Prediction du risque des maladies cardiovasculaires

August 10, 2023

[31]:
```
#!pip install spark
```

[11]:
```
# Importer PySpark
import pyspark
from pyspark.sql import SparkSession
#Create SparkSession
spark = SparkSession.builder.master("local[1]").appName("SparkByExamples.com").
 ↪getOrCreate()
sc=spark.sparkContext
```

[32]:
```
#Installer findspark
#!pip install findspark
```

[24]:
```
# Importer findspark
import findspark
findspark.init()
#importer pyspark
import pyspark
from pyspark.sql import SparkSession
#Creer  SparkSession qui va créer SparkContext.

spark = SparkSession.\
        builder.\
        appName("pyspark-nb-3-analysis").\
        master("spark://spark-master:7077").\
        config("spark.executor.memory", "512m").\
        config("spark.eventLog.enabled", "true").\
        config("spark.eventLog.dir", "file:///opt/workspace/events").\
        getOrCreate()
```

[25]:
```
import pyspark
from pyspark.sql import SparkSession
spark=SparkSession(sc)
```

[26]:
```
df = spark.read.format('csv').load('CVD_cleaned.csv', header=True, sep=",")
```

[27]:
```
df.show(1)
```

```
+--------------+--------------------+--------+------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+----------------+--------------------
-------+-----------------------+
|General_Health|             Checkup|Exercise|Heart_Disease|Skin_Cancer|Other_Ca
ncer|Depression|Diabetes|Arthritis|   Sex|Age_Category|Height_(cm)|Weight_(kg)|
BMI|Smoking_History|Alcohol_Consumption|Fruit_Consumption|Green_Vegetables_Consu
mption|FriedPotato_Consumption|
+--------------+--------------------+--------+------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+----------------+--------------------
-------+-----------------------+
|          Poor|Within the past 2…|      No|           No|         No|
No|        No|      No|      Yes|Female|       70-74|      150.0|
32.66|14.54|           Yes|               0.0|            30.0|
16.0|                  12.0|
+--------------+--------------------+--------+------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+----------------+--------------------
-------+-----------------------+
only showing top 1 row
```

[53]:
```
# Lire le dataframe
health = spark.read.option("inferSchema", True).option('delimiter',',').
  ↪option('header', True).option('encoding', 'UTF-8').csv("CVD_cleaned.csv")
```

[54]:
```
health.show(10)
```

```
+--------------+--------------------+--------+------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+----------------+--------------------
-------+-----------------------+
|General_Health|             Checkup|Exercise|Heart_Disease|Skin_Cancer|Other_Ca
ncer|Depression|Diabetes|Arthritis|   Sex|Age_Category|Height_(cm)|Weight_(kg)|
BMI|Smoking_History|Alcohol_Consumption|Fruit_Consumption|Green_Vegetables_Consu
mption|FriedPotato_Consumption|
+--------------+--------------------+--------+------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+----------------+--------------------
-------+-----------------------+
|          Poor|Within the past 2…|      No|           No|         No|
No|        No|      No|      Yes|Female|       70-74|      150.0|
32.66|14.54|           Yes|               0.0|            30.0|
16.0|                  12.0|
|     Very Good|Within the past year|      No|          Yes|         No|
No|        No|     Yes|       No|Female|       70-74|      165.0|
77.11|28.29|            No|               0.0|            30.0|
```

```
0.0|                   4.0|
|     Very Good|Within the past year|     Yes|           No|         No|
No|        No|     Yes|       No|Female|       60-64|      163.0|
88.45|33.47|             No|               4.0|             12.0|
3.0|                  16.0|
|          Poor|Within the past year|     Yes|          Yes|         No|
No|        No|     Yes|       No|  Male|       75-79|      180.0|
93.44|28.73|             No|               0.0|             30.0|
30.0|                   8.0|
|          Good|Within the past year|      No|           No|         No|
No|        No|      No|       No|  Male|        80+|      191.0|
88.45|24.37|            Yes|               0.0|              8.0|
4.0|                   0.0|
|          Good|Within the past year|      No|           No|         No|
No|       Yes|      No|      Yes|  Male|       60-64|      183.0|
154.22|46.11|             No|               0.0|             12.0|
12.0|                  12.0|
|          Fair|Within the past year|     Yes|          Yes|         No|
No|        No|      No|      Yes|  Male|       60-64|      175.0|
69.85|22.74|            Yes|               0.0|             16.0|
8.0|                   0.0|
|          Good|Within the past year|     Yes|           No|         No|
No|        No|      No|      Yes|Female|       65-69|      165.0|
108.86|39.94|            Yes|               3.0|             30.0|
8.0|                   8.0|
|          Fair|Within the past year|      No|           No|         No|
No|       Yes|      No|       No|Female|       65-69|      163.0|
72.57|27.46|            Yes|               0.0|             12.0|
12.0|                   4.0|
|          Fair|Within the past year|      No|           No|         No|
No|        No|     Yes|      Yes|Female|       70-74|      163.0|
91.63|34.67|             No|               0.0|             12.0|
12.0|                   1.0|
+--------------+--------------------+--------+-------------+-----------+--------
----+----------+--------+---------+------+------------+-----------+-----------+-
----+---------------+------------------+-----------------+--------------------
-------+-----------------------+
only showing top 10 rows
```

[59]:
```
# convertir le dataset en dataframe pandas

df = health.toPandas()
```

[63]:
```
df.head(10)
```

[63]:

	General_Health	Checkup	Exercise	Heart_Disease	Skin_Cancer
0	Poor	Within the past 2 years	No	No	No
1	Very Good	Within the past year	No	Yes	No
2	Very Good	Within the past year	Yes	No	No
3	Poor	Within the past year	Yes	Yes	No
4	Good	Within the past year	No	No	No
5	Good	Within the past year	No	No	No
6	Fair	Within the past year	Yes	Yes	No
7	Good	Within the past year	Yes	No	No
8	Fair	Within the past year	No	No	No
9	Fair	Within the past year	No	No	No

	Other_Cancer	Depression	Diabetes	Arthritis	Sex	Age_Category
0	No	No	No	Yes	Female	70-74
1	No	No	Yes	No	Female	70-74
2	No	No	Yes	No	Female	60-64
3	No	No	Yes	No	Male	75-79
4	No	No	No	No	Male	80+
5	No	Yes	No	Yes	Male	60-64
6	No	No	No	Yes	Male	60-64
7	No	No	No	Yes	Female	65-69
8	No	Yes	No	No	Female	65-69
9	No	No	Yes	Yes	Female	70-74

	Height_(cm)	Weight_(kg)	BMI	Smoking_History	Alcohol_Consumption
0	150.0	32.66	14.54	Yes	0.0
1	165.0	77.11	28.29	No	0.0
2	163.0	88.45	33.47	No	4.0
3	180.0	93.44	28.73	No	0.0
4	191.0	88.45	24.37	Yes	0.0
5	183.0	154.22	46.11	No	0.0
6	175.0	69.85	22.74	Yes	0.0
7	165.0	108.86	39.94	Yes	3.0
8	163.0	72.57	27.46	Yes	0.0
9	163.0	91.63	34.67	No	0.0

	Fruit_Consumption	Green_Vegetables_Consumption	FriedPotato_Consumption
0	30.0	16.0	12.0
1	30.0	0.0	4.0
2	12.0	3.0	16.0
3	30.0	30.0	8.0
4	8.0	4.0	0.0
5	12.0	12.0	12.0
6	16.0	8.0	0.0
7	30.0	8.0	8.0
8	12.0	12.0	4.0
9	12.0	12.0	1.0

ANALYSE DESCRIPTIVE DES DONNEES

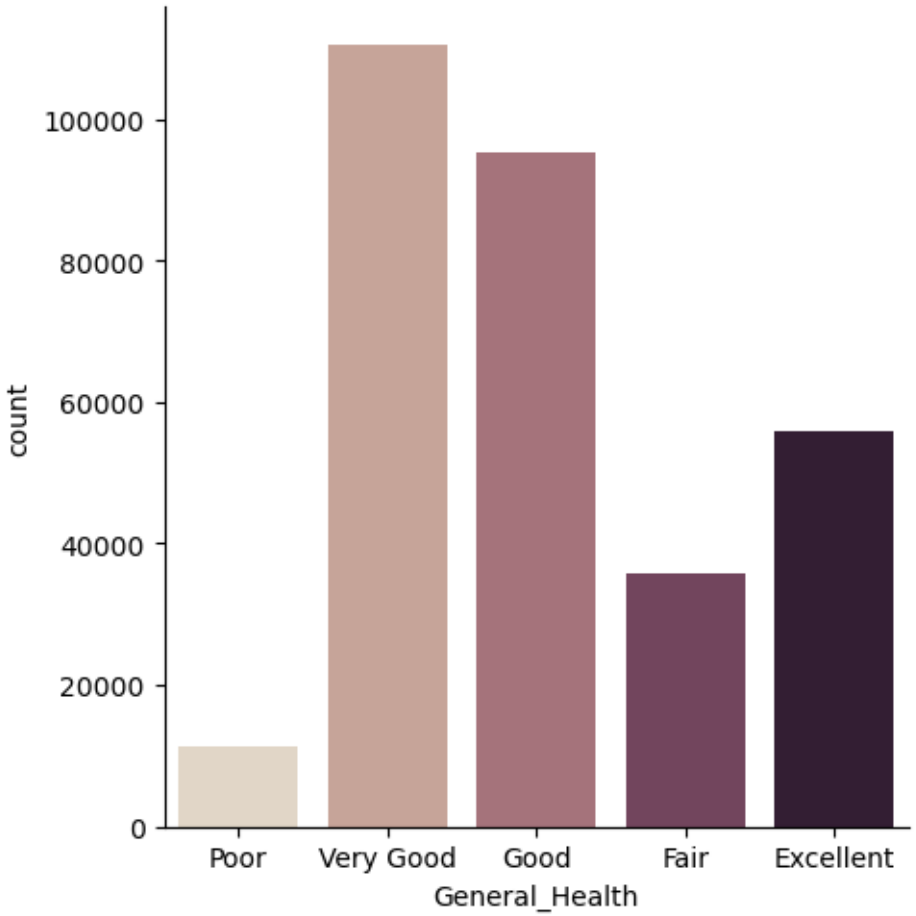
[60]:
```
df.describe()
```

[60]:
```
          Height_(cm)    Weight_(kg)            BMI  Alcohol_Consumption  \
count  308854.000000  308854.000000  308854.000000        308854.000000
mean      170.615249      83.588655      28.626211             5.096366
std        10.658026      21.343210       6.522323             8.199763
min        91.000000      24.950000      12.020000             0.000000
25%       163.000000      68.040000      24.210000             0.000000
50%       170.000000      81.650000      27.440000             1.000000
75%       178.000000      95.250000      31.850000             6.000000
max       241.000000     293.020000      99.330000            30.000000

       Fruit_Consumption  Green_Vegetables_Consumption  \
count      308854.000000                 308854.000000
mean           29.835200                     15.110441
std            24.875735                     14.926238
min             0.000000                      0.000000
25%            12.000000                      4.000000
50%            30.000000                     12.000000
75%            30.000000                     20.000000
max           120.000000                    128.000000

       FriedPotato_Consumption
count             308854.000000
mean                   6.296616
std                    8.582954
min                    0.000000
25%                    2.000000
50%                    4.000000
75%                    8.000000
max                  128.000000
```

[75]:
```
sns.catplot(data=df, x="General_Health", kind="count", palette="ch:.25")
```

```
/opt/conda/lib/python3.11/site-packages/seaborn/axisgrid.py:118: UserWarning:
The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

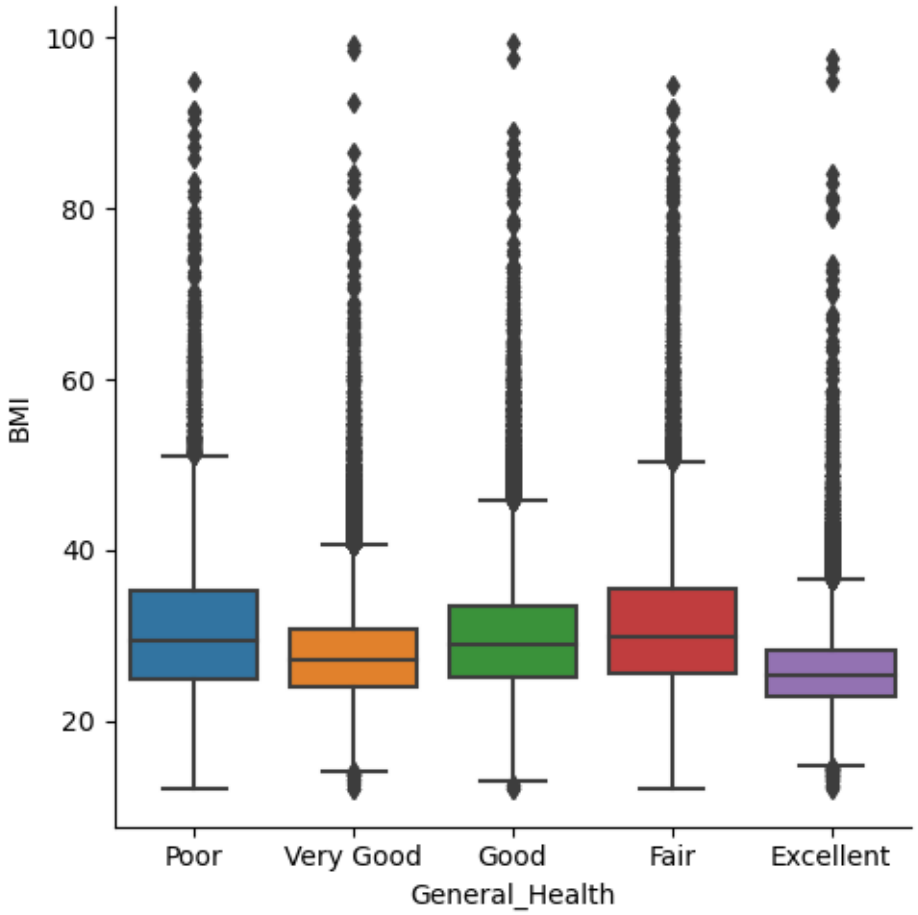
[75]:
```
<seaborn.axisgrid.FacetGrid at 0x7f5e85267010>
```



[66]:
```
#ETAT SANITAIRE ET INDICE TAILLE CORPORELLE
import seaborn as sns
sns.catplot(data=df, x="General_Health", y="BMI", kind="box")
```

```
/opt/conda/lib/python3.11/site-packages/seaborn/axisgrid.py:118: UserWarning:
The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

[66]: <seaborn.axisgrid.FacetGrid at 0x7f5e90a3f010>

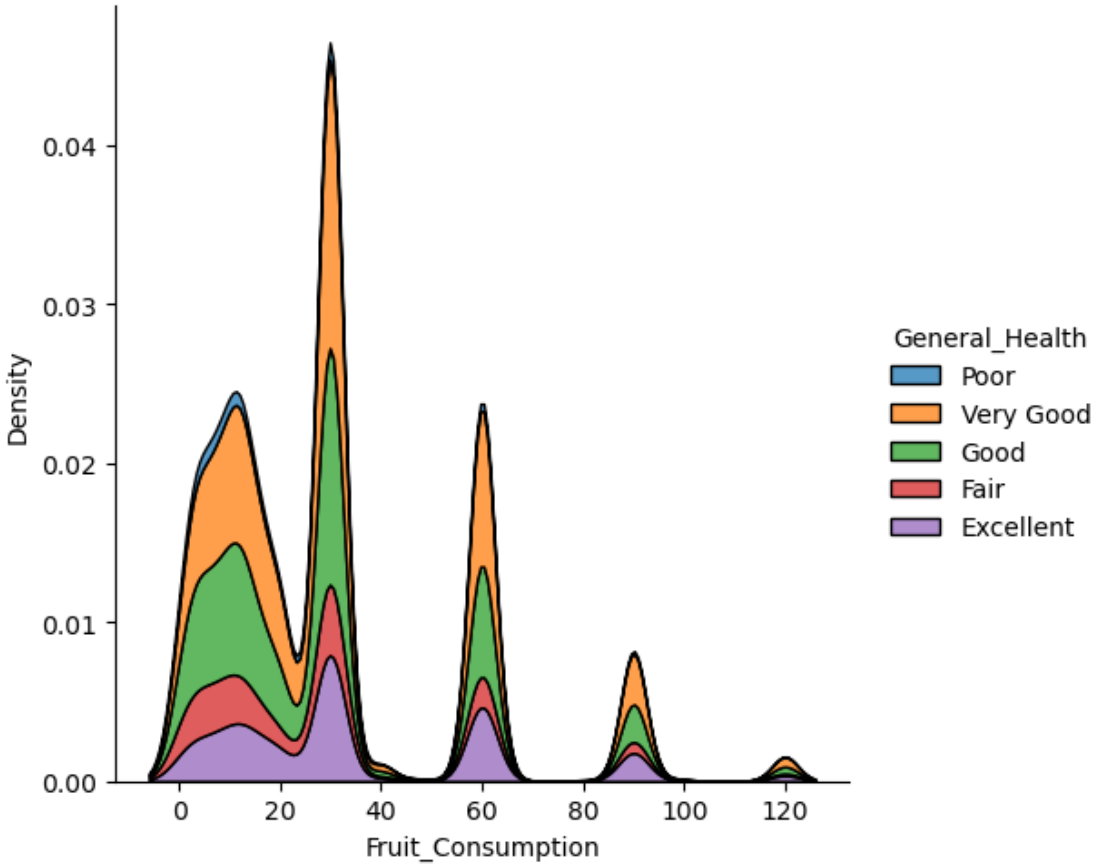


[ ]:
```
#ETAT SANITAIRE ET CONSOMMATION DE LEGUMES_FRUITS
```

[73]:
```
sns.displot(df, x="Fruit_Consumption", hue="General_Health",␣
↪kind="kde",multiple="stack")
```

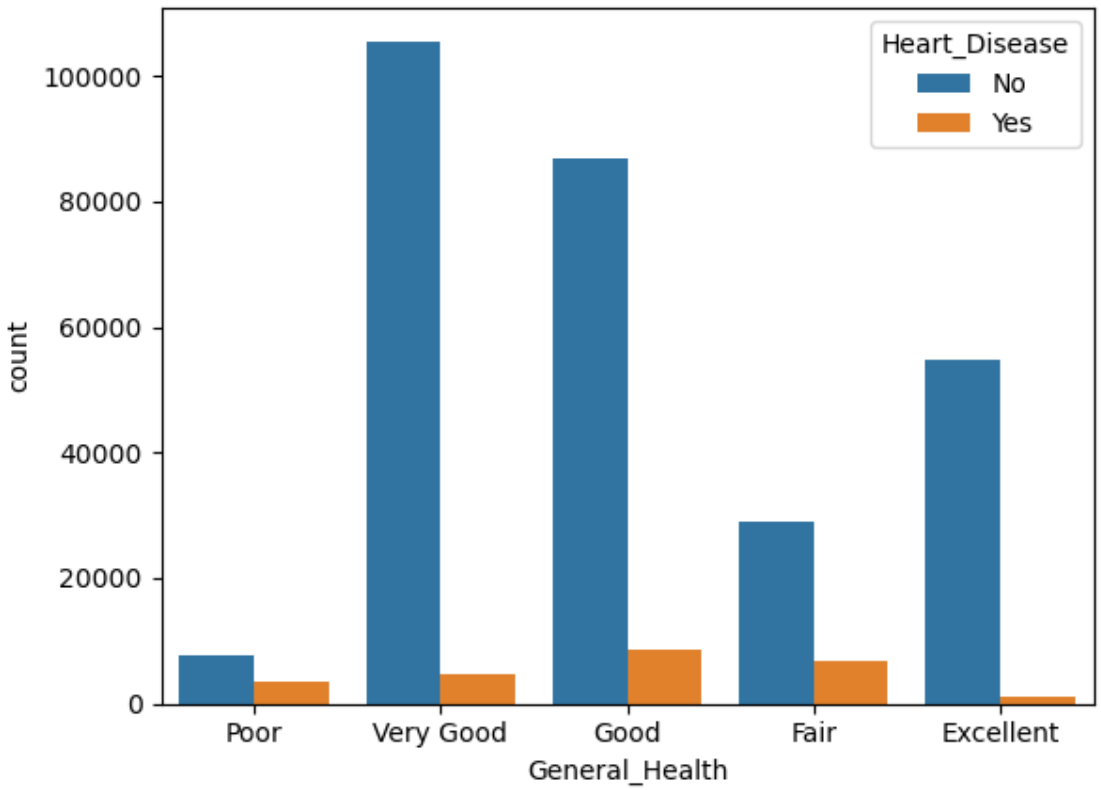
```
/opt/conda/lib/python3.11/site-packages/seaborn/axisgrid.py:118: UserWarning:
The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

[73]:
```
<seaborn.axisgrid.FacetGrid at 0x7f5e91da2910>
```



[76]:
```
sns.countplot(data=df,x='General_Health',hue='Heart_Disease')
```

[76]:
```
<Axes: xlabel='General_Health', ylabel='count'>
```



[79]:
```
#Analyse des corrélations entre les variables

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

df.corr()
```

```
/tmp/ipykernel_105/231525659.py:8: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  df.corr()
```

[79]:

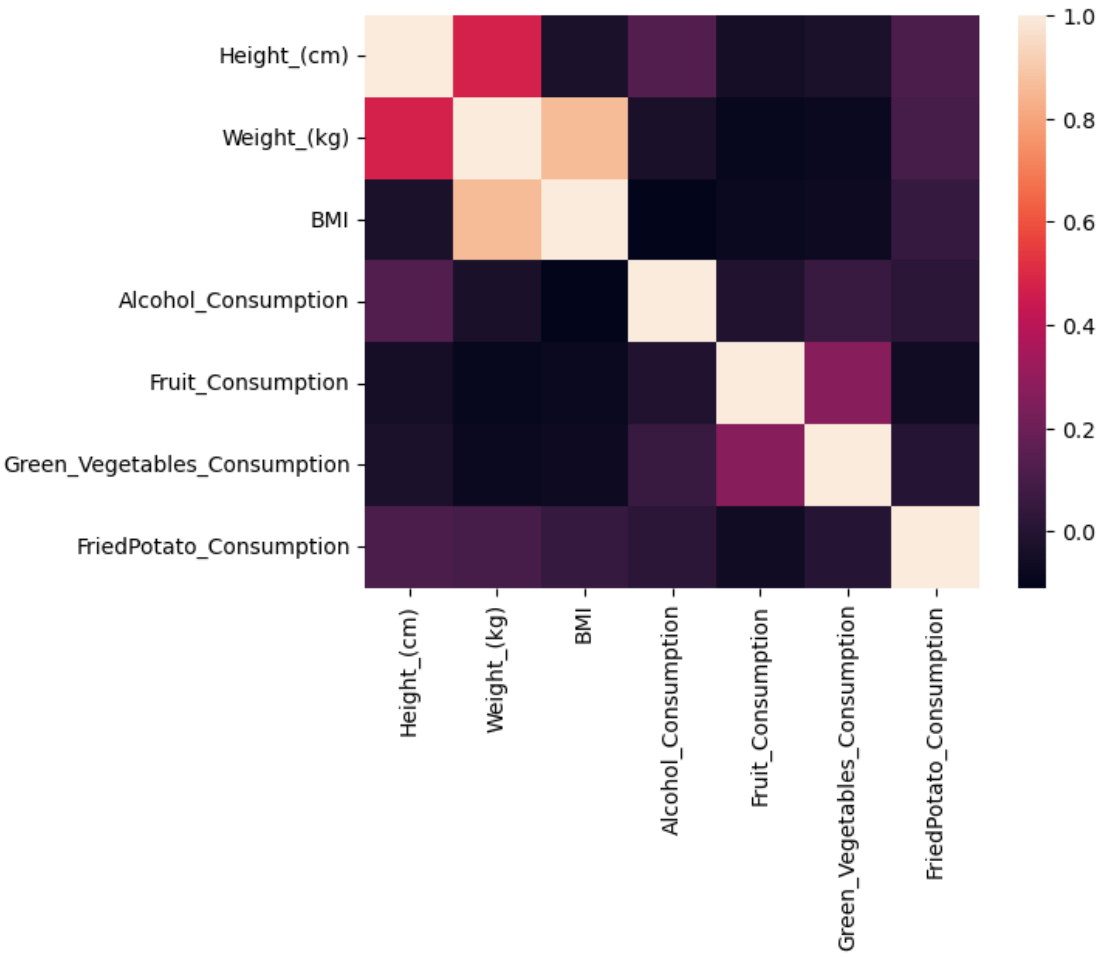
	Height_(cm)	Weight_(kg)	BMI	\
Height_(cm)	1.000000	0.472186	-0.027408	
Weight_(kg)	0.472186	1.000000	0.859699	
BMI	-0.027408	0.859699	1.000000	
Alcohol_Consumption	0.128835	-0.032373	-0.108684	
Fruit_Consumption	-0.045911	-0.090612	-0.076611	
Green_Vegetables_Consumption	-0.030148	-0.075904	-0.070640	

```
FriedPotato_Consumption          0.108795     0.096351  0.048366

                            Alcohol_Consumption  Fruit_Consumption  \
Height_(cm)                           0.128835          -0.045911
Weight_(kg)                          -0.032373          -0.090612
BMI                                  -0.108684          -0.076611
Alcohol_Consumption                   1.000000          -0.012562
Fruit_Consumption                    -0.012562           1.000000
Green_Vegetables_Consumption          0.060053           0.270430
FriedPotato_Consumption               0.020543          -0.060311

                            Green_Vegetables_Consumption  \
Height_(cm)                                    -0.030148
Weight_(kg)                                    -0.075904
BMI                                            -0.070640
Alcohol_Consumption                             0.060053
Fruit_Consumption                               0.270430
Green_Vegetables_Consumption                    1.000000
FriedPotato_Consumption                         0.003180

                            FriedPotato_Consumption
Height_(cm)                                0.108795
Weight_(kg)                                0.096351
BMI                                        0.048366
Alcohol_Consumption                        0.020543
Fruit_Consumption                         -0.060311
Green_Vegetables_Consumption               0.003180
FriedPotato_Consumption                    1.000000
```

[80]:
```
sns.heatmap(df.corr())
```

```
/tmp/ipykernel_105/58359773.py:1: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  sns.heatmap(df.corr())
```

[80]: <Axes: >



[81]:
```
df.groupby('Heart_Disease').count()
```

[81]:

Heart_Disease	General_Health	Checkup	Exercise	Skin_Cancer	Other_Cancer
No	283883	283883	283883	283883	283883
Yes	24971	24971	24971	24971	24971

Heart_Disease	Depression	Diabetes	Arthritis	Sex	Age_Category
No	283883	283883	283883	283883	283883
Yes	24971	24971	24971	24971	24971

Heart_Disease	Height_(cm)	Weight_(kg)	BMI	Smoking_History
No	283883	283883	283883	283883
Yes	24971	24971	24971	24971

```
                Alcohol_Consumption  Fruit_Consumption  \
Heart_Disease
No                           283883             283883
Yes                           24971              24971

                Green_Vegetables_Consumption  FriedPotato_Consumption
Heart_Disease
No                                    283883                   283883
Yes                                    24971                    24971
```

[82]:
```
#K Nearest Neighbors

#CLASSIFICATION ET PREDICTION
```

[83]:
```
#verification des données vides
print(df.isnull().sum())
```

```
General_Health                0
Checkup                       0
Exercise                      0
Heart_Disease                 0
Skin_Cancer                   0
Other_Cancer                  0
Depression                    0
Diabetes                      0
Arthritis                     0
Sex                           0
Age_Category                  0
Height_(cm)                   0
Weight_(kg)                   0
BMI                           0
Smoking_History               0
Alcohol_Consumption           0
Fruit_Consumption             0
Green_Vegetables_Consumption  0
FriedPotato_Consumption       0
dtype: int64
```

[86]:
```
from sklearn.preprocessing import LabelEncoder
#Encodage des données
def label_encoder(y):
    le = LabelEncoder()
    df[y] = le.fit_transform(df[y])
```

```
label_list = ["General_Health","Checkup",␣
 ↪"Exercise","Heart_Disease","Skin_Cancer",␣
 ↪"Other_Cancer","Depression","Diabetes",␣
 ↪"Arthritis","Sex","Age_Category","Smoking_History"]

for l in label_list:
    label_encoder(l)

#Afficher les données
df.head()
```

[86]:

	General_Health	Checkup	Exercise	Heart_Disease	Skin_Cancer
0	3	2	0	0	0
1	4	4	0	1	0
2	4	4	1	0	0
3	3	4	1	1	0
4	2	4	0	0	0

	Other_Cancer	Depression	Diabetes	Arthritis	Sex	Age_Category
0	0	0	0	1	0	10
1	0	0	2	0	0	10
2	0	0	2	0	0	8
3	0	0	2	0	1	11
4	0	0	0	0	1	12

	Height_(cm)	Weight_(kg)	BMI	Smoking_History	Alcohol_Consumption
0	150.0	32.66	14.54	1	0.0
1	165.0	77.11	28.29	0	0.0
2	163.0	88.45	33.47	0	4.0
3	180.0	93.44	28.73	0	0.0
4	191.0	88.45	24.37	1	0.0

	Fruit_Consumption	Green_Vegetables_Consumption	FriedPotato_Consumption
0	30.0	16.0	12.0
1	30.0	0.0	4.0
2	12.0	3.0	16.0
3	30.0	30.0	8.0
4	8.0	4.0	0.0

[ ]:

[ ]:

[ ]:

[ ]:

[ ]:

[ ]:
```
#MACHINE LEARNING KNN CLASSIFICATION
```

[87]:
```
#Importer les librairies
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import GridSearchCV
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score
```

[89]:
```
#Diviser le dataset en variables en dépendantes et indépendantes
X = df.drop(["Heart_Disease"],axis=1)
y = df['Heart_Disease']

#Scinder en données d'entrainement(80%) et de test(20%)
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2,
                                               random_state=42, shuffle=True)

y_train = y_train.values.reshape(-1,1)
y_test = y_test.values.reshape(-1,1)

print("X_train shape:",X_train.shape)
print("X_test shape:",X_test.shape)
print("y_train shape:",y_train.shape)
print("y_test shape:",y_test.shape)
```

```
X_train shape: (247083, 18)
X_test shape: (61771, 18)
y_train shape: (247083, 1)
y_test shape: (61771, 1)
```

[90]:
```
#Standardization des données

#Mise en echelle
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.fit_transform(X_test)
```

[91]:
```
#Stocker les résultats du modele  dans deux  dictionnaires
result_dict_train = {}
result_dict_test = {}
```

[92]:
```
knn = KNeighborsClassifier()
accuracies = cross_val_score(knn, X_train, y_train, cv=5)
knn.fit(X_train,y_train)
y_pred = knn.predict(X_test)

#Afficher la précision
print("Train Score:",np.mean(accuracies))
print("Test Score:",knn.score(X_test,y_test))
```

```
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/opt/conda/lib/python3.11/site-
packages/sklearn/neighbors/_classification.py:228: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
```

```
Train Score: 0.9095688439688555
Test Score: 0.9099739359893801
```

[98]:
```

```

[ ]:

[ ]: