```
from google.colab import files
uploaded = files.upload()
```

Choose files haberman.csv

- **haberman.csv**(application/vnd.ms-excel) - 3124 bytes, last modified: 14/08/2021 - 100% done

```
Saving haberman.csv to haberman.csv
```

1.1 Importing Packages

```
# import the required packages
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

1.2 Reading the file

```
# Read the data from drive and display few records

df= pd.read_csv("haberman.csv")
df.head()
```

	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

1.3 Find out dimension and attributes of dataset

```
df.describe()
```

	age	year	nodes	status
count	306.000000	306.000000	306.000000	306.000000
mean	52.457516	62.852941	4.026144	1.264706
std	10.803452	3.249405	7.189654	0.441899
min	30.000000	58.000000	0.000000	1.000000
25%	44.000000	60.000000	0.000000	1.000000
50%	52.000000	63.000000	1.000000	1.000000
75%	60.750000	65.750000	4.000000	2.000000
max	83.000000	69.000000	52.000000	2.000000

from the above results we can get to know from interesting points

1. Average age of people who got operated.
2. 0(min) to 52(max) nodes were infected due to cancer
3. People got operated in between time frame of year 1958 to 1969.

```
# to check the rows and columns in the dataset
df.shape
```

```
(306, 4)
```

data set contains 306 rows and 4 columns

```
# to see the columns and it's datatypes
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 306 entries, 0 to 305
Data columns (total 4 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   age     306 non-null    int64
 1   year    306 non-null    int64
 2   nodes   306 non-null    int64
 3   status  306 non-null    int64
dtypes: int64(4)
memory usage: 9.7 KB
```

2.0 Objective

1. What is the age group of people who has undergone surgeries?
2. Which year the no. of operations were more?
3. What is the trend on Year over year operations ?
4. Count of people who survived for more than 5 years?
5. Relationship between Axillary node and Age ?
6. How Axillary node and survival rate is related ?

2.1 Data pre-processing and Cleansing

```
# to find if there is any missing values in the dataset

df.isnull().sum()
```

```
age       0
year      0
nodes     0
status    0
dtype: int64
```

```
# to find if there is any NA in the dataset
df.isna().sum()
```

```
age       0
year      0
nodes     0
status    0
dtype: int64
```

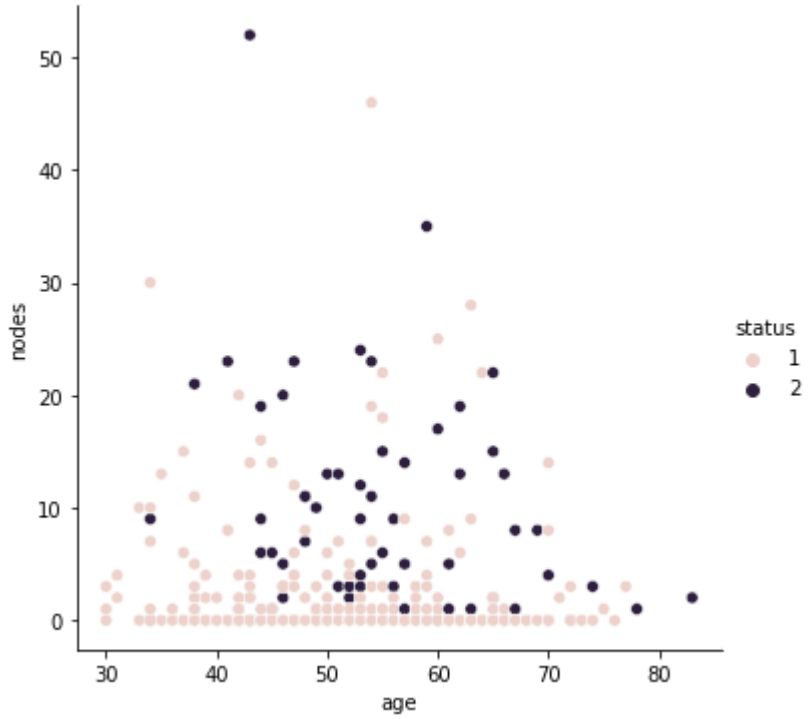
Observation1 : There are no missing values or NA in the dataset so we are good to proceed with data visualization

3.1 Plots

1. 1D plots
2. 2D plots
3. Scatter plots

```
 # 2d Scatter Plot

sns.relplot( data=df, x='age', y='nodes',hue='status', )
```

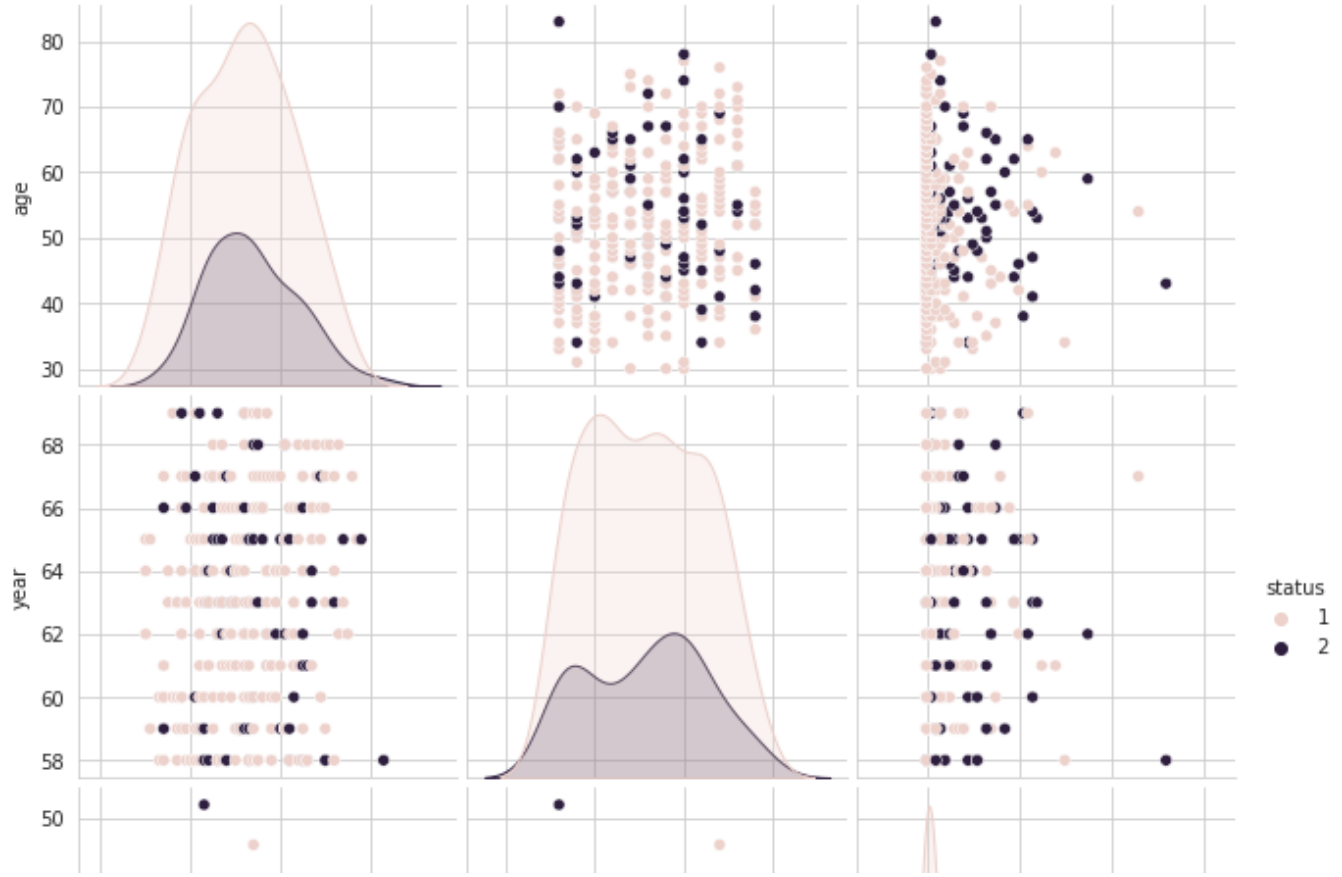
```
<seaborn.axisgrid.FacetGrid at 0x7fcfa8890690>
```



- unable to interpret from the scatter plot above

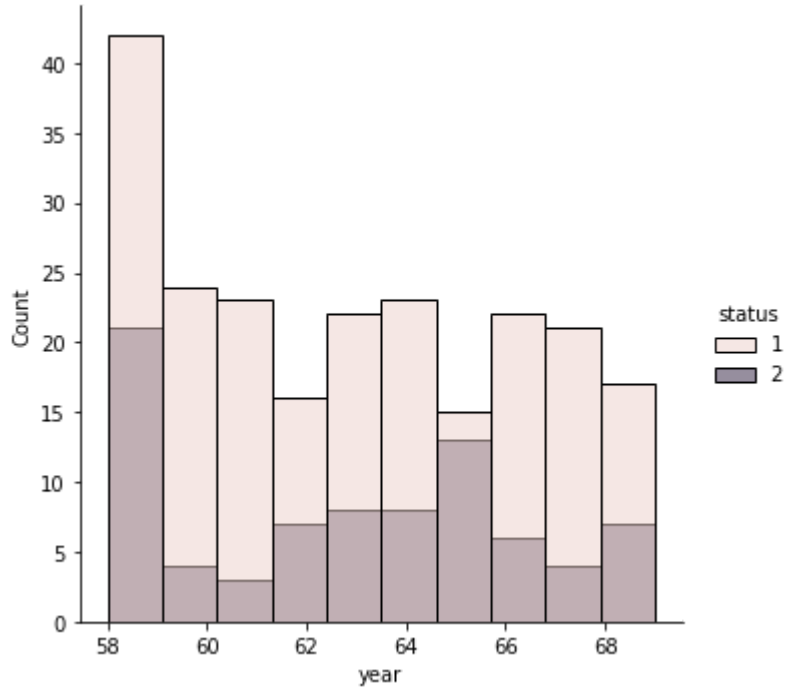
```
# pairwise scatter plot: Pair-Plot
plt.close();
sns.set_style("whitegrid");
sns.pairplot(df, hue="status", size=3);
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:1969: UserWarning: The `size`
  warnings.warn(msg, UserWarning)
```




```
sns.displot(df, x="year", hue="status")
```

```
<seaborn.axisgrid.FacetGrid at 0x7fa8984f3710>
```



- From the above dist plot we can infer two important points

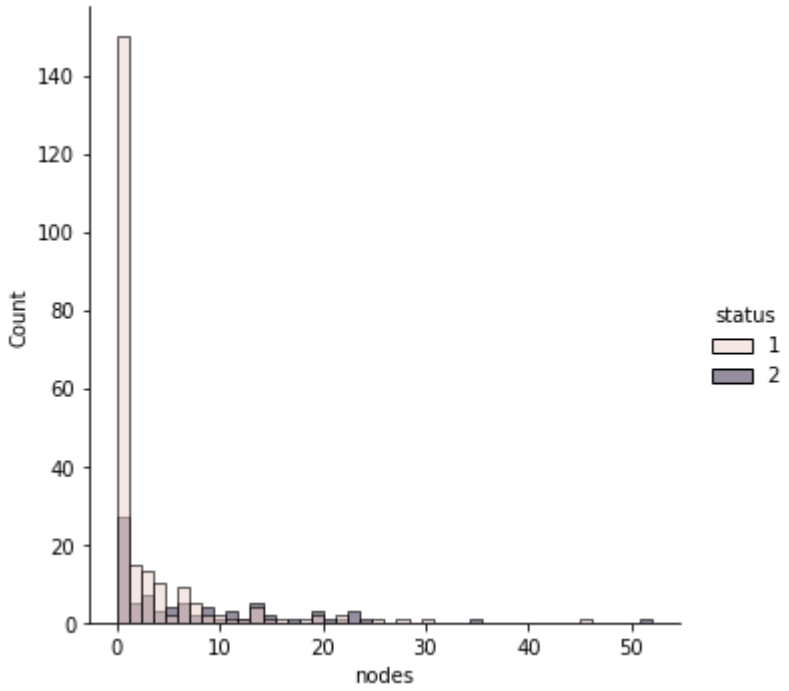
1. People got operated more in initial years and later on started decreasing. Basically the operations count is decreasing over the year.
2. People who got operated survived more than 5 plus years comparatively to the other category.

From the above regplot we can notice 2 points

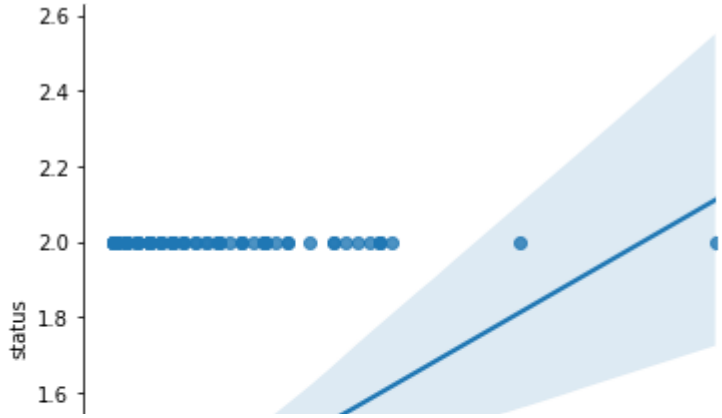
1. Age is not a major factor to have more number of lymph nodes failure or detected positive
2. most of the people of all the age group are having failure nodes ranging between 0 to 5.

```
sns.displot(df, x="nodes", hue="status")
```

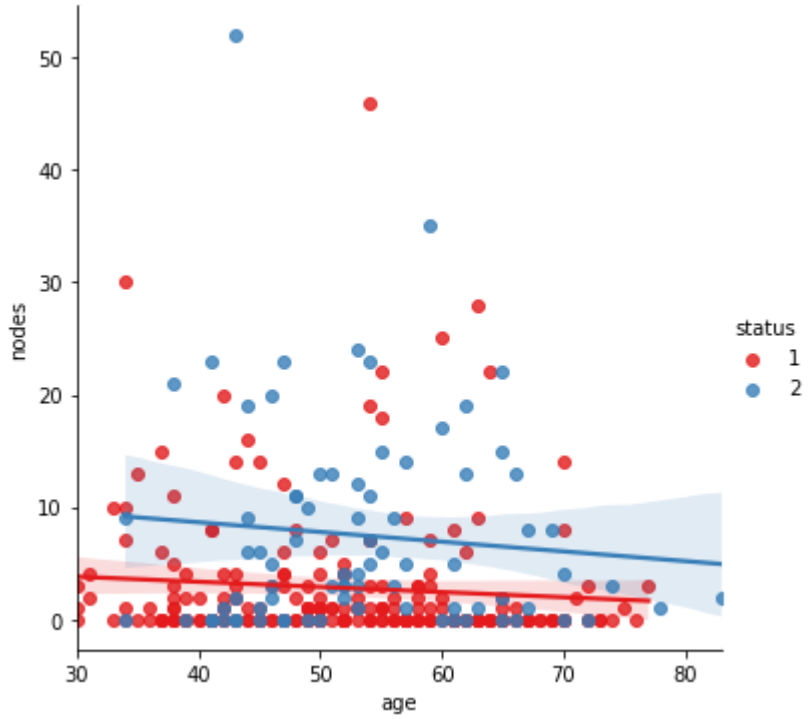
```
<seaborn.axisgrid.FacetGrid at 0x7f2a5f66c550>
```




```
sns.lmplot(x="nodes", y="status", data=df,x_jitter=.05);
```




```
sns.lmplot(x="age", y="nodes", hue="status", data=df,palette="Set1");
```

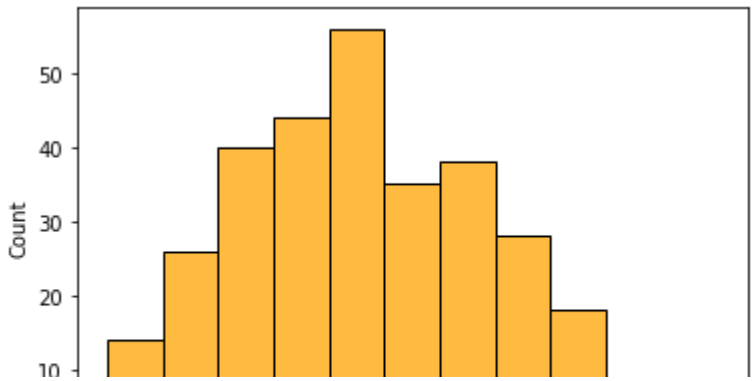


From the above lmplot we can notice 2 points

1. Age is not a major factor to have more number of lymph nodes failure or detected positive
2. most of the people are having across the age group are having failure nodes ranging between 0 to 5.

```
sns.histplot(data=df, x="age", color="orange")
```

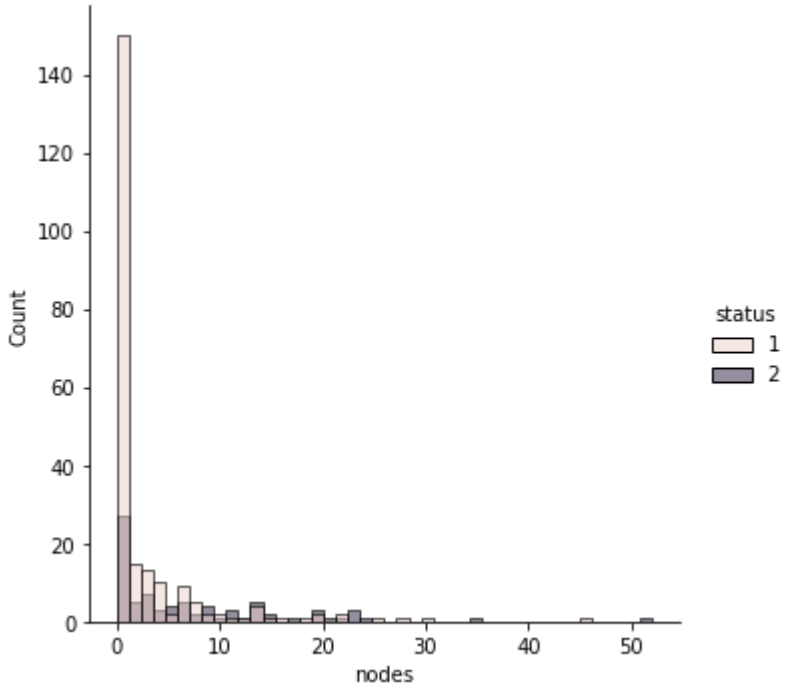
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f2a5ccf9810>
```



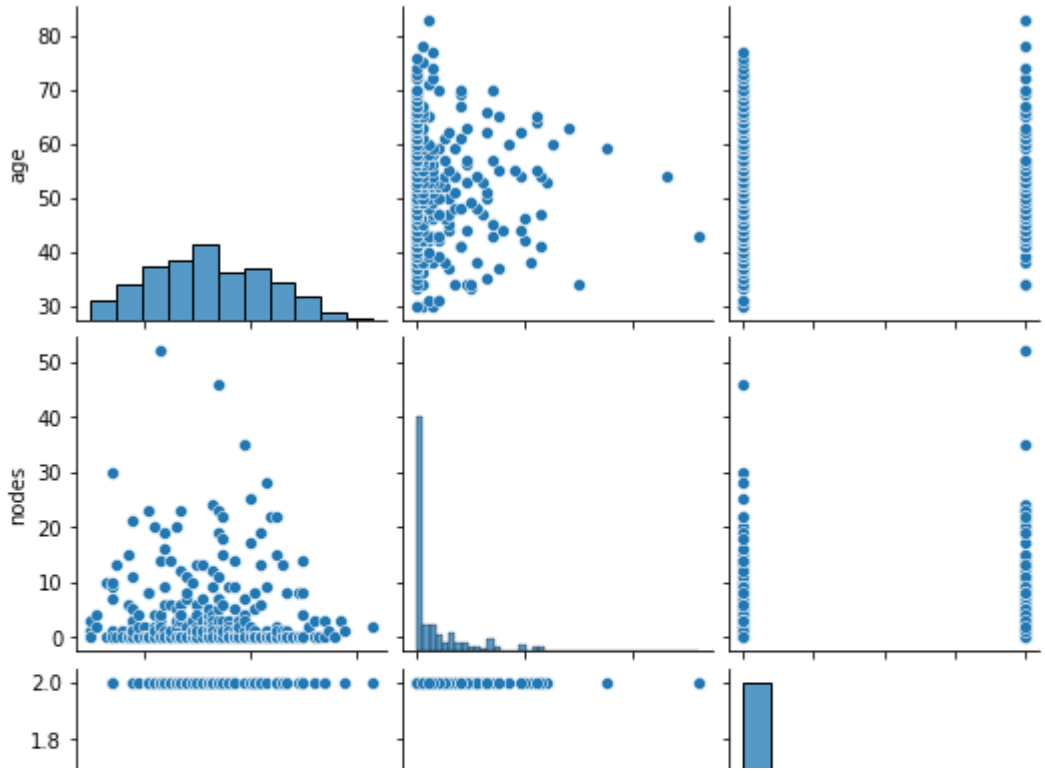
From the above histplot we can observe that people who are in the age group of 50-55 are more to get operated

```
sns.displot(df, x="nodes", hue="status")
```

```
<seaborn.axisgrid.FacetGrid at 0x7fa8ef3999d0>
```




```
sns.pairplot(data = df, vars=['age','nodes','status'])
plt.show()
```



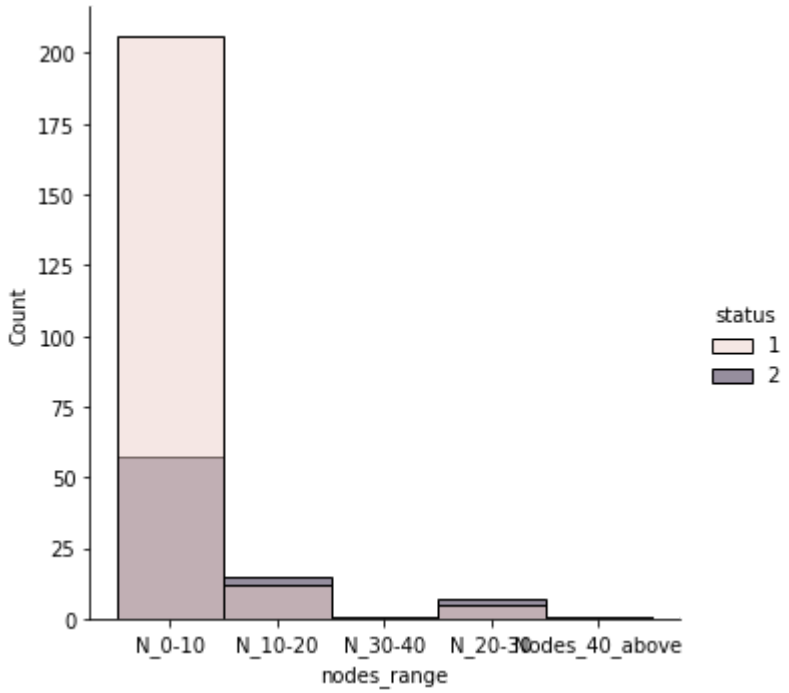

```
# Created a new list called age_group and categorize the "age" numerical values into categori
# "Age_50-70 - for people whose age lies in between 50 to 70 and last one to 70-90"
age_group=[]

for row in df['age']:
  if ( row >= 30 ) and ( row < 50)  : age_group.append('Age_30-50')
  elif ( row >= 50) and ( row < 70) : age_group.append('Age_50-70')
  else: age_group.append('Age_70-90')



df['age_group']=age_group


# Created a new list called nodes and categorize the "age" numerical values into categorical
# "Age_50-70 - for people whose age lies in between 50 to 70 and last one to 70-90"print(df)
```

	age	year	nodes	status	age_group
0	30	64	1	1	Age_30-50
1	30	62	3	1	Age_30-50
2	30	65	0	1	Age_30-50
3	31	59	2	1	Age_30-50
4	31	65	4	1	Age_30-50
..	...	...	...	...	...
301	75	62	1	1	Age_70-90
302	76	67	0	1	Age_70-90
303	77	65	3	1	Age_70-90
304	78	65	1	2	Age_70-90
305	83	58	2	2	Age_70-90

[306 rows x 5 columns]

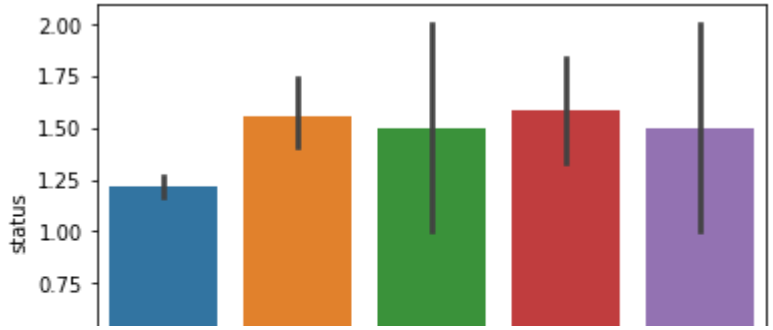
```
# Created a new list called nodes_range and categorize the "nodes" numerical values into cate
# N-0-10 ( for 0 to 10 nodes failure)
# N-10-20 ( for 10 to 20 nodes failure)
# N-20-30 ( for 20 to 30 nodes failure)
# N-30-40 ( for 30 to 40 nodes failure)
# Nodes_40_above ( for 40 nodes and above failure)

nodes_range=[]

for row in df['nodes']:
  if ( row >= 0 ) and ( row < 10) : nodes_range.append('N_0-10')
  elif ( row >= 10) and ( row < 20) : nodes_range.append('N_10-20')
  elif ( row >= 20) and ( row < 30) : nodes_range.append('N_20-30')
  elif ( row >= 30) and ( row < 40) : nodes_range.append('N_30-40')
  else: nodes_range.append('Nodes_40_above')


df['nodes_range']=nodes_range


sns.displot(df, x="nodes_range", hue="status")
```

```
<seaborn.axisgrid.FacetGrid at 0x7f196da69050>
```




```
sns.barplot(x ='nodes_range', y ='status',
data = df)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fcf82e0cb90>
```

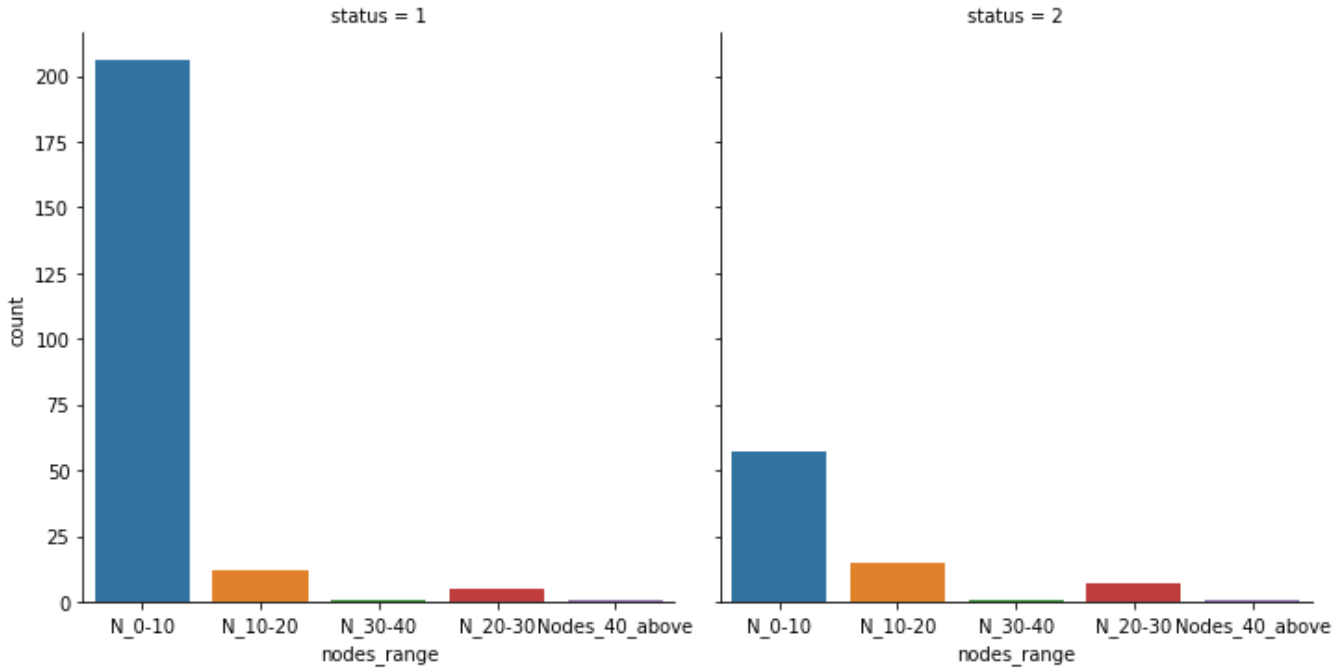



```
df.groupby(['status','nodes_range'])['status'].count()
```

```
status  nodes_range
1       N_0-10            206
        N_10-20            12
        N_20-30             5
        N_30-40             1
        Nodes_40_above      1
2       N_0-10             57
        N_10-20            15
        N_20-30             7
        N_30-40             1
        Nodes_40_above      1
Name: status, dtype: int64
```

Double-click (or enter) to edit

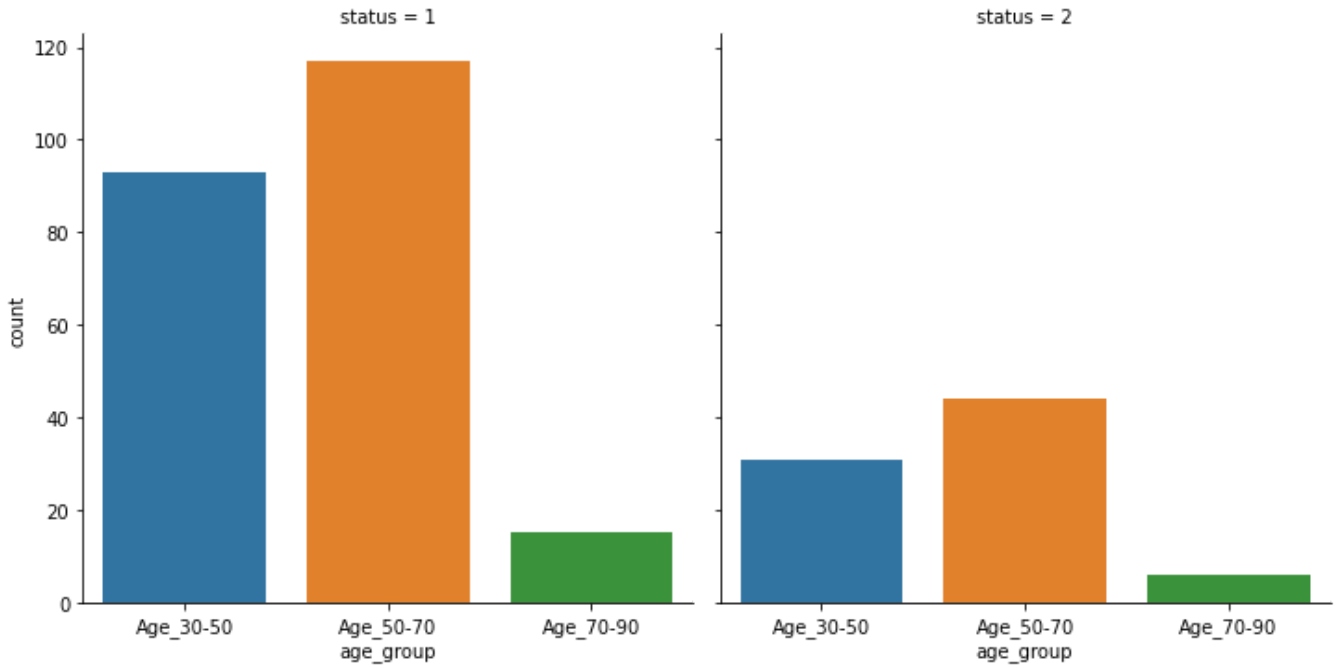
```
sns.catplot(x='nodes_range', col='status', kind='count', data=df);
```



On further drilling down the dataset we noticed the below points

1. People who got operated lived longer than 5 years plus compared to the other category
2. People who suffered with 0-10 nodes failure are more likely to survive (67%) than people who suffered with more nodes failure.
3. People who survived for less than 5 years counts are more when nodes failure is less
4. Nodes failure is indirectly propotional to survival rate.

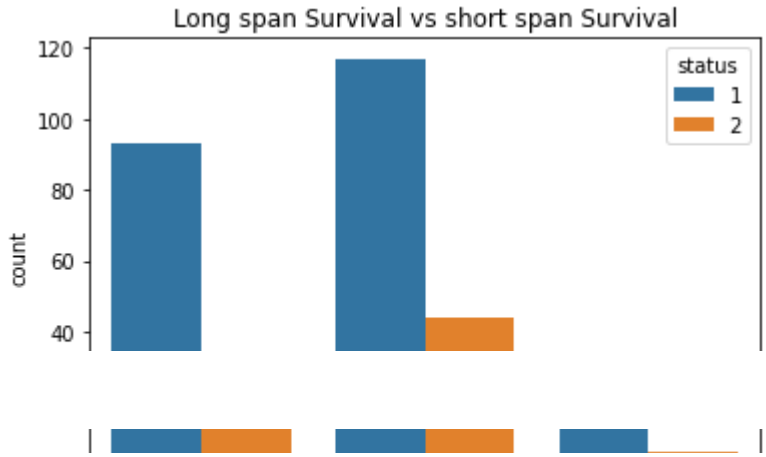
```
sns.catplot(x='age_group', col='status', kind='count', data=df);
```



Double-click (or enter) to edit

```
sns.countplot('age_group', hue='status', data=df)
plt.title('Long span Survival vs short span Survival')
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass th
  FutureWarning
```



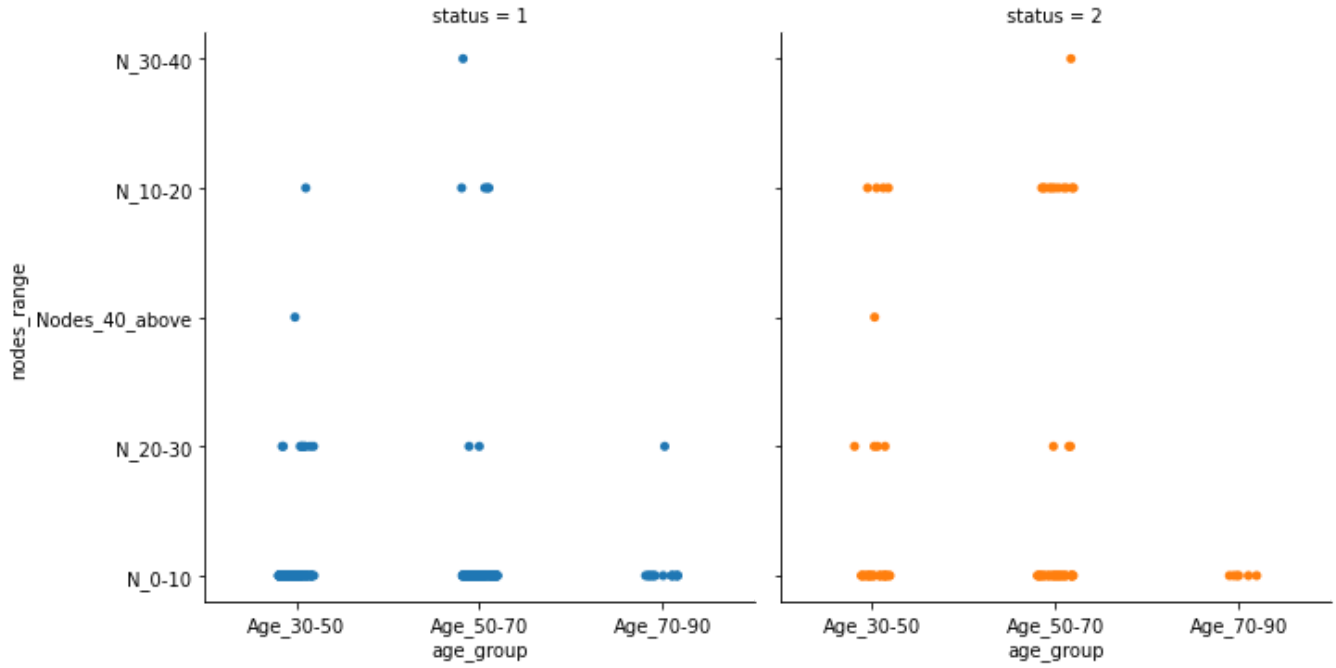
From the above catplot we can also observe that

1. Age group falling in between 50-70 are more prone to cancer
2. Percentage of people who got survived longer is also more compared to other category under 50-70 age group

```
sns.catplot(x="age_group", y="nodes_range", hue="status",
             aspect=2.9,
            kind="swarm", data=df)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/categorical.py:1296: UserWarning: 42.7% c
  warnings.warn(msg, UserWarning)
```

```
g = sns.catplot(x="age_group", y="nodes_range", hue="status",
                col="status", data=df)
```



Observations from the above catplot

1. Irrespective of Age groups, more number of people who got cancer are having nodes failure between 0-10.
2. Also we can observe that Age and Nodes are not dependent or not having any linear relationship

Conclusion and Observations

1. People got operated more in initial years and later on started decreasing. Basically the operations count is decreasing over the year.
2. People who got operated survived more than 5 plus years comparatively to the other category.

3. Age is not a major factor to have more number of lymph nodes failure or detected positive.
4. most of the people of all the age group are having failure nodes ranging between 0 to 5.
5. People who are in the age group of 50-55 are more to get operated.
6. People who got operated lived longer than 5 years plus compared to the other category.
7. People who suffered with 0-10 nodes failure are more likely to survive (67%) than people who suffered with more nodes failure.
8. People who survived for less than 5 years counts are more when nodes failure is less.
9. Nodes failure is indirectly propotional to survival rate. Meaning Less number of nodes failure longer they stay and vice-versa.
10. Irrespective of Age groups, more number of people who got cancer are having nodes failure between 0-10.
11. Age and Nodes are not dependent or not having any linear relationship.