Importing Necessary Libraries

```
import pandas as pd
import numpy as np
```

```
C:\Users\aakas\AppData\Local\Temp\ipykernel_16520\2162656668.py:1:
DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major
release of pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type,
and better interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at
https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

Reading Dataset

```
salary = pd.read_csv("assignment3-part-1-dataset1.csv")

#store = pd.read_csv("assignment3-part-1-dataset2.csv")

salary.head()
```

```
   Unnamed: 0                Company Name       Job Title  Salaries
Reported  \
0           0                     Mu Sigma  Data Scientist
105
1           1                          IBM  Data Scientist
95
2           2  Tata Consultancy Services  Data Scientist
66
3           3           Impact Analytics  Data Scientist
40
4           4                   Accenture  Data Scientist
32

    Location     Salary
0  Bangalore   648573.0
1  Bangalore  1191950.0
2  Bangalore   836874.0
3  Bangalore   669578.0
4  Bangalore   944110.0
```

Replacing ? with NaN

```
salary.replace("?", np.nan,inplace=True)
```

Checking Missing Values

```
salary.isnull().sum()

Unnamed: 0            0
Company Name          0
Job Title             0
Salaries Reported     0
Location              0
Salary                0
dtype: int64
```

Grouping dataset by Job Title

```
salary.groupby("Job Title")

<pandas.core.groupby.generic.DataFrameGroupBy object at
0x000001E13C1BB140>

salary.head()

   Unnamed: 0               Company Name       Job Title  Salaries
Reported  \
0           0                   Mu Sigma  Data Scientist
105
1           1                        IBM  Data Scientist
95
2           2  Tata Consultancy Services  Data Scientist
66
3           3           Impact Analytics  Data Scientist
40
4           4                  Accenture  Data Scientist
32

    Location     Salary
0  Bangalore   648573.0
1  Bangalore  1191950.0
2  Bangalore   836874.0
3  Bangalore   669578.0
4  Bangalore   944110.0
```

Finding Mean

```
mean = salary.groupby("Job Title")["Salary"].mean()
print(mean)

Job Title
Associate Machine Learning Engineer     4.643720e+05
Data Analyst                            6.164699e+05
Data Engineer                           1.309051e+06
Data Science                            3.649053e+05
Data Science Associate                  1.203913e+06
```

```
Data Science Consultant                   2.671464e+06
Data Science Lead                         4.068310e+06
Data Science Manager                      4.619021e+06
Data Scientist                            1.411330e+06
Data Scientist - Trainee                  6.105120e+05
Junior Data Scientist                     5.963231e+05
Lead Data Scientist                       1.852189e+06
Machine Learning Associate                2.951140e+05
Machine Learning Consultant               7.064010e+05
Machine Learning Data Analyst             3.613780e+05
Machine Learning Data Associate           2.758410e+05
Machine Learning Data Associate I         2.585960e+05
Machine Learning Data Associate II        3.832130e+05
Machine Learning Developer                5.811190e+05
Machine Learning Engineer                 7.971884e+05
Machine Learning Scientist                1.701180e+05
Machine Learning Software Engineer        1.397347e+06
Senior Data Scientist                     1.766130e+06
Senior Machine Learning Engineer          1.473436e+06
Software Engineer - Machine Learning      1.566780e+06
Name: Salary, dtype: float64
```

Finding median

```
median = salary.groupby("Job Title")["Salary"].median()
print(median)
```

```
Job Title
Associate Machine Learning Engineer       464372.0
Data Analyst                              508150.5
Data Engineer                             792683.0
Data Science                              240780.0
Data Science Associate                   1203913.0
Data Science Consultant                  2671464.0
Data Science Lead                        4068310.0
Data Science Manager                     4619021.0
Data Scientist                            914480.0
Data Scientist - Trainee                  610512.0
Junior Data Scientist                     554963.0
Lead Data Scientist                      1664364.0
Machine Learning Associate                295114.0
Machine Learning Consultant               706401.0
Machine Learning Data Analyst             361378.0
Machine Learning Data Associate           275841.0
Machine Learning Data Associate I         258596.0
Machine Learning Data Associate II        383213.0
Machine Learning Developer                581119.0
Machine Learning Engineer                 627048.5
Machine Learning Scientist                170118.0
Machine Learning Software Engineer       1397347.0
```

```
Senior Data Scientist                      1733388.0
Senior Machine Learning Engineer           1335445.0
Software Engineer - Machine Learning       1566780.0
Name: Salary, dtype: float64
```

Finding mode

```
mode = salary.groupby("Job Title")["Salary"].apply(lambda
x:x.mode().iloc[0])
print(mode)

# lambda x: This defines an anonymous function (lambda function) that
takes one argument x.
# In this context, x represents each group of salaries within each job
title.

# x.mode(): Inside the lambda function, x is a Series object
containing all the salaries within a specific job title group.
# The mode() function is called on this Series object to compute the
mode, i.e., the most frequently occurring value.

# .iloc[0]: After calculating the mode, .iloc[0] is used to retrieve
the first value from the resulting Series.
# This is necessary because the mode() function may return multiple
values if there are ties for the most frequent value.
# By selecting the first value, we ensure that only one mode value is
returned.
```

```
Job Title
Associate Machine Learning Engineer      464372.0
Data Analyst                             338792.0
Data Engineer                            515940.0
Data Science                             180000.0
Data Science Associate                  1203913.0
Data Science Consultant                 2671464.0
Data Science Lead                       4068310.0
Data Science Manager                    4619021.0
Data Scientist                           600000.0
Data Scientist - Trainee                 610512.0
Junior Data Scientist                    616492.0
Lead Data Scientist                     1520967.0
Machine Learning Associate               295114.0
Machine Learning Consultant              186475.0
Machine Learning Data Analyst            361378.0
Machine Learning Data Associate          275841.0
Machine Learning Data Associate I        258596.0
Machine Learning Data Associate II       383213.0
Machine Learning Developer               410952.0
Machine Learning Engineer                128988.0
Machine Learning Scientist                62160.0
```

```
Machine Learning Software Engineer      1397347.0
Senior Data Scientist                   2474429.0
Senior Machine Learning Engineer         229416.0
Software Engineer - Machine Learning    1521236.0
Name: Salary, dtype: float64
```

Finding minimum value

```
minimum = salary.groupby("Job Title")["Salary"].min()
print(minimum)
```

```
Job Title
Associate Machine Learning Engineer      464372.0
Data Analyst                              10814.0
Data Engineer                             33120.0
Data Science                              60840.0
Data Science Associate                  1203913.0
Data Science Consultant                 2671464.0
Data Science Lead                       4068310.0
Data Science Manager                    4619021.0
Data Scientist                            48000.0
Data Scientist - Trainee                 610512.0
Junior Data Scientist                     60840.0
Lead Data Scientist                     1520967.0
Machine Learning Associate               295114.0
Machine Learning Consultant              186475.0
Machine Learning Data Analyst            361378.0
Machine Learning Data Associate          275841.0
Machine Learning Data Associate I        258596.0
Machine Learning Data Associate II       383213.0
Machine Learning Developer               410952.0
Machine Learning Engineer                 21628.0
Machine Learning Scientist                62160.0
Machine Learning Software Engineer      1397347.0
Senior Data Scientist                    324089.0
Senior Machine Learning Engineer         229416.0
Software Engineer - Machine Learning    1521236.0
Name: Salary, dtype: float64
```

Finding Maximum Values

```
maximum = salary.groupby("Job Title")["Salary"].max()
print(maximum)
```

```
Job Title
Associate Machine Learning Engineer     4.643720e+05
Data Analyst                            3.900962e+07
Data Engineer                           1.190400e+08
Data Science                            2.000000e+06
Data Science Associate                  1.203913e+06
```

```
Data Science Consultant                    2.671464e+06
Data Science Lead                          4.068310e+06
Data Science Manager                       4.619021e+06
Data Scientist                             1.661404e+08
Data Scientist - Trainee                   6.105120e+05
Junior Data Scientist                      1.498750e+06
Lead Data Scientist                        2.839138e+06
Machine Learning Associate                 2.951140e+05
Machine Learning Consultant                1.226327e+06
Machine Learning Data Analyst              3.613780e+05
Machine Learning Data Associate            2.758410e+05
Machine Learning Data Associate I          2.585960e+05
Machine Learning Data Associate II         3.832130e+05
Machine Learning Developer                 7.512860e+05
Machine Learning Engineer                  6.518917e+06
Machine Learning Scientist                 2.780760e+05
Machine Learning Software Engineer         1.397347e+06
Senior Data Scientist                      3.654010e+06
Senior Machine Learning Engineer           3.110514e+06
Software Engineer - Machine Learning       1.612324e+06
Name: Salary, dtype: float64
```

Finding Standard Deviation

```
std = salary.groupby("Job Title")["Salary"].std()
std.replace(np.NaN, 0, inplace=True)
print(std)
```

```
Job Title
Associate Machine Learning Engineer        0.000000e+00
Data Analyst                               1.292116e+06
Data Engineer                              6.009190e+06
Data Science                               3.388020e+05
Data Science Associate                     0.000000e+00
Data Science Consultant                    0.000000e+00
Data Science Lead                          0.000000e+00
Data Science Manager                       0.000000e+00
Data Scientist                             5.140558e+06
Data Scientist - Trainee                   0.000000e+00
Junior Data Scientist                      3.931792e+05
Lead Data Scientist                        5.017356e+05
Machine Learning Associate                 0.000000e+00
Machine Learning Consultant                7.352864e+05
Machine Learning Data Analyst              0.000000e+00
Machine Learning Data Associate            0.000000e+00
Machine Learning Data Associate I          0.000000e+00
Machine Learning Data Associate II         0.000000e+00
Machine Learning Developer                 2.406525e+05
Machine Learning Engineer                  7.047460e+05
Machine Learning Scientist                 1.526757e+05
```

```
Machine Learning Software Engineer      0.000000e+00
Senior Data Scientist                   7.833905e+05
Senior Machine Learning Engineer        9.506370e+05
Software Engineer - Machine Learning    6.440894e+04
Name: Salary, dtype: float64
```

Installing Libraries

```
%pip install matplotlib

Requirement already satisfied: matplotlib in c:\users\aakas\appdata\
local\programs\python\python312\lib\site-packages (3.8.3)Note: you may
need to restart the kernel to use updated packages.

Requirement already satisfied: contourpy>=1.0.1 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\users\aakas\appdata\
local\programs\python\python312\lib\site-packages (from matplotlib)
(0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (4.49.0)
Requirement already satisfied: kiwisolver>=1.3.1 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (1.4.5)
Requirement already satisfied: numpy<2,>=1.21 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (1.26.4)
Requirement already satisfied: packaging>=20.0 in c:\users\aakas\
appdata\roaming\python\python312\site-packages (from matplotlib)
(23.2)
Requirement already satisfied: pillow>=8 in c:\users\aakas\appdata\
local\programs\python\python312\lib\site-packages (from matplotlib)
(10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (3.1.1)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\aakas\
appdata\local\programs\python\python312\lib\site-packages (from
matplotlib) (2.8.2)
Requirement already satisfied: six>=1.5 in c:\users\aakas\appdata\
roaming\python\python312\site-packages (from python-dateutil>=2.7-
>matplotlib) (1.16.0)
```

Importing Libraries

```
import pandas as pd
import numpy as np

import matplotlib.pyplot as plt

C:\Users\aakas\AppData\Local\Temp\ipykernel_15468\3311980270.py:1:
DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major
release of pandas (pandas 3.0),
```

```
(to allow more performant data types, such as the Arrow string type,
and better interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at
https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd

virus = pd.read_csv("assignment3-part2.csv")

virus.replace("?", np.nan, inplace=True)

virus.isna().sum()

Unnamed: 0    0
ANTI_A        0
ANTI_B        0
V1            0
dtype: int64
```

Binning

```
num_bin = 5

label = ["A", "B", "C","D","E"]

virus["E-W-Partition"] = pd.cut(virus["V1"], bins=num_bin,
labels=label)
virus["E-F-Partition"] = pd.qcut(virus["V1"], q = num_bin,
labels=label)

virus.iloc[:]
```

	Unnamed: 0	ANTI_A	ANTI_B	V1	E-W-Partition	E-F-Partition
0	0	2.77	98.1	6.0	A	A
1	1	9.79	16.8	6.7	A	A
2	2	9.29	13.6	7.5	A	A
3	3	3.41	1.6	7.6	A	A
4	4	9.83	55.3	8.4	A	A
5	5	5.76	94.4	9.3	A	A
6	6	2.73	67.2	9.4	A	A
7	7	0.17	41.9	9.6	A	A
8	8	7.50	22.7	10.6	A	B
9	9	0.21	39.6	11.2	A	B
10	10	0.66	61.6	11.3	A	B
11	11	2.84	78.9	11.5	A	B
12	12	7.90	15.5	11.5	A	B
13	13	2.00	93.3	11.9	A	B
14	14	5.07	87.9	13.0	A	B
15	15	2.14	85.0	13.8	A	B

16	16	9.94	16.4	14.1	A	C
17	17	7.21	20.6	14.9	A	C
18	18	4.41	4.8	15.2	A	C
19	19	8.70	48.3	15.8	A	C
20	20	3.05	86.3	16.5	A	C
21	21	9.34	52.6	17.7	A	C
22	22	7.36	13.0	21.4	A	C
23	23	7.79	61.4	55.5	C	C
24	24	4.24	53.3	60.0	D	D
25	25	0.63	11.3	61.4	D	D
26	26	1.43	26.2	62.1	D	D
27	27	1.44	32.9	64.9	D	D
28	28	7.34	83.4	64.9	D	D
29	29	1.74	12.7	69.0	D	D
30	30	6.12	35.4	70.1	D	D
31	31	7.59	76.7	73.4	D	D
32	32	7.31	58.4	74.9	E	E
33	33	7.17	86.9	76.8	E	E
34	34	2.99	20.6	77.0	E	E
35	35	2.84	33.6	77.9	E	E
36	36	0.67	9.2	80.1	E	E
37	37	8.62	78.9	81.2	E	E
38	38	7.44	98.8	83.8	E	E
39	39	7.21	88.0	90.7	E	E

Dividing Dataset with V1 less than and greater than 40

```
threshold = 40

virus_low = virus[virus["V1"] < threshold]
virus_high = virus[virus["V1"] > threshold]

virus_low.describe()
```

	Unnamed: 0	ANTI_A	ANTI_B	V1
count	23.00000	23.000000	23.000000	23.000000
mean	11.00000	5.307826	48.495652	11.952174
std	6.78233	3.363449	32.804302	3.830840
min	0.00000	0.170000	1.600000	6.000000
25%	5.50000	2.750000	16.600000	9.350000
50%	11.00000	5.070000	48.300000	11.500000
75%	16.50000	8.300000	81.950000	14.500000
max	22.00000	9.940000	98.100000	21.400000

```
virus_high.describe()
```

	Unnamed: 0	ANTI_A	ANTI_B	V1
count	17.000000	17.000000	17.000000	17.000000
mean	31.000000	4.857059	51.041176	71.982353
std	5.049752	2.937230	30.416526	9.593112

```
min     23.000000   0.630000   9.200000  55.500000
25%     27.000000   1.740000  26.200000  64.900000
50%     31.000000   6.120000  53.300000  73.400000
75%     35.000000   7.340000  78.900000  77.900000
max     39.000000   8.620000  98.800000  90.700000
```

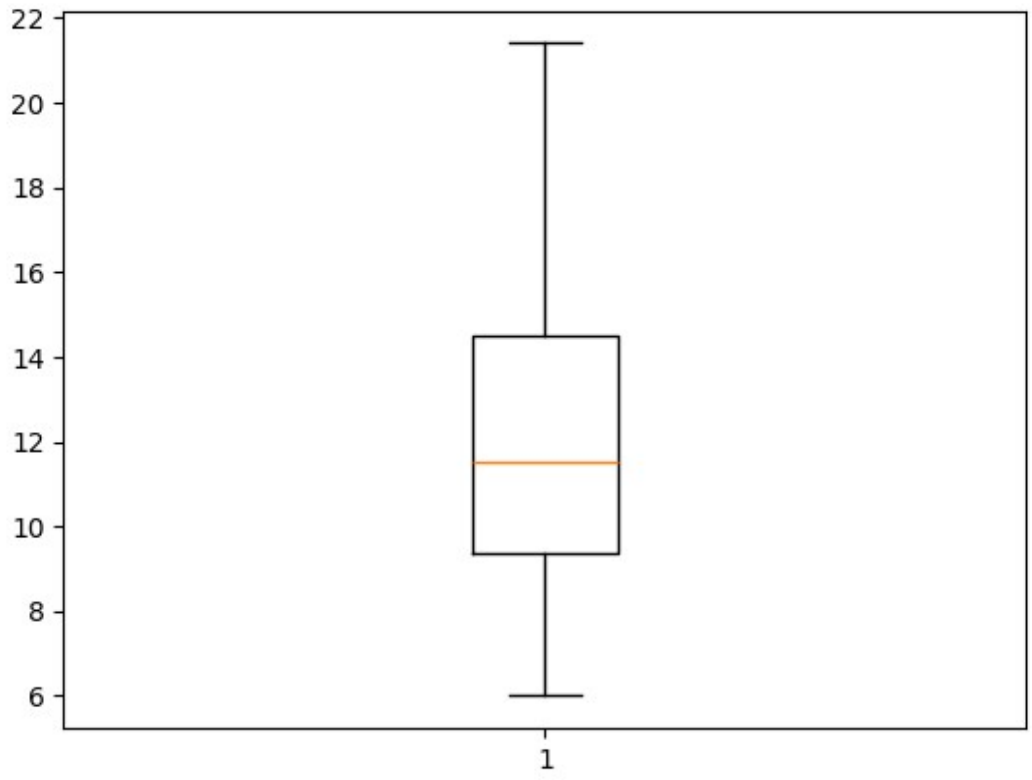
Plotting Boxplot from V1 for both low and high groups

```
fig = plt.figure(figsize= (10,5))
```

```
<Figure size 1000x500 with 0 Axes>
```

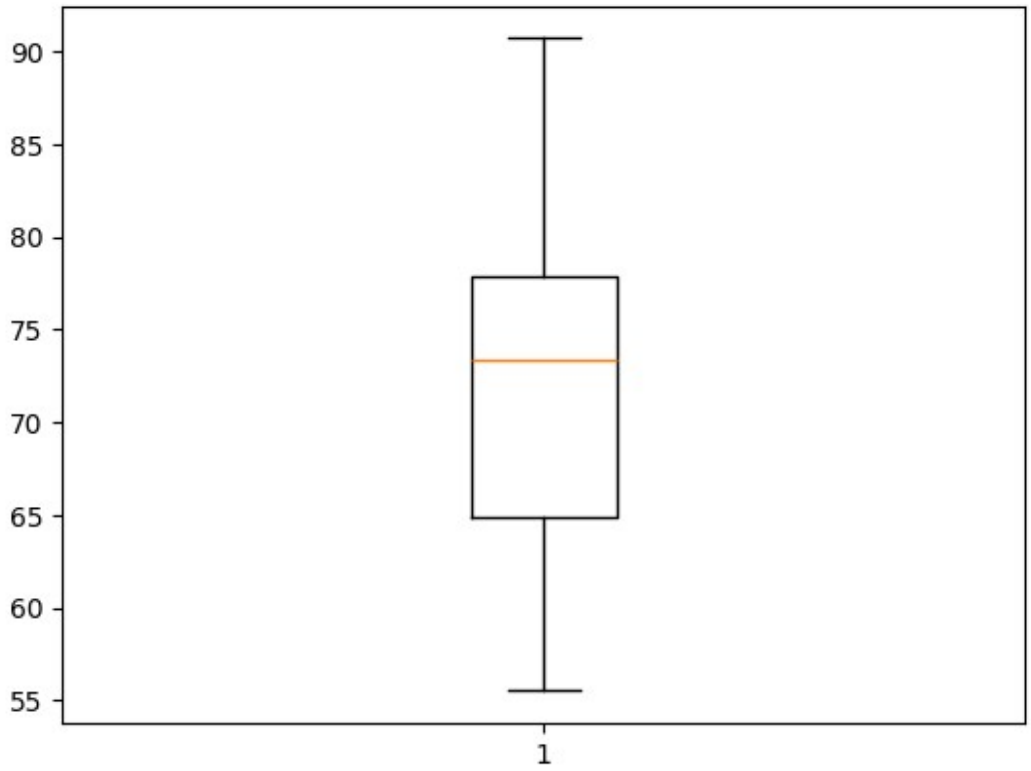
```
plt.boxplot(virus_low["V1"])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x1fa7218c560>,
  <matplotlib.lines.Line2D at 0x1fa7218c890>],
 'caps': [<matplotlib.lines.Line2D at 0x1fa7218cb90>,
  <matplotlib.lines.Line2D at 0x1fa7218ce90>],
 'boxes': [<matplotlib.lines.Line2D at 0x1fa7218c350>],
 'medians': [<matplotlib.lines.Line2D at 0x1fa7218d190>],
 'fliers': [<matplotlib.lines.Line2D at 0x1fa7218d4c0>],
 'means': []}
```




```
plt.boxplot(virus_high["V1"])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x1fa744275c0>,
  <matplotlib.lines.Line2D at 0x1fa74427830>],
 'caps': [<matplotlib.lines.Line2D at 0x1fa74427b30>,
  <matplotlib.lines.Line2D at 0x1fa74427e60>],
 'boxes': [<matplotlib.lines.Line2D at 0x1fa74427380>],
 'medians': [<matplotlib.lines.Line2D at 0x1fa74458170>],
 'fliers': [<matplotlib.lines.Line2D at 0x1fa744584a0>],
 'means': []}
```




```
virus_low["ANTI_A"] = (virus_low["ANTI_A"] -
virus_low["ANTI_A"].min())/(virus_low["ANTI_A"].max() -
virus_low["ANTI_A"].min())
virus_low["ANTI_B"] = (virus_low["ANTI_B"] -
virus_low["ANTI_B"].min())/(virus_low["ANTI_B"].max() -
virus_low["ANTI_B"].min())
virus_low
```

```
C:\Users\aakas\AppData\Local\Temp\ipykernel_15468\3142245604.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
```

```
  virus_low["ANTI_A"] = (virus_low["ANTI_A"] -
virus_low["ANTI_A"].min())/(virus_low["ANTI_A"].max() -
virus_low["ANTI_A"].min())
C:\Users\aakas\AppData\Local\Temp\ipykernel_15468\3142245604.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  virus_low["ANTI_B"] = (virus_low["ANTI_B"] -
virus_low["ANTI_B"].min())/(virus_low["ANTI_B"].max() -
virus_low["ANTI_B"].min())
```

	Unnamed: 0	ANTI_A	ANTI_B	V1	E-W-Partition	E-F-Partition
0	0	0.266121	1.000000	6.0	A	A
1	1	0.984647	0.157513	6.7	A	A
2	2	0.933470	0.124352	7.5	A	A
3	3	0.331627	0.000000	7.6	A	A
4	4	0.988741	0.556477	8.4	A	A
5	5	0.572160	0.961658	9.3	A	A
6	6	0.262027	0.679793	9.4	A	A
7	7	0.000000	0.417617	9.6	A	A
8	8	0.750256	0.218653	10.6	A	B
9	9	0.004094	0.393782	11.2	A	B
10	10	0.050154	0.621762	11.3	A	B
11	11	0.273286	0.801036	11.5	A	B
12	12	0.791198	0.144041	11.5	A	B
13	13	0.187308	0.950259	11.9	A	B
14	14	0.501535	0.894301	13.0	A	B
15	15	0.201638	0.864249	13.8	A	B
16	16	1.000000	0.153368	14.1	A	C
17	17	0.720573	0.196891	14.9	A	C
18	18	0.433982	0.033161	15.2	A	C
19	19	0.873081	0.483938	15.8	A	C
20	20	0.294780	0.877720	16.5	A	C
21	21	0.938588	0.528497	17.7	A	C
22	22	0.735926	0.118135	21.4	A	C

Min-Max Normalization

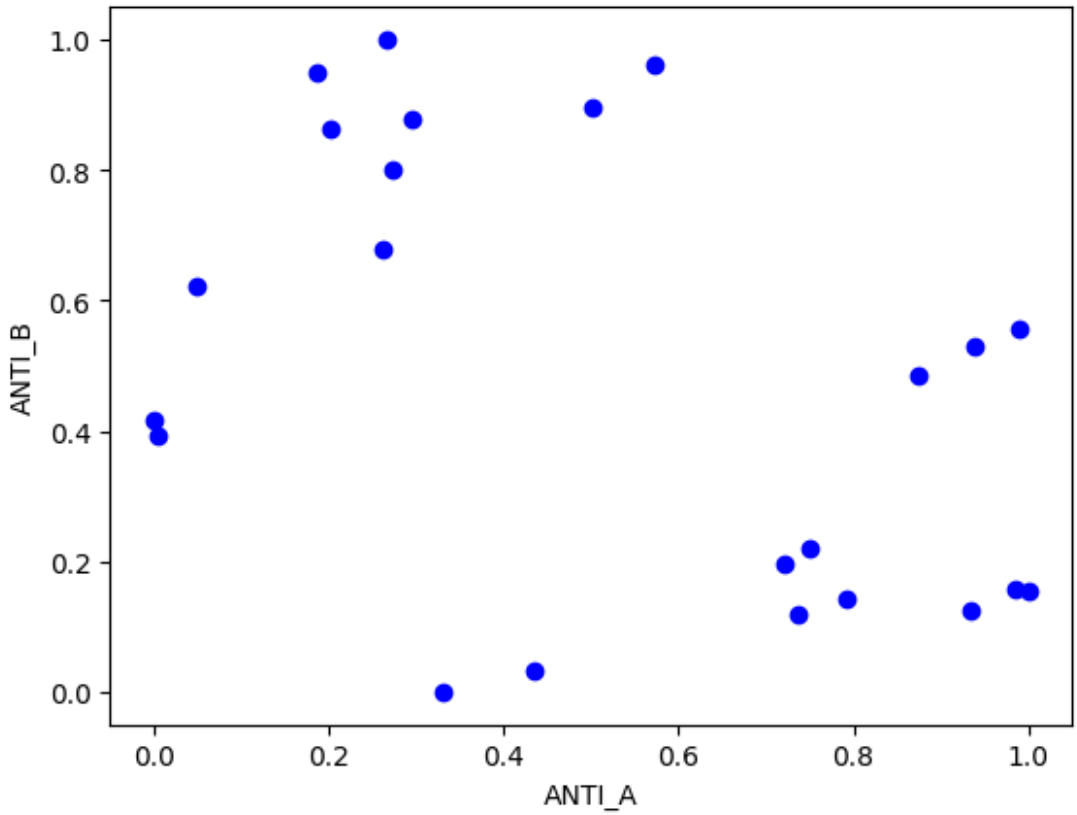
```
virus_high["ANTI_A"] = (virus_high["ANTI_A"] -
virus_high["ANTI_A"].min())/(virus_high["ANTI_A"].max() -
virus_high["ANTI_A"].min())
virus_high["ANTI_B"] = (virus_high["ANTI_B"] -
virus_high["ANTI_B"].min())/(virus_high["ANTI_B"].max() -
virus_high["ANTI_B"].min())
virus_high
```

```
C:\Users\aakas\AppData\Local\Temp\ipykernel_15468\34499113.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  virus_high["ANTI_A"] = (virus_high["ANTI_A"] -
virus_high["ANTI_A"].min())/(virus_high["ANTI_A"].max() -
virus_high["ANTI_A"].min())
C:\Users\aakas\AppData\Local\Temp\ipykernel_15468\34499113.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  virus_high["ANTI_B"] = (virus_high["ANTI_B"] -
virus_high["ANTI_B"].min())/(virus_high["ANTI_B"].max() -
virus_high["ANTI_B"].min())
```

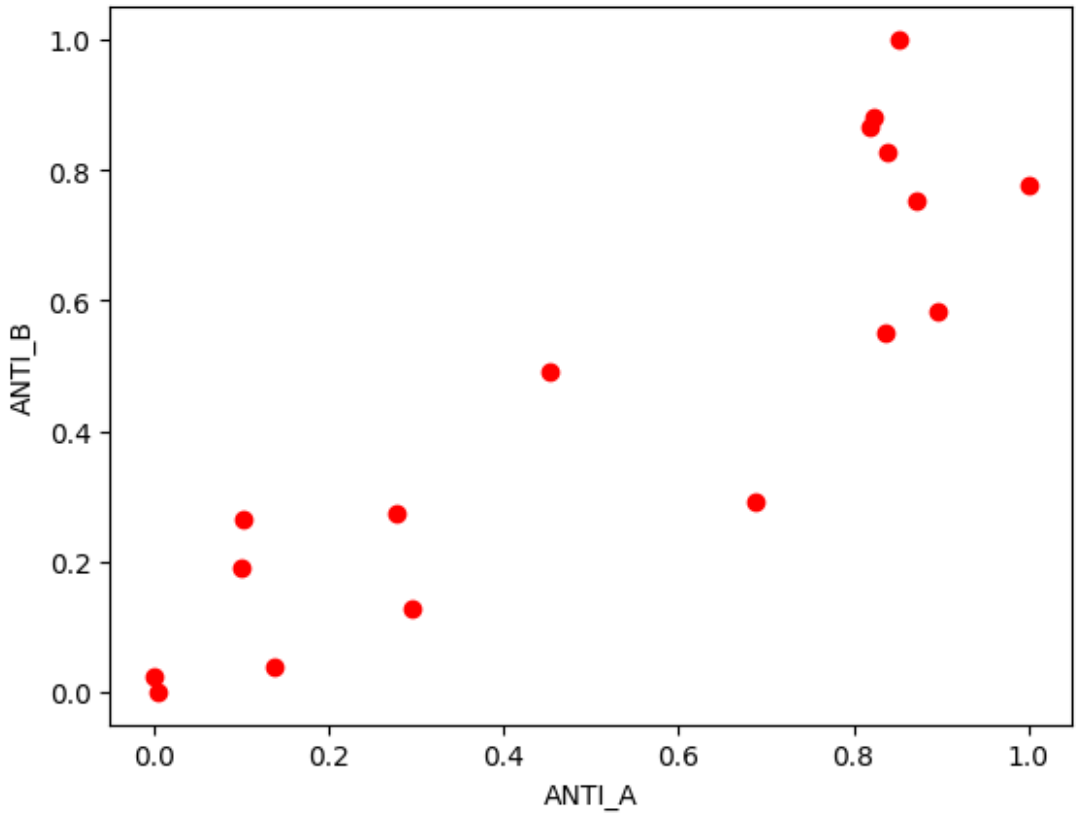
	Unnamed: 0	ANTI_A	ANTI_B	V1	E-W-Partition	E-F-Partition
23	23	0.896120	0.582589	55.5	C	C
24	24	0.451815	0.492187	60.0	D	D
25	25	0.000000	0.023438	61.4	D	D
26	26	0.100125	0.189732	62.1	D	D
27	27	0.101377	0.264509	64.9	D	D
28	28	0.839800	0.828125	64.9	D	D
29	29	0.138924	0.039062	69.0	D	D
30	30	0.687109	0.292411	70.1	D	D
31	31	0.871089	0.753348	73.4	D	D
32	32	0.836045	0.549107	74.9	E	E
33	33	0.818523	0.867188	76.8	E	E
34	34	0.295369	0.127232	77.0	E	E
35	35	0.276596	0.272321	77.9	E	E
36	36	0.005006	0.000000	80.1	E	E
37	37	1.000000	0.777902	81.2	E	E
38	38	0.852315	1.000000	83.8	E	E
39	39	0.823529	0.879464	90.7	E	E

Plotting Scatterplot

```
plt.scatter(virus_low["ANTI_A"], virus_low["ANTI_B"], c="blue")
plt.xlabel("ANTI_A")
plt.ylabel("ANTI_B")
plt.show()
```




```
plt.scatter(virus_high["ANTI_A"], virus_high["ANTI_B"], c="red")
plt.xlabel("ANTI_A")
plt.ylabel("ANTI_B")
plt.show()
```



Corelation between ANTI_A and ANTI_B

```
virus_low["ANTI_A"].corr(virus_low["ANTI_B"])
```

```
-0.44962747254599306
```

```
virus_high["ANTI_A"].corr(virus_high["ANTI_B"])
```

```
0.8938242533758364
```

For low values, we must use only one of the medicines i.e ANTI_A or ANTI_B as the corelation is negative but for high values, we can use both ANTI_A and ANTI_B together as the corelation is positive