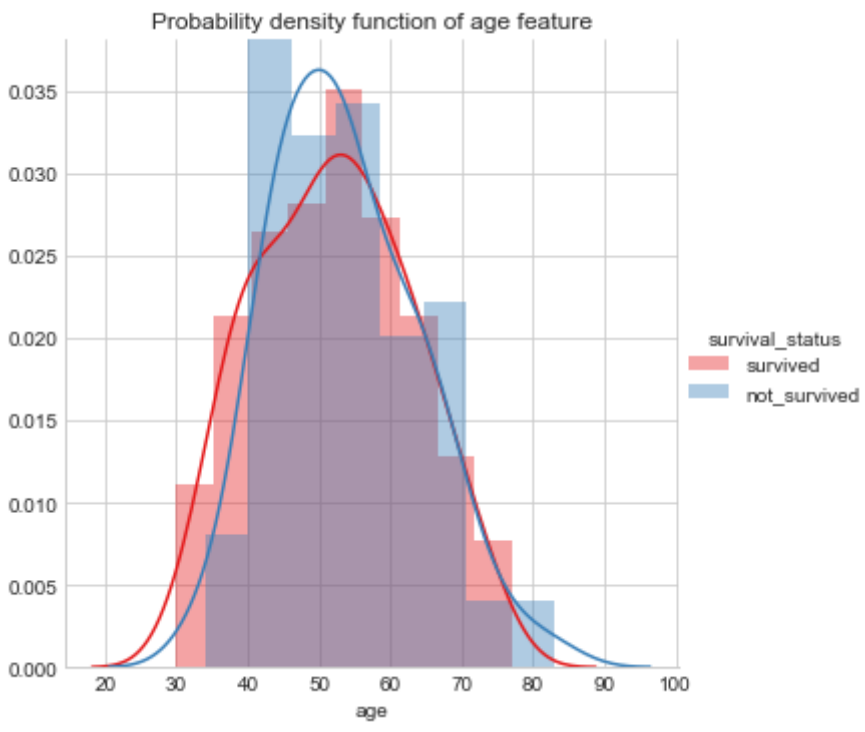
- Overlapping is there .No information found in year of operation feature
- Data is of 1958 to 1969

In [310]:
```
plt.plot(survived['axillary_nodes'],np.zeros_like(survived['axillary_nodes']),'y^')
plt.plot(not_survived['axillary_nodes'],np.zeros_like(not_survived['axillary_nodes']),'bo')
plt.xlabel('axillary_nodes')
plt.show();
```

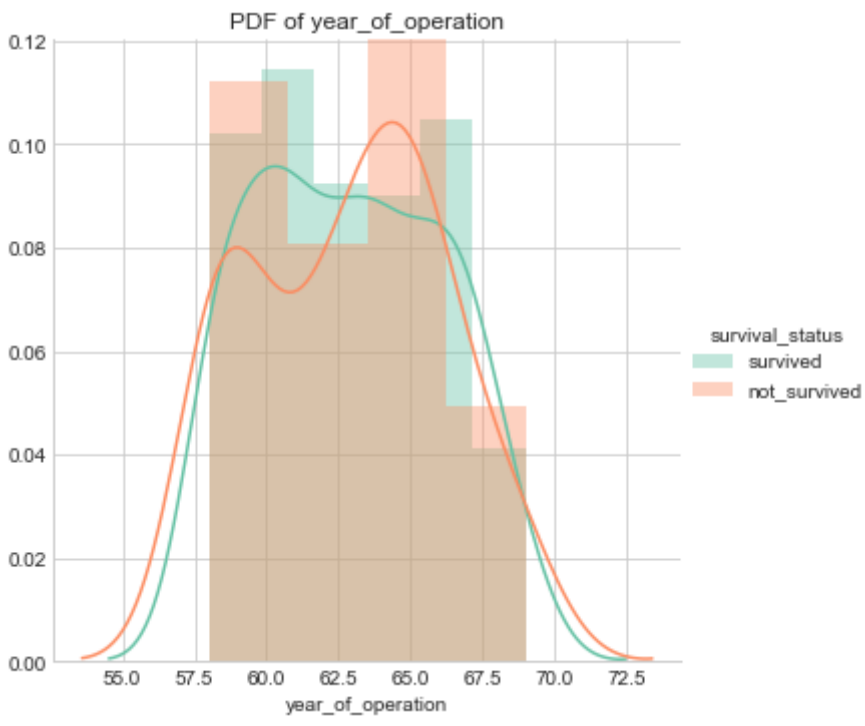


In [311]:
```
import warnings
warnings.filterwarnings('ignore')
```

In [312]:
```
sns.set_style('whitegrid')
sns.FacetGrid(df,hue='survival_status',size=5,palette='Set1')\
    .map(sns.distplot,'age')\
    .add_legend();
plt.xlabel('age')
plt.title('Probability density function of age feature')
plt.show();


```



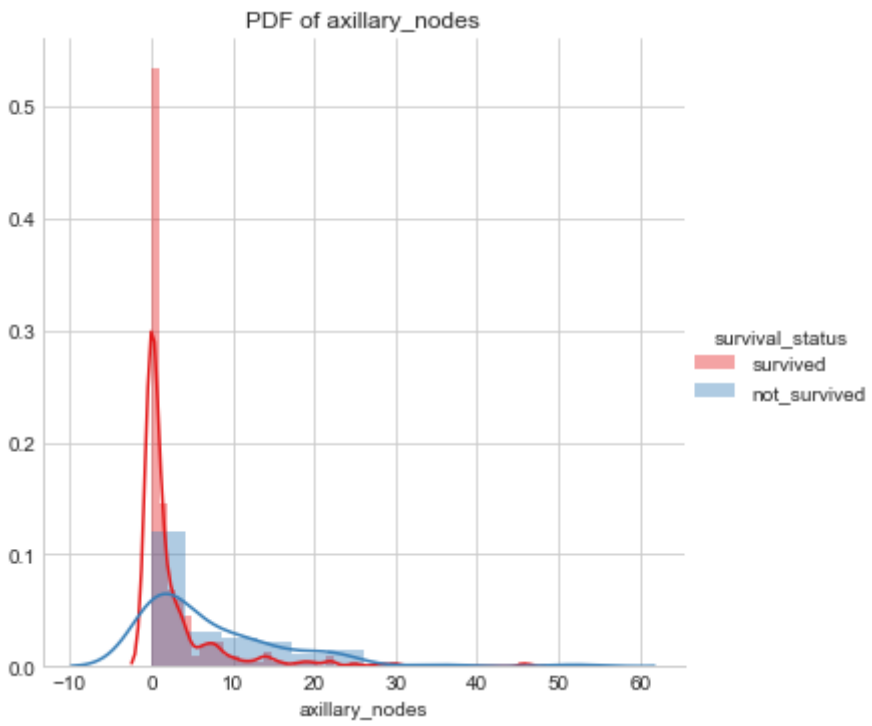
In [313]:
```
sns.set_style('whitegrid')
sns.FacetGrid(df,hue='survival_status',size=5,palette='Set2')\
    .map(sns.distplot,'year_of_operation')\
    .add_legend();
plt.title('PDF of year_of_operation')
plt.show();
```



OBSERVATION :

- Overlapping is there

In [314]:
```
sns.set_style('whitegrid')
sns.FacetGrid(df,hue='survival_status',size=5,palette='Set1')\
    .map(sns.distplot,'axillary_nodes')\
    .add_legend();
plt.title('PDF of axillary_nodes')
plt.show()
```



In [332]:
```
df['survival_status'][df['axillary_nodes']==0][df['survival_status']=='survived'].count()
```

Out[332]: 117

In [333]:
```
df['survival_status'][df['axillary_nodes']==0][df['survival_status']=='not_survived'].count()
```

Out[333]: 19

OBSERVATION:

- when axillary nodes are equal to zero 116 survived for more than 5 years and 19 survived within 5 years..
- Therefore axillary nodes are less more are the chances of survival

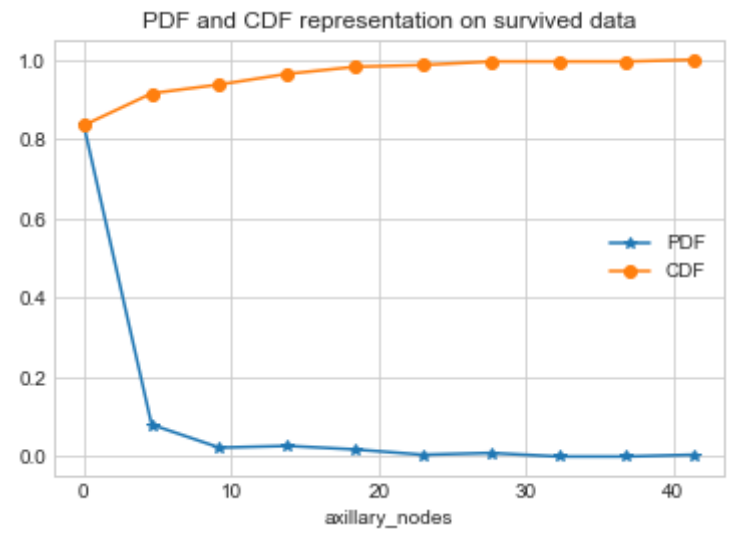
In [ ]:
```
counts,bin_edges=np.histogram(df['axillary_nodes'],density=True,bins=10)
pdf=counts/sum(counts)
print(pdf)
print(bin_edges)

cdf=np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf,label='PDF',color='r',marker='o')
plt.plot(bin_edges[1:],cdf,label='CDF',color='g',marker='o')
plt.legend()
plt.xlabel('axillary_nodes')
plt.title('PDF and CDF representation on whole data')
plt.show();
```

OBSERVATION:

- There are almost 80% data points which have axillary nodes <= 4

In [316]:
```
counts,bin_edges=np.histogram(df['axillary_nodes'][df['survival_status']=='survived'],density=True,)
pdf=counts/sum(counts)
print(pdf)
print(bin_edges)

cdf=np.cumsum(pdf)
plt.plot(bin_edges[:-1],pdf,label='PDF',marker='*')
plt.plot(bin_edges[:-1],cdf,label='CDF',marker='o')
plt.xlabel('axillary_nodes')
plt.title('PDF and CDF representation on survived data')
plt.legend()
plt.show();
```

```
[0.83482143 0.08035714 0.02232143 0.02678571 0.01785714 0.00446429
 0.00892857 0.         0.         0.00446429]
[ 0.   4.6  9.2 13.8 18.4 23.  27.6 32.2 36.8 41.4 46. ]
```

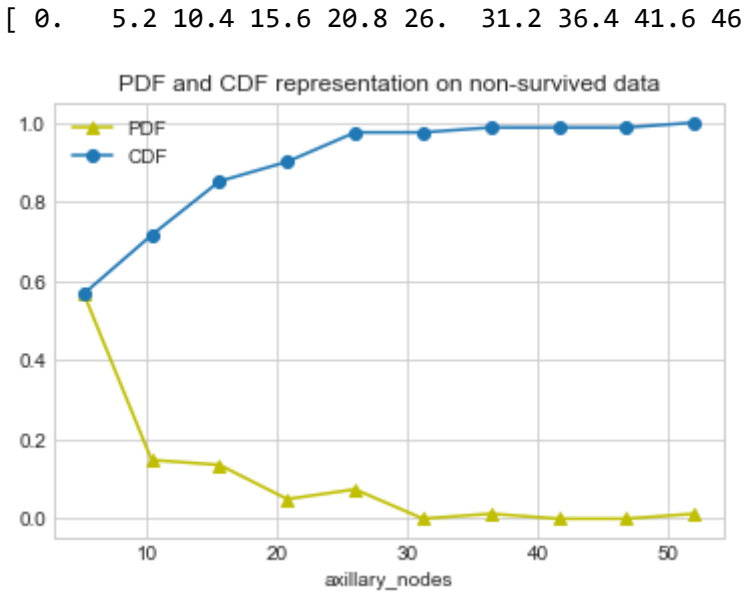


OBSERVATION :

- Almost 95% data points from survived data set only having axillary nodes <=10 So there are more chances of survival when axillary nodes <=10
- Approx 82 % from survived list survived when axillary nodes = 0.

In [317]:
```
counts,bin_edges=np.histogram(df['axillary_nodes'][df['survival_status']=='not_survived'],density=True,bins=10)
pdf=counts/sum(counts)
print(pdf)
print(bin_edges)

cdf=np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf,label='PDF',color='y',marker='^')
plt.plot(bin_edges[1:],cdf,label='CDF',marker='o')
plt.xlabel('axillary_nodes')
plt.xlabel('axillary_nodes')
plt.title('PDF and CDF representation on non-survived data')
plt.legend()
plt.show();
```

```
[0.56790123 0.14814815 0.13580247 0.04938272 0.07407407 0.
 0.01234568 0.         0.         0.01234568]
[ 0.   5.2 10.4 15.6 20.8 26.  31.2 36.4 41.6 46.8 52. ]
```

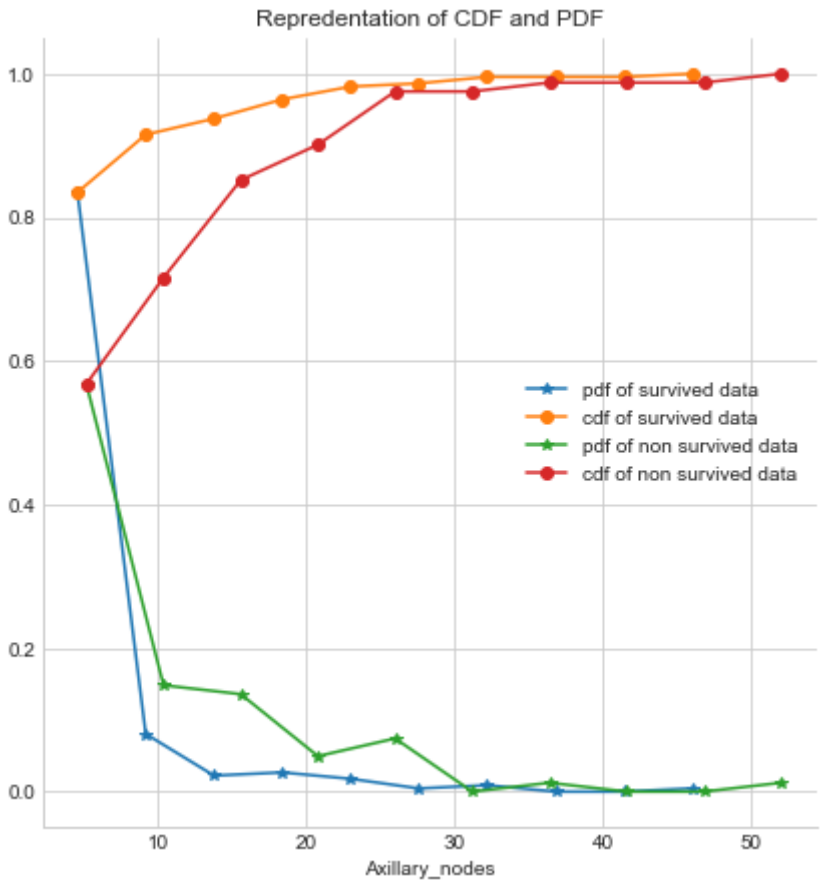


In [318]:
```
df[df['axillary_nodes']<0].count()
```

Out[318]:
```
age                 0
year_of_operation   0
axillary_nodes      0
survival_status     0
dtype: int64
```

In [319]:
```
sns.FacetGrid(df,size=6)
counts,bin_edges=np.histogram(df['axillary_nodes'][df['survival_status']=='survived'],density=True,bins=10)
pdf=counts/sum(counts)
print(pdf)
print(bin_edges)

cdf=np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf,label='pdf of survived data',marker='*')
plt.plot(bin_edges[1:],cdf,label='cdf of survived data',marker='o')

counts,bin_edges=np.histogram(df['axillary_nodes'][df['survival_status']=='not_survived'],density=True,bins=10)
pdf=counts/sum(counts)
print(pdf)
print(bin_edges)

cdf=np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf,label='pdf of non survived data',marker='*')
plt.plot(bin_edges[1:],cdf,label='cdf of non survived data',marker='o')
plt.legend()
plt.title('Repredentation of CDF and PDF')
plt.xlabel('Axillary_nodes')
plt.show()
```

```
[0.83482143 0.08035714 0.02232143 0.02678571 0.01785714 0.00446429
 0.00892857 0.         0.         0.00446429]
[ 0.   4.6  9.2 13.8 18.4 23.  27.6 32.2 36.8 41.4 46. ]
[0.56790123 0.14814815 0.13580247 0.04938272 0.07407407 0.
 0.01234568 0.         0.         0.01234568]
[ 0.   5.2 10.4 15.6 20.8 26.  31.2 36.4 41.6 46.8 52. ]
```



In [320]:
```
df[df['axillary_nodes']==0][df['survival_status']=='survived'].count()
```

Out[320]:
```
age                 117
year_of_operation   117
axillary_nodes      117
survival_status     117
dtype: int64
```

OBSERVATION :

- At axil nodes = 0 only 19 persons non survived from 81 (non- survivied) list . i.e less than 24% non survived when axillary nodes =0.
- At axil nodes = 0 117 people survived from 224 (survivied list) i.e greater than 50% survived when axillary nodes=0.

In [321]:
```
# Mean , Variance ,Std - deviation
print('Means:')
print(np.mean(survived['axillary_nodes']))
print(np.mean(not_survived['axillary_nodes']))

print('\nStd-deviation:')
print(np.std(survived['axillary_nodes']))
print(np.std(not_survived['axillary_nodes']))

```

```
Means:
2.799107142857143
7.45679012345679

Std-deviation:
5.869092706952768
9.128776076761632
```

In [322]:
```
print('Means:')
print(np.mean(survived['age']))
print(np.mean(not_survived['age']))

print('\nStd-deviation:')
print(np.std(survived['age']))
print(np.std(not_survived['age']))

```

```
Means:
52.11607142857143
53.67901234567901

Std-deviation:
10.913004640364269
10.10418219303131
```

In [323]:
```
print('Means:')
print(np.mean(survived['year_of_operation']))
print(np.mean(not_survived['year_of_operation']))

print('\nStd-deviation:')
print(np.std(survived['year_of_operation']))
print(np.std(not_survived['year_of_operation']))

```

```
Means:
62.857142857142854
62.82716049382716

Std-deviation:
3.2220145175061514
3.3214236255207883
```

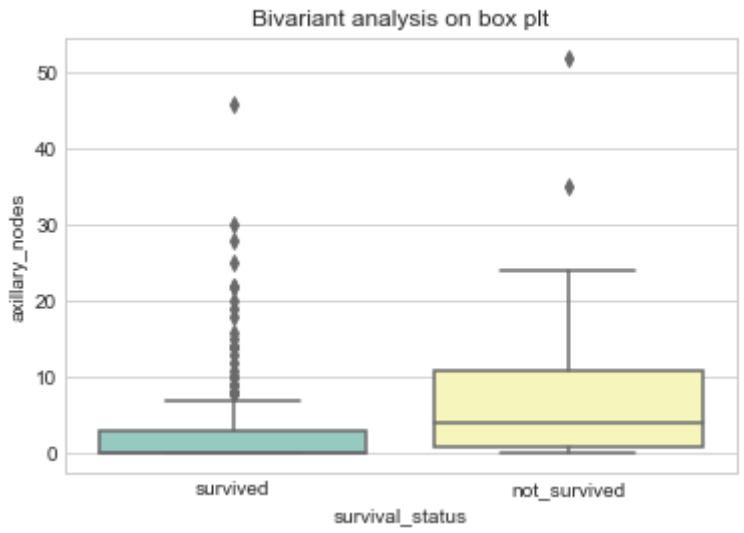
In [324]:
```
# median , Percentiles , Quantiles, IQR ,MAD
print('\n Medians: ')
print(np.median(survived['axillary_nodes']))
print(np.median(not_survived['axillary_nodes']))

print('\n Quantitles:')
print(np.percentile(survived['axillary_nodes'],np.arange(0,100,25)))
print(np.percentile(not_survived['axillary_nodes'],np.arange(0,100,25)))

from statsmodels import robust
print('\n MAD:')
print(robust.mad(survived['axillary_nodes']))
print(robust.mad(not_survived['axillary_nodes']))

```

```
 Medians:
0.0
4.0

 Quantitles:
[0. 0. 0. 3.]
[ 0.  1.  4. 11.]

 MAD:
0.0
5.930408874022408
```

OBSERVATION :

- Median of survived list is 0. Therfore , more chances of survival when axil nodes = 0

In [325]:
```
sns.boxplot(data=df,x='survival_status',y='axillary_nodes',palette='Set3')
plt.title('Bivariant analysis on box plt')
plt.show()

```

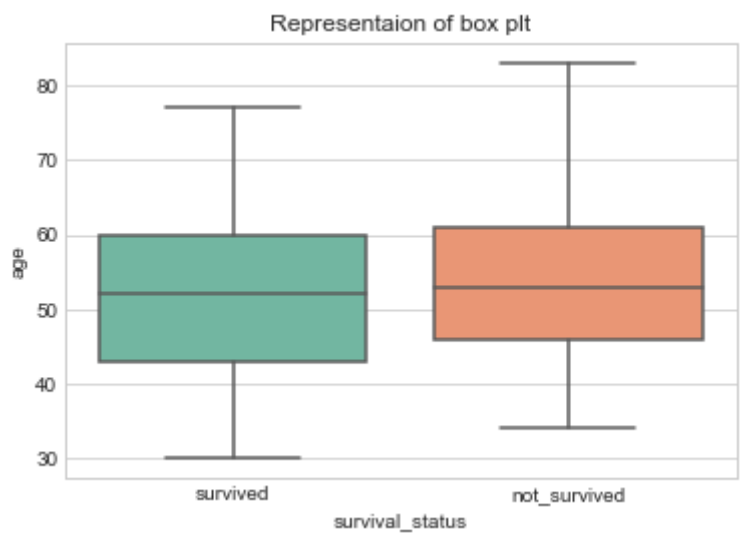


OBSERVATION :

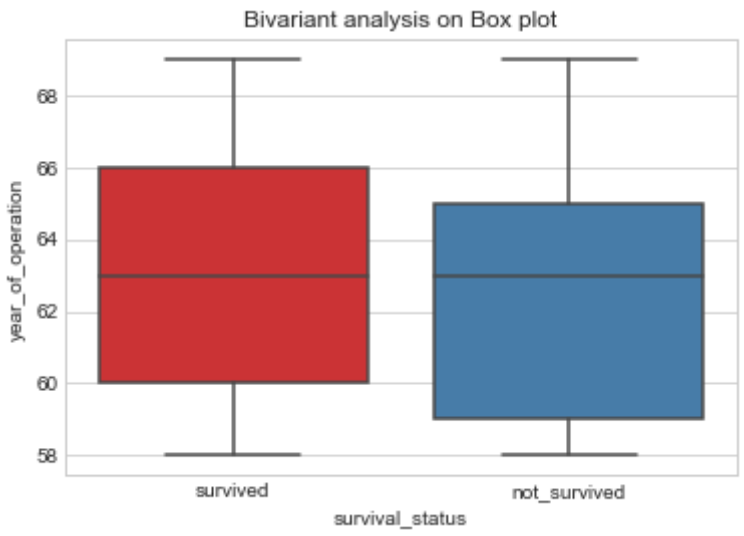
- Again, more chances of survival when axillary nodes = 0.

In [326]:
```
sns.boxplot(data=df,x='survival_status',y='age',palette='Set2')
plt.title('Representaion of box plt')
```

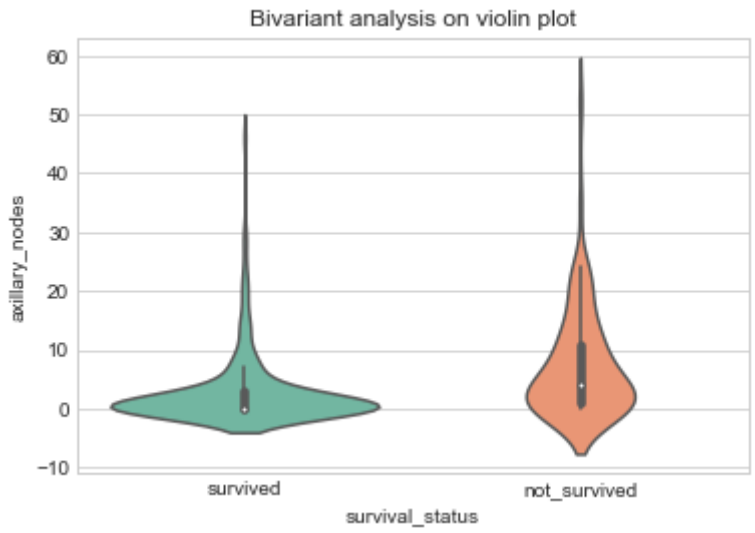
Out[326]: Text(0.5,1,'Representaion of box plt')



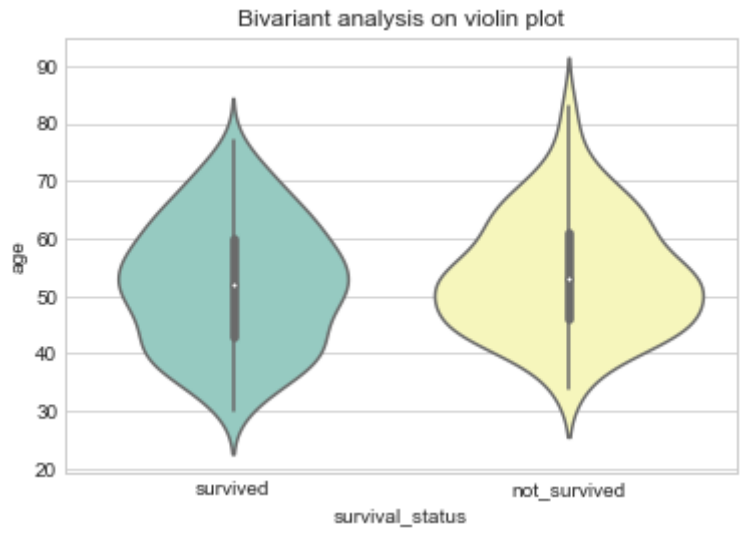
In [327]:
```
sns.boxplot(data=df,x='survival_status',y='year_of_operation',palette='Set1')
plt.title('Bivariant analysis on Box plot')
plt.show()
```



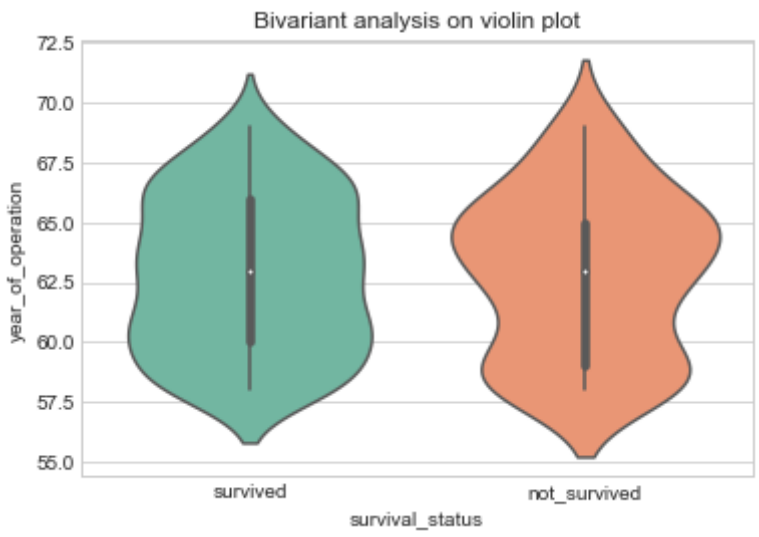
In [328]:
```
# Violin Plots
sns.violinplot(data=df,x='survival_status',y='axillary_nodes',palette='Set2')
plt.title('Bivariant analysis on violin plot')
plt.show()
```



In [329]:
```
sns.violinplot(data=df,x='survival_status',y='age',palette='Set3')
plt.title('Bivariant analysis on violin plot')
plt.show();
```



In [330]:
```
sns.violinplot(data=df,x='survival_status',y='year_of_operation',palette='Set2')
plt.title('Bivariant analysis on violin plot')
plt.show()
```



OBSERVATION :

- No information Found in violin plots.

In [ ]:
```

```