Assignment_4

November 8, 2021

0.1 Haberman Cancer Survival dataset

Toy Dataset: Haberman Dataset (Source: https://www.kaggle.com/gilsousa/habermans-survival-data-set)

- The dataset contains cases from a study that was conducted between 1958 and 1970 at the University of Chicago's Billings Hospital on the survival of patients who had undergone surgery for breast cancer.
- Number of Attributes: 4 (including the class attribute)
- Objective:To find which feature (age of the patient/year of operation/number of Aux nodes) affects the most for Survival of the patient after Surgery.

[1]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import warnings
warnings.filterwarnings('ignore')
hcs = pd.read_csv("haberman.csv")
hcs.head()
```

[1]:

	age	year	nodes	status
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

0.1.1 number of datapoints and features :

[2]:
```
print(hcs.shape)
```

```
(306, 4)
```

0.1.2 Column names and their description :

[3]:
```
print(hcs.columns)
```

```
Index(['age', 'year', 'nodes', 'status'], dtype='object')
```

Column description :

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

0.1.3 number of patients survived more than 5 years(1) and died within 5 years(2)

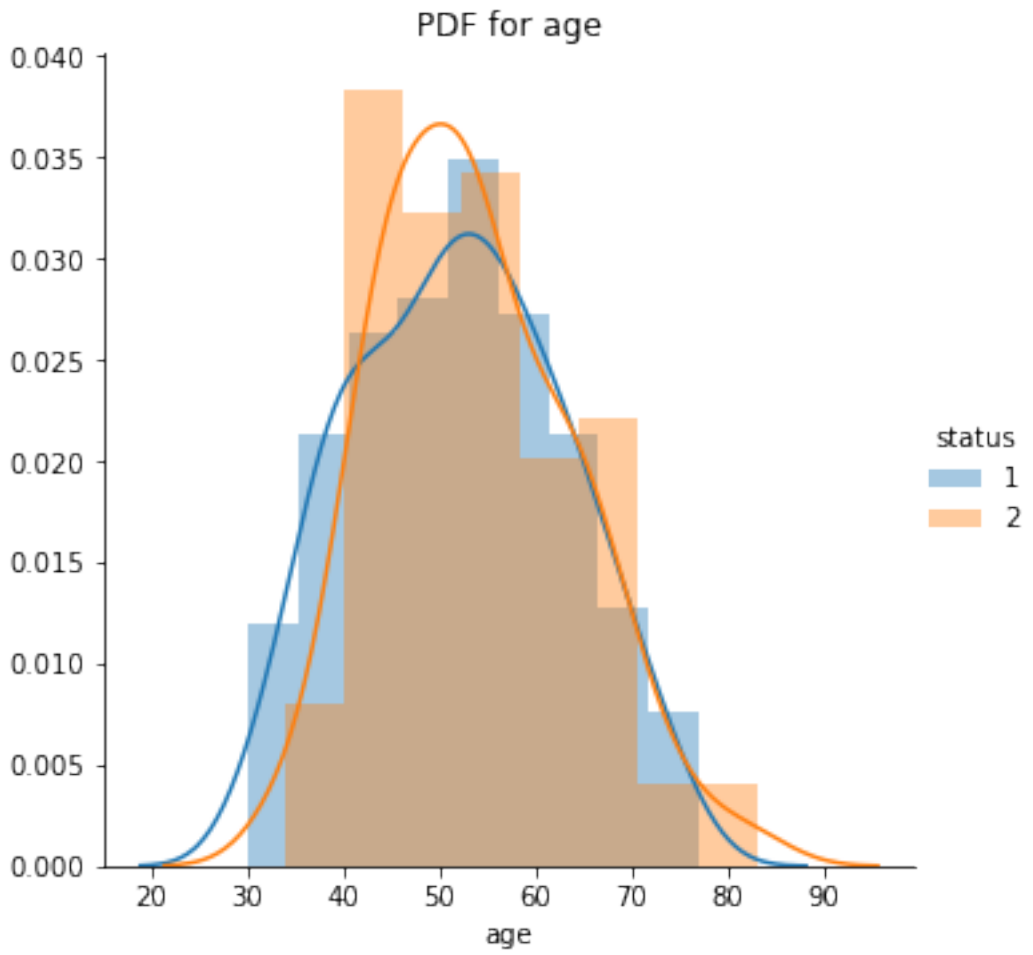
[4]:
```
print(hcs["status"].value_counts())
```

```
1    225
2     81
Name: status, dtype: int64
```

0.2 Univariate Analysis:

0.2.1 PDF :

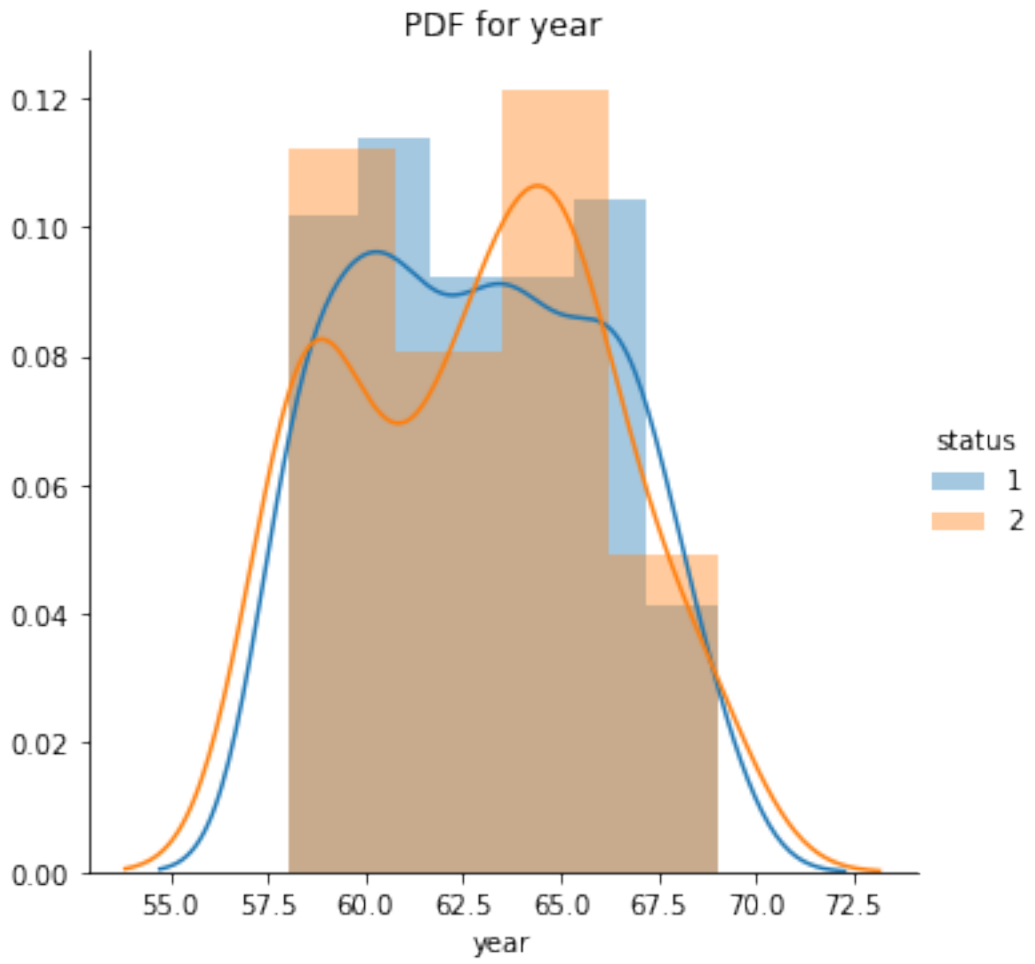
[5]:
```
# PDF for age

sns.FacetGrid(hcs,hue="status",size=5)\
    .map(sns.distplot,"age")\
        .add_legend()
plt.title("PDF for age")
plt.show()
```



Observations:

- age feature shows lot of overlap between the two classes.
- It can be seen that people with age 45-60 have undergone the cancer surgery the most.
- PDF is almost normally distributed

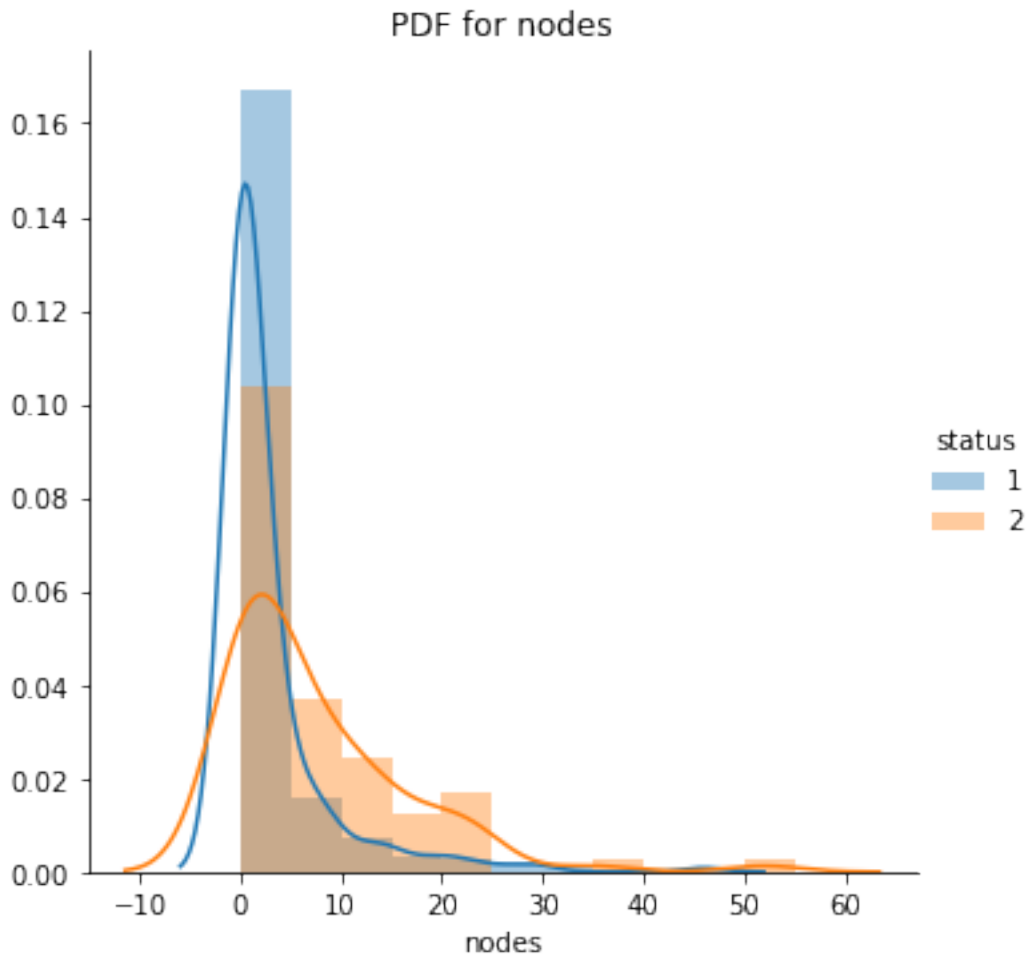
[6]:
```
# PDF for year

sns.FacetGrid(hcs,hue='status',size=5)\
    .map(sns.distplot,'year')\
        .add_legend()
plt.title("PDF for year")
plt.show()
```



0.2.2 Observations :

- year feature also shows lot of overlap between the two classes.
- From blue peak we can see that for surgeries performed between 1960-1962,patients survived more than 5 years after surgery. - From orange peak we can see that for surgeries performed between 1963-1966,patients died within 5 years of surgery.

[7]:
```
# PDF for nodes

binn=[i*5 for i in range(0,12)]
sns.FacetGrid(hcs,hue="status", size=5)\
    .map(sns.distplot,"nodes",bins=binn)\
        .add_legend()
plt.title("PDF for nodes")
plt.show()
```



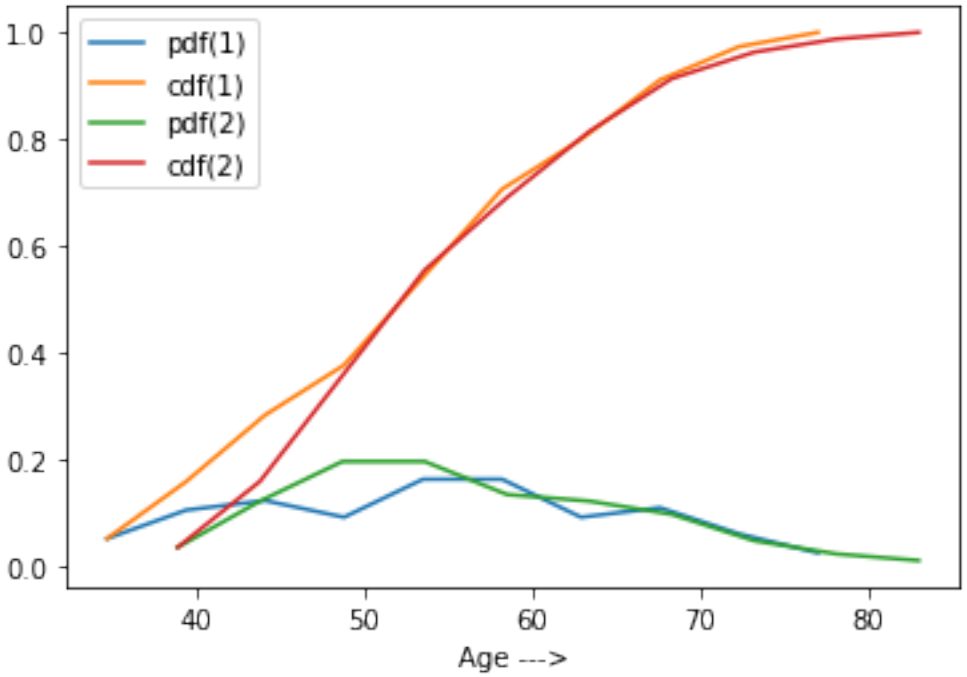
0.2.3 Observations:

- nodes feature also shows lot of overlap between the two classes.
- Most people who have survived more than 5 years and died within 5 years after the surgery had 0-5 positive axillary nodes.

0.2.4 CDF :

[8]:
```
# CDF for age

one = hcs[hcs.status == 1]
two = hcs[hcs.status == 2]

# CDF of age for people who survived more than 5 years after Surgery

counts,bin_edges = np.histogram(one['age'],bins=10,density=True)
pdf = counts/sum(counts)
```

```
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)

#CDF of age for people who within 5 years after Surgery

counts,bin_edges = np.histogram(two['age'],bins=10,density=True)
pdf = counts/sum(counts)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)
plt.xlabel("Age --->")
plt.legend(["pdf(1)","cdf(1)","pdf(2)","cdf(2)"])
plt.show()
```

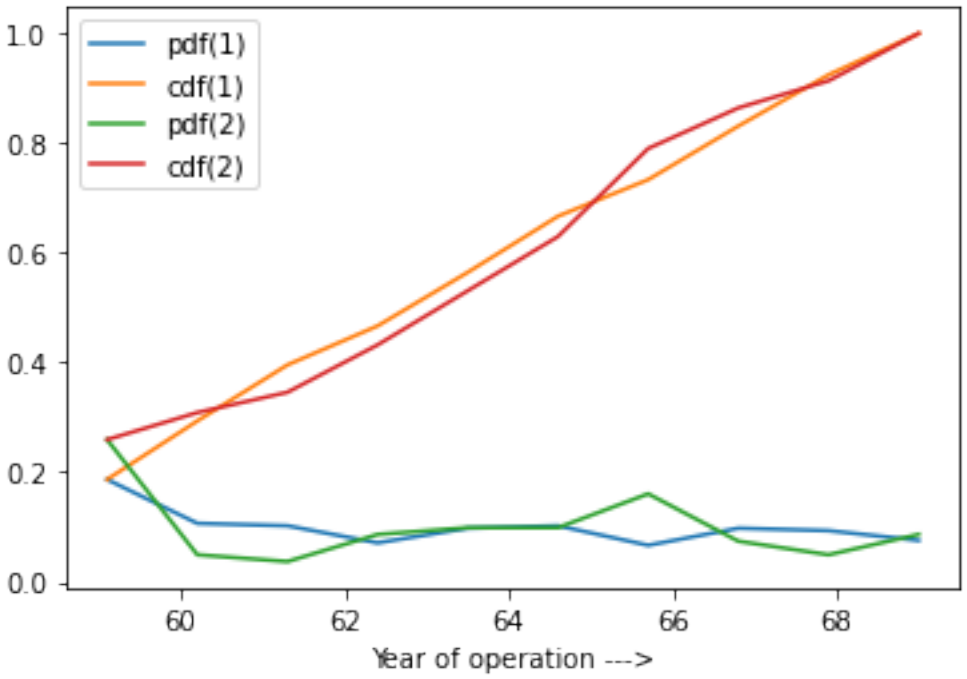


Observations :

- CDF for patients survived after 5 years and died within 5 years is almost same for age 50 and above.
- From the CDFs we can say 80% of the patients for both the classes are under the age 65.

[9]:
```
# CDF of year under which patients has undergone operation and survived more than 5 years.

counts,bin_edges = np.histogram(one['year'],bins=10,density=True)
```

```
pdf = counts/sum(counts)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)

# CDF of year under which patients has undergone operation and died within 5␣
 ↪years.

counts,bin_edges = np.histogram(two['year'],bins=10,density=True)
pdf = counts/sum(counts)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)
plt.xlabel("Year of operation --->")
plt.legend(["pdf(1)","cdf(1)","pdf(2)","cdf(2)"])
plt.show()
```

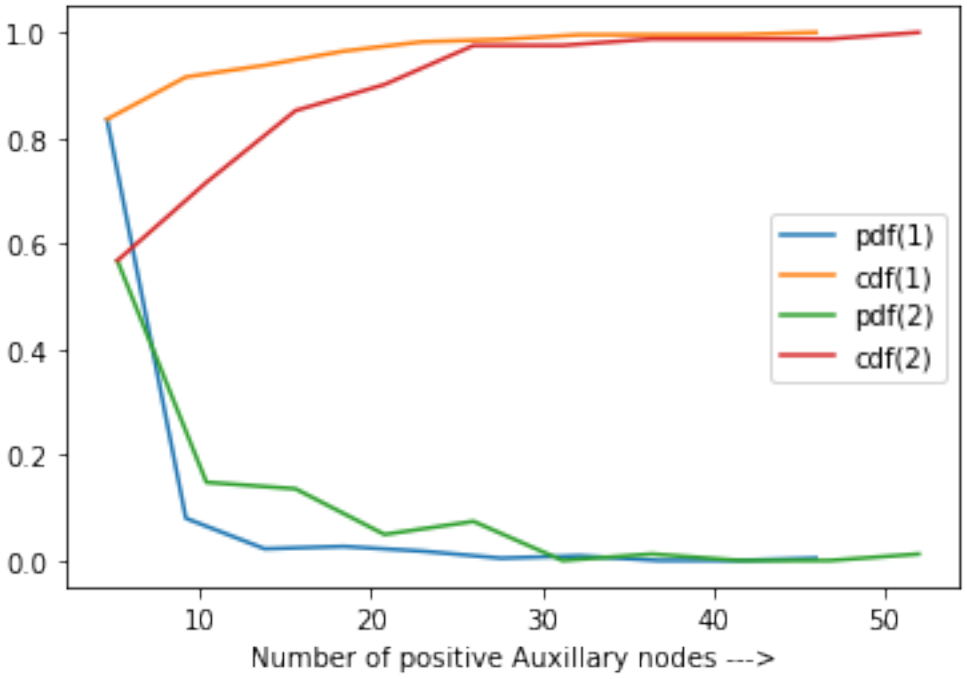


Observations :

- From the CDFs we can say 70% of the patients for both the classes were operated between 1959-65

[10]:
```
# CDF of number of Auxillary nodes for patients who survived more than 5 years.

counts,bin_edges = np.histogram(one['nodes'],bins=10,density=True)
```

```
pdf = counts/sum(counts)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)

# CDF of number of Auxillary nodes for patients who died within 5 years.

counts,bin_edges = np.histogram(two['nodes'],bins=10,density=True)
pdf = counts/sum(counts)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:],cdf)
plt.xlabel("Number of positive Auxillary nodes --->")
plt.legend(["pdf(1)","cdf(1)","pdf(2)","cdf(2)"])
plt.show()
```

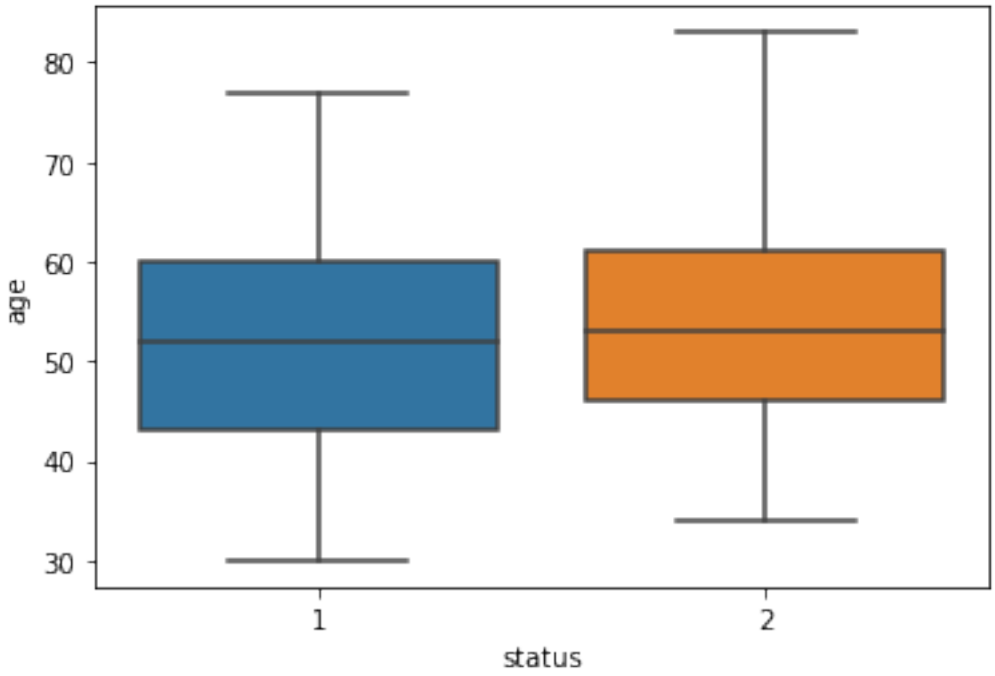


Observations:

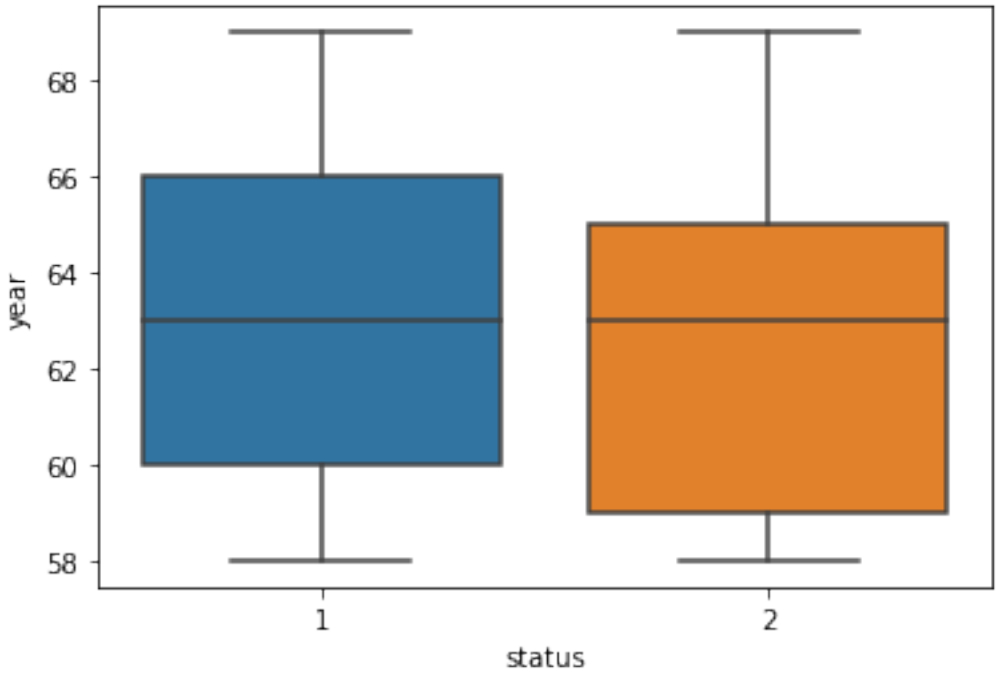
- 82% of the patients who survived more than 5 years had 0-5 Aux nodes.
- 58% of the patients who died within 5 years had 0-5 Aux nodes.

0.2.5 Box Plot :

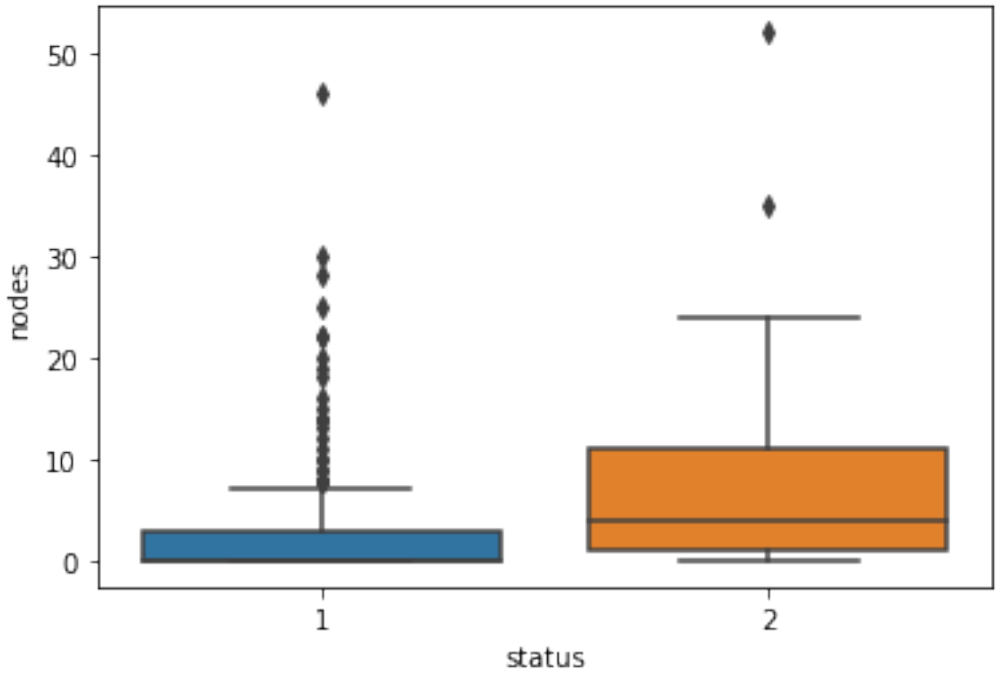
[11]:
```
sns.boxplot(x='status',y='age', data=hcs)
plt.show()
```



[12]:
```
sns.boxplot(x='status',y='year', data=hcs)
plt.show()
```



[13]:
```
sns.boxplot(x='status',y='nodes', data=hcs)
plt.show()
```

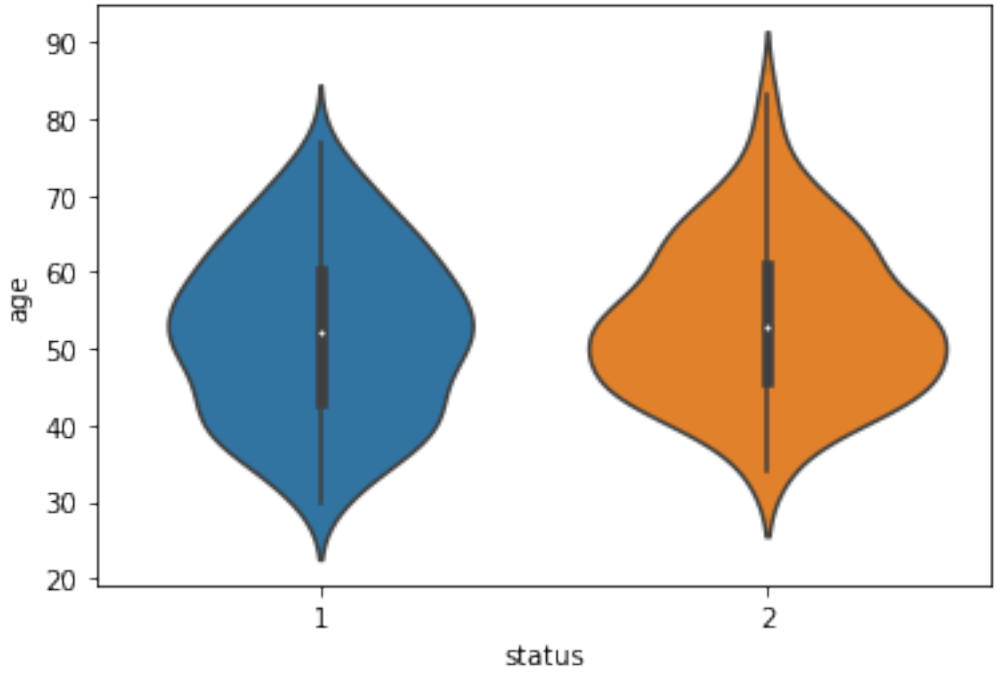


Observations :

- age and year don't have any outliers.
- For number of Aux nodes we can see the outliers.
  - Patients having more than 8 positive axial nodes have less probability of survival.

0.2.6 Violin Plot :

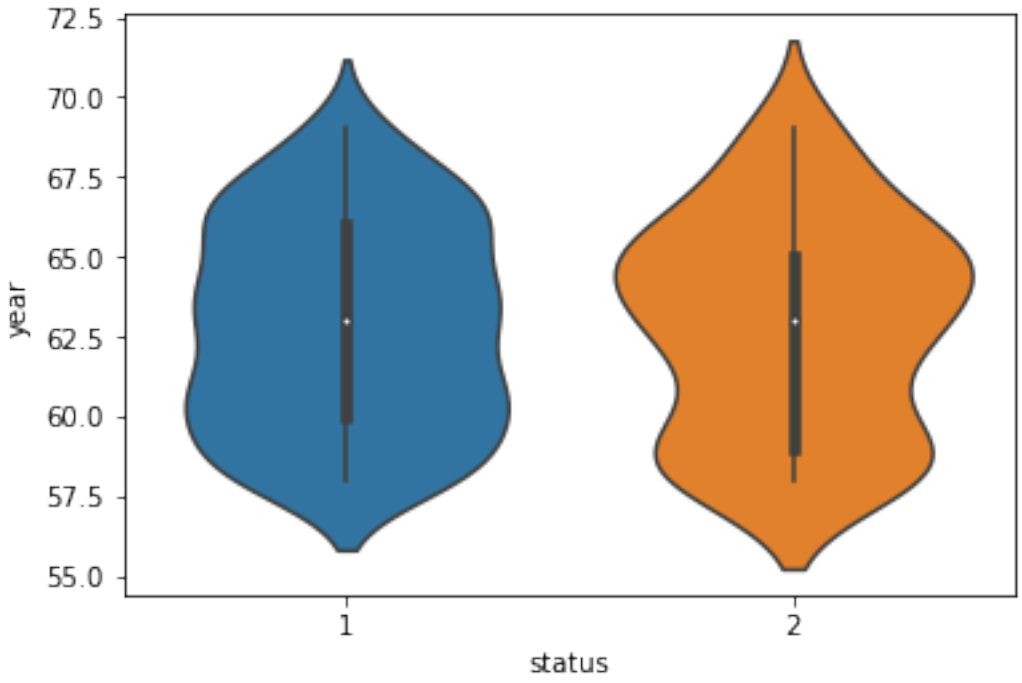
[14]:
```
sns.violinplot(x="status", y="age", data=hcs, size=8)
plt.show()
```



Observations :

- Majority of the patients who undergone the operation were between 40-65 in age.

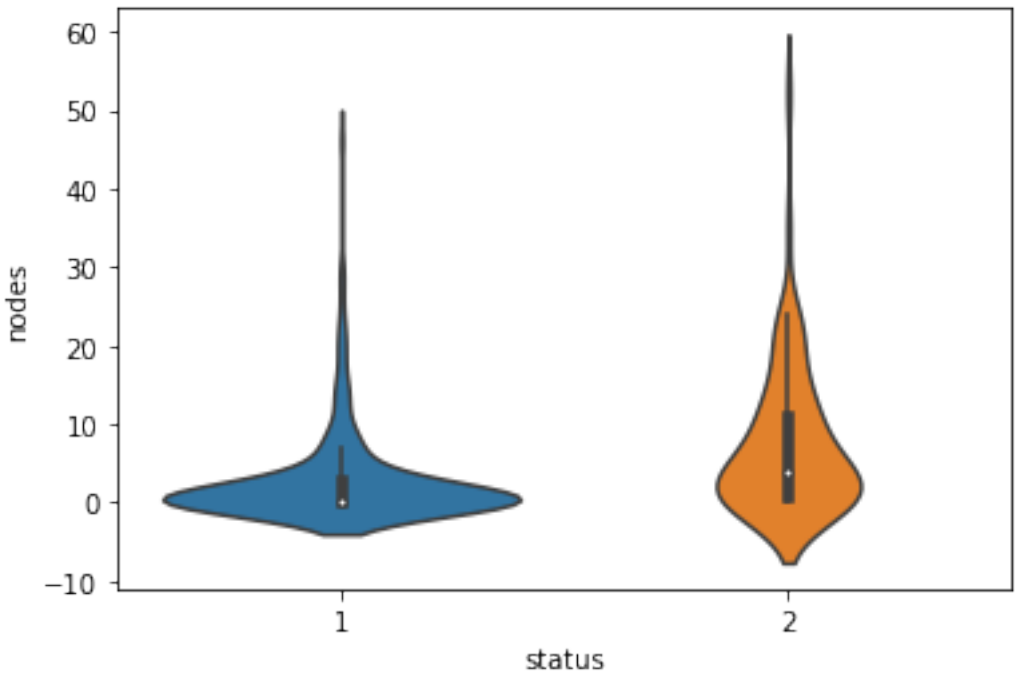
[15]:
```
sns.violinplot(x="status", y="year", data=hcs, size=8)
plt.show()
```



Observations :

- Majority of the the operations were conducted between 1958-1967

[16]:
```
sns.violinplot(x="status", y="nodes", data=hcs, size=8)
plt.show()
```



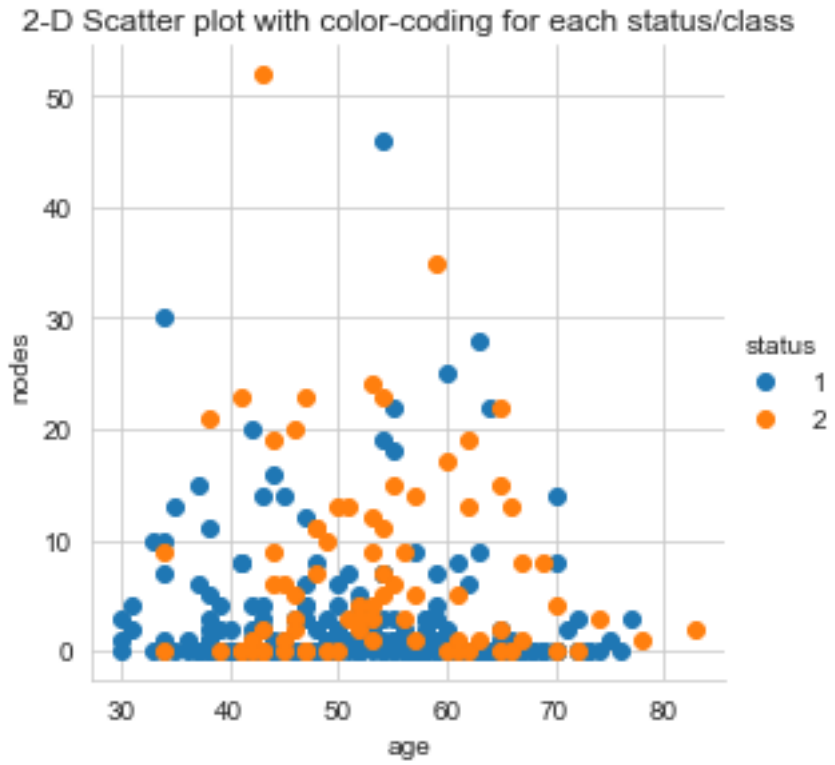
Observations :

- Majority of the patients who survived had 0-6 Aux nodes
- around 40% of the patients who died within 5 years had more than 6 Aux nodes

0.3 Bivariate Analysis :

0.3.1 2-D Scatter Plot :

[17]:
```
# 2-D Scatter plot for age and nodes

sns.set_style("whitegrid");
sns.FacetGrid(hcs, hue="status", size=4) \
   .map(plt.scatter, "age", "nodes") \
   .add_legend();
plt.title('2-D Scatter plot with color-coding for each status/class')
plt.show();
```

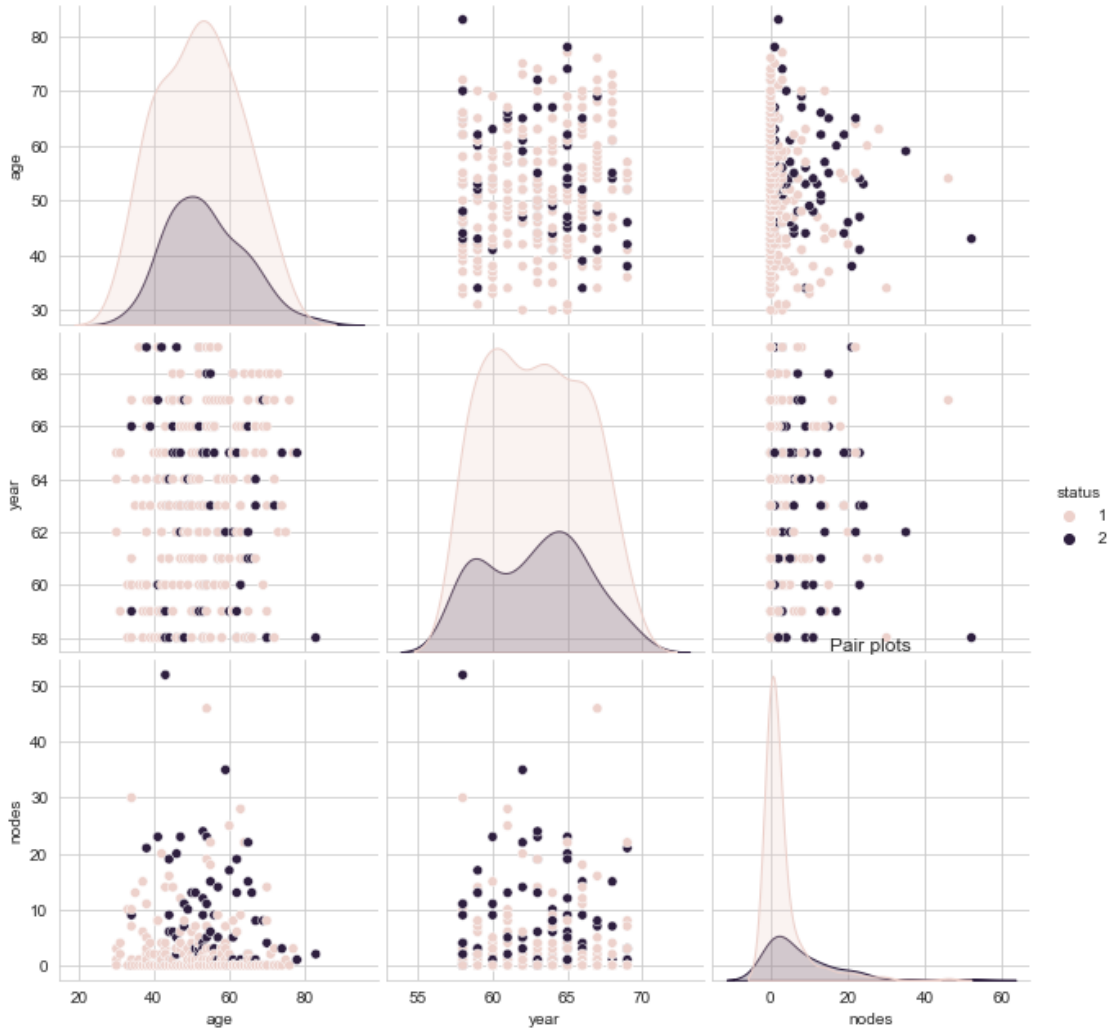


Observations :

- We can't tell anything with this graph
- Points for each class intersected.
- we get the similar results for nodes-year,age-year 2-D scatter plots.

0.3.2 Pair-Plots :

[18]:
```
plt.close();
sns.set_style("whitegrid");
sns.pairplot(hcs, hue="status", size=3);
plt.title('Pair plots')
plt.show()
```



Observations :

- We can see that we can't tell anything through these graphs since all the points are overlapped.

0.4 Summary :

- We can't really say the key feature for the classification but we can consider 'nodes'.
- Patients who had more than 5 nodes are mostly likely to die within 5 years after the surgery.
- We could also see most of the patients were between 40-65 in age.