Analysis on Acute Liver Failure using Apache Hadoop

Submitted By

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1. Data Cleaning

In [69]:
```
import pandas as pd
import numpy as np
import statsmodels.api as sapi
from statsmodels.formula.api import ols
import matplotlib.pyplot as plt
```

In [70]:
```
df = pd.read_csv('data.csv')
```

In [71]:
```
print(df.head)
```

```
<bound method NDFrame.head of       Age Gender Region  Weight  Height  Body Mass Index  Obesity  Waist  \
0      65      M   east    56.0   162.1            21.31      0.0   83.6
1      36      M  south    60.2   162.2            22.88      0.0   76.6
2      66      M   east    83.9   162.5            31.77      1.0  113.2
3      54      M   east    69.4   160.5            26.94      0.0   77.9
4      63      M  north    73.1   159.2            28.84      0.0   89.3
...   ...    ...    ...     ...     ...              ...      ...    ...
8780   35      F   east    70.0   171.5            23.80      0.0   87.5
8781   66      F  north   102.0   180.7            31.24      1.0  113.2
8782   37      F  south    84.4   186.0            24.40      0.0   93.6
8783   39      F   east    92.1   184.8            26.97      0.0   98.2
8784   70      M   east    58.5   161.1            22.54      0.0   99.4

      Maximum Blood Pressure  Minimum Blood Pressure  ...  PoorVision  \
0                      135.0                    71.0  ...         0.0
1                       96.0                    52.0  ...         0.0
2                      115.0                    57.0  ...         0.0
3                      110.0                    57.0  ...         0.0
4                      132.0                    73.0  ...         0.0
...                      ...                     ...  ...         ...
8780                   114.0                    76.0  ...         0.0
8781                   117.0                    72.0  ...         0.0
8782                   144.0                    82.0  ...         0.0
8783                   121.0                    75.0  ...         0.0
8784                   125.0                    82.0  ...         NaN

      Alcohol Consumption  HyperTension  Family  HyperTension  Diabetes  \
0                       1           0.0                     0       0.0
1                       0           0.0                     0       0.0
2                       1           0.0                     0       1.0
3                       1           0.0                     0       0.0
4                       0           1.0                     0       0.0
...                   ...           ...                   ...       ...
8780                    1           0.0                     1       0.0
8781                    0           1.0                     0       0.0
8782                    0           1.0                     0       0.0
8783                    0           0.0                     0       0.0
8784                    0           1.0                     1       0.0

      Family Diabetes  Hepatitis  Family Hepatitis  Chronic Fatigue  ALF
0                   1        1.0               0.0              0.0  0.0
```

```
1                  0        0.0              0.0              0.0  0.0
2                  0        0.0              0.0              0.0  0.0
3                  0        0.0              0.0              0.0  0.0
4                  0        0.0              0.0              0.0  0.0
...              ...        ...              ...              ...  ...
8780               1        0.0              0.0              0.0  NaN
8781               1        0.0              0.0              0.0  NaN
8782               0        0.0              0.0              0.0  NaN
8783               0        0.0              0.0              0.0  NaN
8784               0        0.0              0.0              0.0  NaN

[8785 rows x 30 columns]>
```

In [72]:
```
df = df.dropna(axis = 0, subset=['ALF'])
df = df.drop(['Region'], axis=1)
```

In [73]:
```
df.drop(['Source of Care'], axis=1)
```

In [74]:
```
df = df.replace(to_replace="M", value=0)
```

In [75]:
```
df = df.replace(to_replace="F", value=1)
```

In [76]:
```
print(df.info)
```

```
<bound method DataFrame.info of       Age  Gender  Weight  Height  Body Mass Index  Obesity  Waist  \
0      65       0    56.0   162.1            21.31      0.0   83.6
1      36       0    60.2   162.2            22.88      0.0   76.6
2      66       0    83.9   162.5            31.77      1.0  113.2
3      54       0    69.4   160.5            26.94      0.0   77.9
4      63       0    73.1   159.2            28.84      0.0   89.3
...   ...     ...     ...     ...              ...      ...    ...
5995   77       1   109.3   185.8            31.66      1.0  117.2
5996   49       1    86.6   168.9            30.36      1.0   99.5
5997   30       1    78.0   174.9            25.50      0.0   89.2
5998   75       1    78.8   176.5            25.30      0.0  100.4
5999   35       0    62.3   164.2            23.11      0.0   87.2

      Maximum Blood Pressure  Minimum Blood Pressure  Good Cholesterol  ...  \
0                      135.0                    71.0              48.0  ...
1                       96.0                    52.0              31.0  ...
2                      115.0                    57.0              44.0  ...
3                      110.0                    57.0              74.0  ...
4                      132.0                    73.0              67.0  ...
...                      ...                     ...               ...  ...
5995                   149.0                    77.0              33.0  ...
5996                   130.0                    75.0              38.0  ...
5997                   126.0                    83.0              40.0  ...
5998                   129.0                    50.0              58.0  ...
5999                    95.0                    59.0              52.0  ...

      PoorVision  Alcohol Consumption  HyperTension  Family  HyperTension  \
0            0.0                    1           0.0                     0
1            0.0                    0           0.0                     0
2            0.0                    1           0.0                     0
3            0.0                    1           0.0                     0
4            0.0                    0           1.0                     0
...          ...                  ...           ...                   ...
5995         0.0                    1           1.0                     0
5996         0.0                    0           1.0                     1
5997         0.0                    0           0.0                     1
5998         0.0                    1           1.0                     0
5999         0.0                    1           0.0                     0

      Diabetes  Family Diabetes  Hepatitis  Family Hepatitis  Chronic Fatigue  \
0          0.0                1        1.0               0.0              0.0
```

```
1          0.0               0        0.0               0.0               0.0
2          1.0               0        0.0               0.0               0.0
3          0.0               0        0.0               0.0               0.0
4          0.0               0        0.0               0.0               0.0
...        ...             ...        ...               ...               ...
5995       0.0               0        0.0               0.0               0.0
5996       0.0               0        0.0               0.0               0.0
5997       0.0               1        0.0               0.0               0.0
5998       1.0               1        0.0               0.0               0.0
5999       0.0               0        0.0               0.0               0.0

      ALF
0     0.0
1     0.0
2     0.0
3     0.0
4     0.0
...   ...
5995  1.0
5996  0.0
5997  0.0
5998  0.0
5999  0.0

[6000 rows x 28 columns]>
```

In [52]:
```
df.isnull().sum()
```

Out[52]:
```
Age                          0
Gender                       0
Weight                     133
Height                     139
Body Mass Index            206
Obesity                    206
Waist                      215
Maximum Blood Pressure     206
Minimum Blood Pressure     252
Good Cholesterol             8
Bad Cholesterol              8
Total Cholesterol            6
Dyslipidemia                 0
PVD                          0
Physical Activity            8
Education                   15
Unmarried                  301
Income                     792
PoorVision                 376
Alcohol Consumption          0
HyperTension                53
Family  HyperTension         0
Diabetes                     1
Family Diabetes              0
Hepatitis                   13
Family Hepatitis             3
Chronic Fatigue             26
ALF                          0
dtype: int64
```

In [77]:
```
df.columns
```

Out[77]:
```
Index(['Age', 'Gender', 'Weight', 'Height', 'Body Mass Index', 'Obesity',
       'Waist', 'Maximum Blood Pressure', 'Minimum Blood Pressure',
       'Good Cholesterol', 'Bad Cholesterol', 'Total Cholesterol',
       'Dyslipidemia', 'PVD', 'Physical Activity', 'Education', 'Unmarried',
       'Income', 'PoorVision', 'Alcohol Consumption', 'HyperTension',
       'Family  HyperTension', 'Diabetes', 'Family Diabetes', 'Hepatitis',
       'Family Hepatitis', 'Chronic Fatigue', 'ALF'],
      dtype='object')
```

2. Dataset Transformation & Featureset Selection

In [59]:
```
from sklearn.impute import SimpleImputer
imp = SimpleImputer(strategy = 'median')
```

In [80]:
```
imputer = imp.fit_transform(df)
```

In [81]:
```
df = pd.DataFrame(imputer, columns = ['Age', 'Gender', 'Weight', 'Height', 'Body Mass Index', 'Obesity',
       'Waist', 'Maximum Blood Pressure', 'Minimum Blood Pressure',
       'Good Cholesterol', 'Bad Cholesterol', 'Total Cholesterol',
       'Dyslipidemia', 'PVD', 'Physical Activity', 'Education', 'Unmarried',
       'Income', 'PoorVision', 'Alcohol Consumption', 'HyperTension',
       'Family  HyperTension', 'Diabetes', 'Family Diabetes', 'Hepatitis',
       'Family Hepatitis', 'Chronic Fatigue', 'ALF'])
```

In [82]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6000 entries, 0 to 5999
Data columns (total 28 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   Age                     6000 non-null   float64
 1   Gender                  6000 non-null   float64
 2   Weight                  6000 non-null   float64
 3   Height                  6000 non-null   float64
 4   Body Mass Index         6000 non-null   float64
 5   Obesity                 6000 non-null   float64
 6   Waist                   6000 non-null   float64
 7   Maximum Blood Pressure  6000 non-null   float64
 8   Minimum Blood Pressure  6000 non-null   float64
 9   Good Cholesterol        6000 non-null   float64
 10  Bad Cholesterol         6000 non-null   float64
 11  Total Cholesterol       6000 non-null   float64
 12  Dyslipidemia            6000 non-null   float64
 13  PVD                     6000 non-null   float64
 14  Physical Activity       6000 non-null   float64
 15  Education               6000 non-null   float64
 16  Unmarried               6000 non-null   float64
 17  Income                  6000 non-null   float64
 18  PoorVision              6000 non-null   float64
 19  Alcohol Consumption     6000 non-null   float64
 20  HyperTension            6000 non-null   float64
 21  Family  HyperTension    6000 non-null   float64
 22  Diabetes                6000 non-null   float64
 23  Family Diabetes         6000 non-null   float64
 24  Hepatitis               6000 non-null   float64
 25  Family Hepatitis        6000 non-null   float64
 26  Chronic Fatigue         6000 non-null   float64
 27  ALF                     6000 non-null   float64
dtypes: float64(28)
memory usage: 1.3 MB
```

In [83]:
```
df.isnull().sum()
```

Out[83]:
```
Age                       0
Gender                    0
Weight                    0
Height                    0
Body Mass Index           0
Obesity                   0
Waist                     0
Maximum Blood Pressure    0
Minimum Blood Pressure    0
Good Cholesterol          0
Bad Cholesterol           0
Total Cholesterol         0
Dyslipidemia              0
PVD                       0
Physical Activity         0
Education                 0
Unmarried                 0
Income                    0
PoorVision                0
Alcohol Consumption       0
HyperTension              0
Family  HyperTension      0
Diabetes                  0
Family Diabetes           0
Hepatitis                 0
Family Hepatitis          0
Chronic Fatigue           0
ALF                       0
dtype: int64
```

In [85]:
```
df.duplicated().sum()
```

Out[85]:
```
0
```

In [89]:
```
df = df.drop(['Education'], axis=1)
```

In [90]:
```
df = df.drop(['Unmarried'], axis=1)
```

In [91]:
```
df = df.drop(['Income'], axis=1)
```

In [92]:
```
df = df.drop(['PoorVision'], axis=1)
```

In [93]:
```
df = df.drop(['Family  HyperTension'], axis=1)
```

In [94]:
```
df = df.drop(['Family Diabetes'], axis=1)
```

In [95]:
```
df = df.drop(['Family Hepatitis'], axis=1)
```

In [97]:
```
df = df.drop(['Total Cholesterol'], axis=1)
```

In [100…
```
df = df.drop(['Body Mass Index'], axis=1)
```

In [101…
```
print(df.columns)
```

```
Index(['Age', 'Gender', 'Weight', 'Height', 'Obesity', 'Waist',
       'Maximum Blood Pressure', 'Minimum Blood Pressure', 'Good Cholesterol',
       'Bad Cholesterol', 'Dyslipidemia', 'PVD', 'Physical Activity',
       'Alcohol Consumption', 'HyperTension', 'Diabetes', 'Hepatitis',
       'Chronic Fatigue', 'ALF'],
      dtype='object')
```

In [104…
```
correlation_matrix = df.corr()
print(correlation_matrix)
```

	Age	Gender	Weight	Height	Obesity	\
Age	1.000000	0.036107	-0.050409	-0.142165	-0.010784	
Gender	0.036107	1.000000	0.262554	0.658381	-0.093773	
Weight	-0.050409	0.262554	1.000000	0.456077	0.653691	
Height	-0.142165	0.658381	0.456077	1.000000	-0.054439	
Obesity	-0.010784	-0.093773	0.653691	-0.054439	1.000000	
Waist	0.166562	0.147834	0.861026	0.191410	0.664947	
Maximum Blood Pressure	0.550409	0.040082	0.046244	-0.101181	0.070082	
Minimum Blood Pressure	0.021012	0.157751	0.171857	0.155947	0.093578	
Good Cholesterol	0.040207	-0.321735	-0.311201	-0.195449	-0.176433	
Bad Cholesterol	0.137055	0.034017	0.133646	-0.032161	0.121845	
Dyslipidemia	0.023648	0.093051	0.074541	0.046044	0.049582	
PVD	0.224636	0.007159	-0.039060	-0.040972	-0.013339	
Physical Activity	-0.176247	0.138845	-0.040471	0.100093	-0.074705	
Alcohol Consumption	0.204649	0.166499	0.096855	0.105108	0.019732	
HyperTension	0.494107	-0.005176	0.114159	-0.084227	0.140328	
Diabetes	0.246114	0.029199	0.123964	-0.030196	0.102135	
Hepatitis	0.262740	0.074138	0.020138	-0.005351	0.018684	
Chronic Fatigue	0.178995	0.026828	0.023145	-0.019194	0.013529	
ALF	0.367639	-0.014440	-0.020067	-0.049144	-0.004880	

	Waist	Maximum Blood Pressure	\
Age	0.166562	0.550409	
Gender	0.147834	0.040082	
Weight	0.861026	0.046244	
Height	0.191410	-0.101181	
Obesity	0.664947	0.070082	
Waist	1.000000	0.172412	
Maximum Blood Pressure	0.172412	1.000000	
Minimum Blood Pressure	0.122926	0.342136	
Good Cholesterol	-0.304485	0.013825	
Bad Cholesterol	0.230464	0.140884	
Dyslipidemia	0.086945	0.004047	
PVD	0.029130	0.162407	
Physical Activity	-0.100970	-0.078323	
Alcohol Consumption	0.127995	0.069757	
HyperTension	0.234503	0.614382	
Diabetes	0.216776	0.180972	
Hepatitis	0.076710	0.134701	
Chronic Fatigue	0.060157	0.058925	
ALF	0.057309	0.210808	

	Minimum Blood Pressure	Good Cholesterol	\
Age	0.021012	0.040207	
Gender	0.157751	-0.321735	
Weight	0.171857	-0.311201	
Height	0.155947	-0.195449	
Obesity	0.093578	-0.176433	
Waist	0.122926	-0.304485	
Maximum Blood Pressure	0.342136	0.013825	
Minimum Blood Pressure	1.000000	-0.081173	
Good Cholesterol	-0.081173	1.000000	
Bad Cholesterol	0.125484	-0.205887	
Dyslipidemia	0.040961	-0.223024	
PVD	-0.050270	-0.009633	
Physical Activity	0.021676	-0.012398	
Alcohol Consumption	0.001408	-0.014434	
HyperTension	0.231141	-0.004968	
Diabetes	-0.037376	-0.115069	
Hepatitis	-0.045615	-0.068754	
Chronic Fatigue	-0.043259	-0.041364	
ALF	-0.083787	-0.031834	

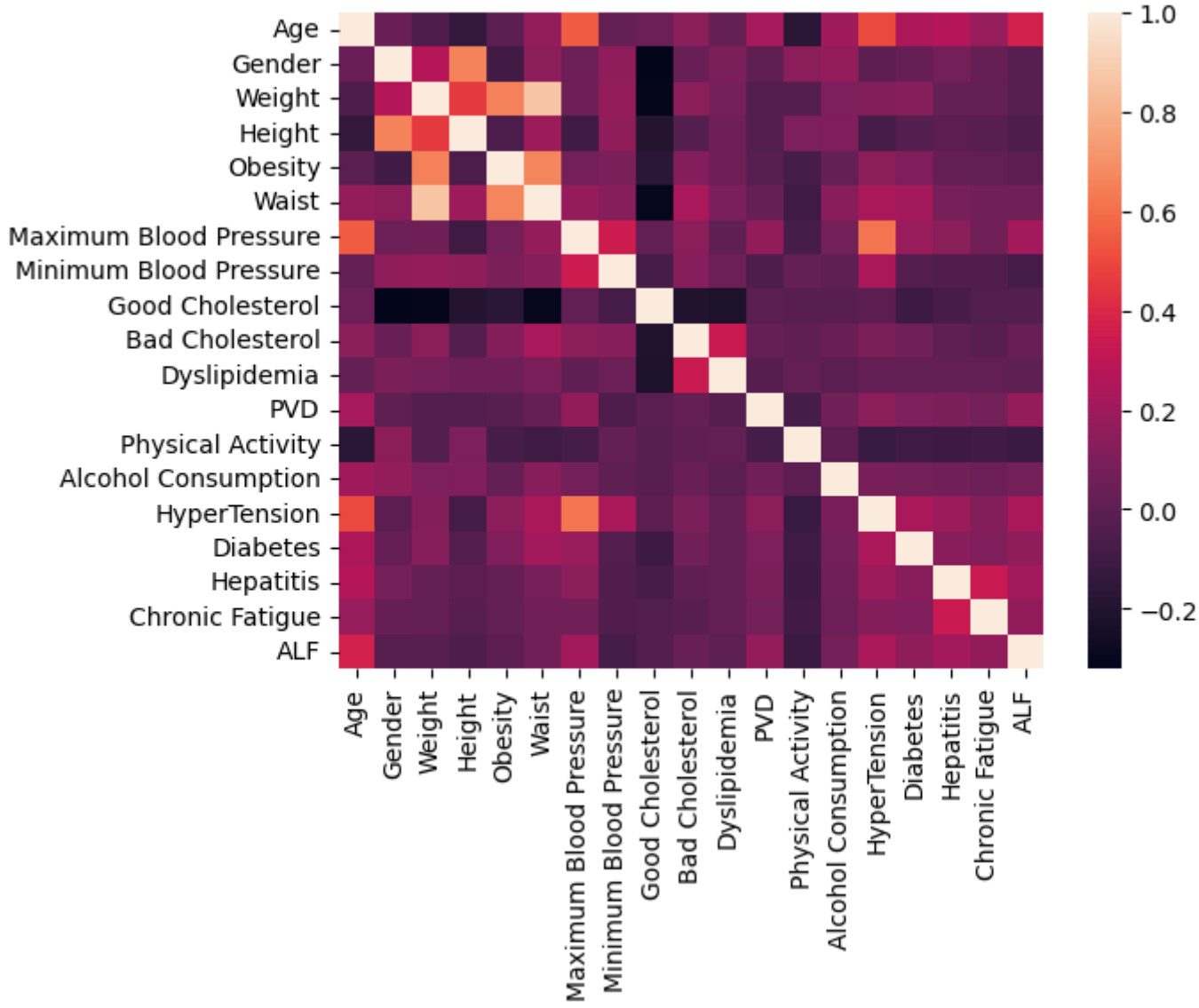
	Bad Cholesterol	Dyslipidemia	PVD	\
Age	0.137055	0.023648	0.224636	
Gender	0.034017	0.093051	0.007159	
Weight	0.133646	0.074541	-0.039060	
Height	-0.032161	0.046044	-0.040972	
Obesity	0.121845	0.049582	-0.013339	
Waist	0.230464	0.086945	0.029130	
Maximum Blood Pressure	0.140884	0.004047	0.162407	
Minimum Blood Pressure	0.125484	0.040961	-0.050270	
Good Cholesterol	-0.205887	-0.223024	-0.009633	
Bad Cholesterol	1.000000	0.329482	0.025065	
Dyslipidemia	0.329482	1.000000	-0.022533	
PVD	0.025065	-0.022533	1.000000	
Physical Activity	0.005558	0.016826	-0.078894	
Alcohol Consumption	0.035926	-0.007238	0.055674	
HyperTension	0.096066	0.015236	0.144254	
Diabetes	0.062955	0.017941	0.097127	
Hepatitis	0.004171	0.014779	0.093426	
Chronic Fatigue	-0.015938	0.016747	0.066849	

```
ALF                          0.033486      0.001812  0.168850

                      Physical Activity  Alcohol Consumption  HyperTension  \
Age                           -0.176247             0.204649      0.494107
Gender                         0.138845             0.166499     -0.005176
Weight                        -0.040471             0.096855      0.114159
Height                         0.100093             0.105108     -0.084227
Obesity                       -0.074705             0.019732      0.140328
Waist                         -0.100970             0.127995      0.234503
Maximum Blood Pressure        -0.078323             0.069757      0.614382
Minimum Blood Pressure         0.021676             0.001408      0.231141
Good Cholesterol              -0.012398            -0.014434     -0.004968
Bad Cholesterol                0.005558             0.035926      0.096066
Dyslipidemia                   0.016826            -0.007238      0.015236
PVD                           -0.078894             0.055674      0.144254
Physical Activity              1.000000            -0.006001     -0.122501
Alcohol Consumption           -0.006001             1.000000      0.084390
HyperTension                  -0.122501             0.084390      1.000000
Diabetes                      -0.104853             0.068137      0.232138
Hepatitis                     -0.111249             0.062271      0.190364
Chronic Fatigue               -0.089957             0.042908      0.119757
ALF                           -0.119604             0.067631      0.234026

                      Diabetes  Hepatitis  Chronic Fatigue       ALF
Age                   0.246114   0.262740         0.178995  0.367639
Gender                0.029199   0.074138         0.026828 -0.014440
Weight                0.123964   0.020138         0.023145 -0.020067
Height               -0.030196  -0.005351        -0.019194 -0.049144
Obesity               0.102135   0.018684         0.013529 -0.004880
Waist                 0.216776   0.076710         0.060157  0.057309
Maximum Blood Pressure  0.180972   0.134701         0.058925  0.210808
Minimum Blood Pressure -0.037376  -0.045615        -0.043259 -0.083787
Good Cholesterol      -0.115069  -0.068754        -0.041364 -0.031834
Bad Cholesterol        0.062955   0.004171        -0.015938  0.033486
Dyslipidemia           0.017941   0.014779         0.016747  0.001812
PVD                    0.097127   0.093426         0.066849  0.168850
Physical Activity     -0.104853  -0.111249        -0.089957 -0.119604
Alcohol Consumption    0.068137   0.062271         0.042908  0.067631
HyperTension           0.232138   0.190364         0.119757  0.234026
Diabetes               1.000000   0.130432         0.103233  0.155656
Hepatitis              0.130432   1.000000         0.331046  0.214724
```

```
Chronic Fatigue         0.103233   0.331046         1.000000  0.161900
ALF                     0.155656   0.214724         0.161900  1.000000
```

In [105…
```
import seaborn as sb
sb.heatmap(correlation_matrix,
        xticklabels=correlation_matrix.columns,
        yticklabels=correlation_matrix.columns)
```

Out[105]: <AxesSubplot:>



In [106…
```
print(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6000 entries, 0 to 5999
Data columns (total 19 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   Age                     6000 non-null   float64
 1   Gender                  6000 non-null   float64
 2   Weight                  6000 non-null   float64
 3   Height                  6000 non-null   float64
 4   Obesity                 6000 non-null   float64
 5   Waist                   6000 non-null   float64
 6   Maximum Blood Pressure  6000 non-null   float64
 7   Minimum Blood Pressure  6000 non-null   float64
 8   Good Cholesterol        6000 non-null   float64
 9   Bad Cholesterol         6000 non-null   float64
 10  Dyslipidemia            6000 non-null   float64
 11  PVD                     6000 non-null   float64
 12  Physical Activity       6000 non-null   float64
 13  Alcohol Consumption     6000 non-null   float64
 14  HyperTension            6000 non-null   float64
 15  Diabetes                6000 non-null   float64
 16  Hepatitis               6000 non-null   float64
 17  Chronic Fatigue         6000 non-null   float64
 18  ALF                     6000 non-null   float64
dtypes: float64(19)
memory usage: 890.8 KB
None
```

3. Model Selection

1. Naive Bayes

In [108…

```
y = df['ALF']
df = df.drop('ALF',axis=1)
X = df
```

In [112…
```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X = sc.fit_transform(X)
```

In [113…
```
#splitting our dataset into training sets and teset sets

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,stratify = y)
```

In [114…
```
from sklearn.naive_bayes import GaussianNB
gnb = GaussianNB()
gnb.fit(X_train, y_train)
```

Out[114]:
```
▾ GaussianNB

GaussianNB()
```

In [115…
```
y_pred = gnb.predict(X_test)
y_pred
```

Out[115]:
```
array([0., 0., 0., ..., 0., 0., 1.])
```

In [116…
```
from sklearn.metrics import accuracy_score

print('Model accuracy score: {0:0.4f}'. format(accuracy_score(y_test, y_pred)))
```

```
Model accuracy score: 0.8740
```

In [117…
```
# print the scores on training and test set

print('Training set score: {:.4f}'.format(gnb.score(X_train, y_train)))
print('Test set score: {:.4f}'.format(gnb.score(X_test, y_test)))
```

```
Training set score: 0.8560
Test set score: 0.8740
```

In [118…
```
from sklearn.metrics import confusion_matrix

cm = confusion_matrix(y_test, y_pred)

print('Confusion matrix\n\n', cm)
print('\nTrue Positives(TP) = ', cm[0,0])
print('\nTrue Negatives(TN) = ', cm[1,1])
print('\nFalse Positives(FP) = ', cm[0,1])
print('\nFalse Negatives(FN) = ', cm[1,0])
```

```
Confusion matrix

 [[1241  143]
 [  46   70]]

True Positives(TP) =  1241

True Negatives(TN) =  70

False Positives(FP) =  143

False Negatives(FN) =  46
```

2. KNN

In [137…
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score, classification_report, confusi
```

In [126…
```
knn = KNeighborsClassifier(n_neighbors=7)
```

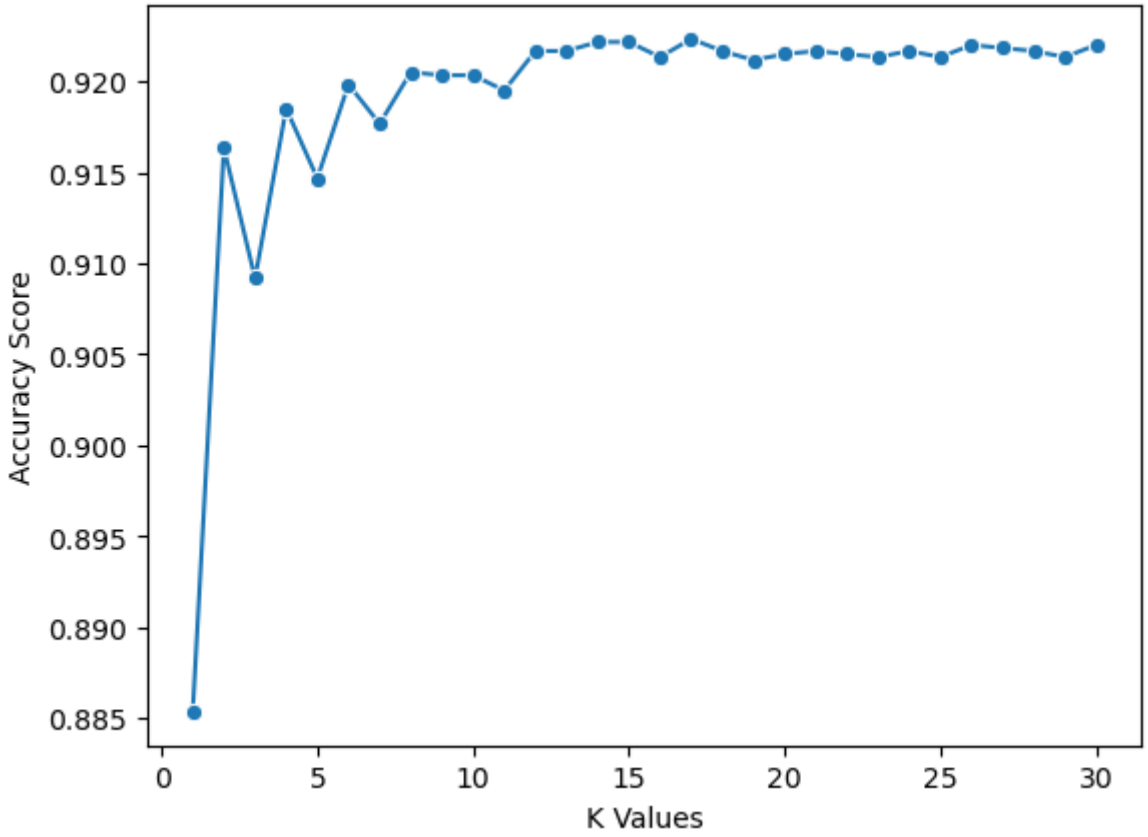
In [127…
```
knn.fit(X_train, y_train)
```

Out[127]:
```
▾       KNeighborsClassifier

KNeighborsClassifier(n_neighbors=7)
```

In [132…
```
k_values = [i for i in range (1,31)]
scores = []

scaler = StandardScaler()
X = scaler.fit_transform(X)

for k in k_values:
    knn = KNeighborsClassifier(n_neighbors=k)
    score = cross_val_score(knn, X, y, cv=5)
    scores.append(np.mean(score))
```

In [134…
```
sb.lineplot(x = k_values, y = scores, marker = 'o')
plt.xlabel("K Values")
plt.ylabel("Accuracy Score")
```

Out[134]:
```
Text(0, 0.5, 'Accuracy Score')
```



In [135…
```
best_index = np.argmax(scores)
best_k = k_values[best_index]

knn = KNeighborsClassifier(n_neighbors=best_k)
knn.fit(X_train, y_train)
```

Out[135]:
```
▾ KNeighborsClassifier

KNeighborsClassifier(n_neighbors=17)
```

In [140…

```
y_pred = knn.predict(X_test)

accuracy = accuracy_score(y_test, y_pred)
precision = precision_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
print("Conclusion")
print("K = ",best_k)
print("Accuracy:", accuracy)
print("Precision:", precision)
print("Recall:", recall)
```

```
Conclusion
K =  17
Accuracy: 0.918
Precision: 0.23076923076923078
Recall: 0.02586206896551724
```

In [ ]: