IT 503 Strategic Planning and Management

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• In this test, you will design models to predict the number of deaths due to covid-19 Pandemic in Africas region.

• Use python 3.7 or higher for implementation.

• Take the screen shots of your codes and upload in the university platform and also share your uploaded codes/output in your Github account with the Instructor.

• Use the following methodology with respective performance evaluation metrics such as correlations, p-value, and F-1Scores:

1. Pearson Correlations (5 marks)
2. Decision Trees Classifier. (15 marks)

Data set obtained from URL: https://github.com/mkumakech/Covid-19_Pandemic/blob/master/Africa_Covid.csv As at: July 11th 2021 at 6.00 PM

In [1]:
```
#importing libraries for analysis
! pip install seaborn
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import StandardScaler,PolynomialFeatures
%matplotlib inline
```

```
Requirement already satisfied: seaborn in /srv/conda/envs/notebook/lib/python3.6/site-packages (0.11.1)
Requirement already satisfied: numpy>=1.15 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from seaborn) (1.19.5)
Requirement already satisfied: pandas>=0.23 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from seaborn) (1.1.5)
Requirement already satisfied: scipy>=1.0 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from seaborn) (1.5.3)
Requirement already satisfied: matplotlib>=2.2 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from seaborn) (3.3.4)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in /srv/conda/envs/notebook/lib/python3.6/site-packages
(from matplotlib>=2.2->seaborn) (2.4.7)
Requirement already satisfied: python-dateutil>=2.1 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from matplotlib>=
2.2->seaborn) (2.8.1)
Requirement already satisfied: pillow>=6.2.0 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from matplotlib>=2.2->sea
born) (8.2.0)
Requirement already satisfied: cycler>=0.10 in /srv/conda/envs/notebook/lib/python3.6/site-packages/cycler-0.10.0-py3.6.egg (fr
om matplotlib>=2.2->seaborn) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from matplotlib>=2.2-
>seaborn) (1.3.1)
Requirement already satisfied: six in /srv/conda/envs/notebook/lib/python3.6/site-packages (from cycler>=0.10->matplotlib>=2.2-
>seaborn) (1.15.0)
Requirement already satisfied: pytz>=2017.2 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from pandas>=0.23->seabor
n) (2021.1)
```

In [2]:
```
#Load file. This has global regions
Data=pd.read_csv("WHO COVID-19 global table data June 27th 2021 at 6.00 PM.csv",sep=",")
#view first five rows
Data.head()
```

Out[2]:

	Name	WHO Region	Cases - cumulative total	Cases - cumulative total per 100000 population	Cases - newly reported in last 7 days	Cases - newly reported in last 7 days per 100000 population	Cases - newly reported in last 24 hours	Deaths - cumulative total	Deaths - cumulative total per 100000 population	Deaths - newly reported in last 7 days	Deaths - newly reported in last 7 days per 100000 population	Deaths - newly reported in last 24 hours	Transmission Classification
0	Global	NaN	179688071	2305.281168	2565745	32.917207	437764	3899172	50.024399	57897	0.742789	9218	NaN
1	United States of America	Americas	33257768	10047.580000	82369	24.880000	14239	597727	180.580000	2136	0.650000	355	Community transmission
2	India	South-East Asia	30134445	2183.650000	371652	26.930000	51667	393310	28.500000	9820	0.710000	1329	Clusters of cases
3	Brazil	Americas	18169881	8548.140000	541293	254.650000	115228	507109	238.570000	13416	6.310000	2392	Community transmission
4	France	Europe	5655376	8695.310000	11620	17.870000	1796	110001	169.130000	258	0.400000	44	Community transmission

Cleaning of imported Data

In [3]:
```
#Extracting only for Africa region
new_file = Data.loc[(Data['WHO Region'] == 'Africa')]
#preview first five rows of new data set
new_file.head()
```

Out[3]:

	Name	WHO Region	Cases - cumulative total	Cases - cumulative total per 100000 population	Cases - newly reported in last 7 days	Cases - newly reported in last 7 days per 100000 population	Cases - newly reported in last 24 hours	Deaths - cumulative total	Deaths - cumulative total per 100000 population	Deaths - newly reported in last 7 days	Deaths - newly reported in last 7 days per 100000 population	Deaths - newly reported in last 24 hours	Transmission Classification
19	South Africa	Africa	1877143	3165.04	91064	153.54	16078	59406	100.16	1083	1.83	148	Community transmission
67	Ethiopia	Africa	275601	239.73	826	0.72	99	4296	3.74	34	0.03	4	Community transmission
81	Kenya	Africa	181239	337.06	3957	7.36	741	3538	6.58	104	0.19	24	Community transmission
83	Nigeria	Africa	167401	81.21	259	0.13	70	2118	1.03	1	0.00	0	Community transmission
87	Zambia	Africa	140620	764.91	18376	99.96	3594	1855	10.09	330	1.80	61	Community transmission

In [4]:
```
#Renaming some columns to make it easy to read'
new_file.rename(columns = {'Name':'Country','Cases - cumulative total':'Cases(Cum.Total)',
                           'Cases - cumulative total per 100000 population':'Cases(Cum.Total)per 100000 population',
                           'Cases - newly reported in last 7 days':'Cases(last 7 days)',
                           'Cases - newly reported in last 7 days per 100000 population':'Cases(last 7 days)per 100000 population',
                           'Cases - newly reported in last 24 hours':'Cases(last 24 hours)',
                           'Deaths - cumulative total':'Deaths(Cum.Total)','Deaths - cumulative total per 100000 population':
                           'Deaths(Cum.Total) per 100000 population', 'Deaths reported in last 7 days':
                           'Deaths(last 7 days)','Deaths - newly reported in last 7 days per 100000 population':
                           'Deaths(last 7 days)per 100000 population','Deaths - newly reported in last 24 hours':
                           'Deaths(last 24 hours)'}, inplace = True)
```

```
/srv/conda/envs/notebook/lib/python3.6/site-packages/pandas/core/frame.py:4308: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

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

In [5]:
```
#First five raws
new_file.head()
```

Out[5]:

	Country	WHO Region	Cases(Cum.Total)	Cases(Cum.Total)per 100000 population	Cases(last 7 days)	Cases(last 7 days)per 100000 population	Cases(last 24 hours)	Deaths(Cum.Total)	Deaths(Cum.Total) per 100000 population	Deaths - newly reported in last 7 days	Deaths(last 7 days)per 100000 population	De
19	South Africa	Africa	1877143	3165.04	91064	153.54	16078	50406	100.16	1083	1.83	
67	Ethiopia	Africa	275601	239.73	826	0.72	99	4296	3.74	34	0.03	
81	Kenya	Africa	181239	337.06	3957	7.36	741	3538	6.58	104	0.19	
83	Nigeria	Africa	167401	81.21	259	0.13	70	2118	1.03	1	0.00	
87	Zambia	Africa	140620	764.91	18376	99.96	3594	1855	10.09	330	1.80	

In [6]:
```
#Data set Summary
new_file.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 50 entries, 19 to 233
Data columns (total 13 columns):
 #   Column                                  Non-Null Count  Dtype
---  ------                                  --------------  -----
 0   Country                                 50 non-null     object
 1   WHO Region                              50 non-null     object
 2   Cases(Cum.Total)                        50 non-null     int64
 3   Cases(Cum.Total)per 100000 population   50 non-null     float64
 4   Cases(last 7 days)                      50 non-null     int64
 5   Cases(last 7 days)per 100000 population 50 non-null     float64
 6   Cases(last 24 hours)                    50 non-null     int64
 7   Deaths(Cum.Total)                       50 non-null     int64
 8   Deaths(Cum.Total) per 100000 population 50 non-null     float64
 9   Deaths - newly reported in last 7 days  50 non-null     int64
 10  Deaths(last 7 days)per 100000 population 50 non-null    float64
 11  Deaths(last 24 hours)                   50 non-null     int64
 12  Transmission Classification             50 non-null     object
dtypes: float64(4), int64(6), object(3)
memory usage: 5.5+ KB
```

In [7]:
```
#Countrie in Americas region as per dataset
new_file['WHO Region'].value_counts().to_frame()
```

Out[7]:

	WHO Region
Africa	50

We have 50 countries in Africa region

In [8]:
```
#Data Set Description
new_file.describe()
```

Out[8]:

	Cases(Cum.Total)	Cases(Cum.Total)per 100000 population	Cases(last 7 days)	Cases(last 7 days)per 100000 population	Cases(last 24 hours)	Deaths(Cum.Total)	Deaths(Cum.Total) per 100000 population	Deaths - newly reported in last 7 days	Deaths(last 7 days)per 100000 population	Deaths 24 ho
count	5.000000e+01	50.000000	50.000000	50.000000	50.000000	50.0000	50.000000	50.000000	50.000000	50.00
mean	7.822606e+04	1060.529800	3215.760000	45.727200	610.260000	1870.3800	12.735600	49.460000	0.533800	8.38
std	2.653622e+05	2523.380276	13082.564441	155.697475	2367.162193	8368.0771	21.314941	163.081701	1.534344	25.24
min	0.000000e+00	0.000000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.00
25%	6.333500e+03	101.417500	38.750000	0.837500	0.250000	116.2500	1.197500	0.000000	0.000000	0.00
50%	1.995850e+04	230.955000	243.000000	2.670000	14.000000	255.5000	3.170000	3.000000	0.035000	0.00
75%	4.712000e+04	505.582500	947.500000	10.495000	102.000000	902.7500	10.315000	18.000000	0.150000	1.00
max	1.877143e+06	15364.980000	91064.000000	1004.610000	16078.000000	59406.0000	100.160000	1083.000000	7.790000	148.00

In [9]:
```
new_file.shape
```

Out[9]:
```
(50, 13)
```

Type *Markdown* and LaTeX: α^2

In [10]:
```
Data.corr()
```

Out[10]:

	Cases - cumulative total	Cases - cumulative total per 100000 population	Cases - newly reported in last 7 days	Cases - newly reported in last 7 days per 100000 population	Cases - newly reported in last 24 hours	Deaths - cumulative total	Deaths - cumulative total per 100000 population	Deaths - newly reported in last 7 days	Deaths - newly reported in last 7 days per 100000 population	Deaths - newly reported in last 24 hours
Cases - cumulative total	1.000000	0.027569	0.978863	0.010259	0.971479	0.995058	0.054887	0.976867	0.035097	0.972573
Cases - cumulative total per 100000 population	0.027569	1.000000	0.010991	0.357719	0.015625	0.026548	0.718680	0.011532	0.231071	0.013631
Cases - newly reported in last 7 days	0.978863	0.010991	1.000000	0.055610	0.998240	0.983080	0.047521	0.998197	0.092341	0.997081
Cases - newly reported in last 7 days per 100000 population	0.010259	0.357719	0.055610	1.000000	0.062694	0.015148	0.146441	0.053239	0.676276	0.057219
Cases - newly reported in last 24 hours	0.971479	0.015625	0.998240	0.062694	1.000000	0.978802	0.054995	0.996831	0.103809	0.997981
Deaths - cumulative total	0.995058	0.026548	0.983080	0.015148	0.978802	1.000000	0.082230	0.981125	0.049299	0.979466
Deaths - cumulative total per 100000 population	0.054887	0.718680	0.047521	0.146441	0.054995	0.082230	1.000000	0.058554	0.311722	0.060981
Deaths - newly reported in last 7 days	0.976867	0.011532	0.998197	0.053239	0.996831	0.981125	0.058554	1.000000	0.106937	0.999032
Deaths - newly reported in last 7 days per 100000 population	0.035097	0.231071	0.092341	0.676276	0.103809	0.049299	0.311722	0.106937	1.000000	0.112537
Deaths - newly reported in last 24 hours	0.972573	0.013631	0.997081	0.057219	0.997981	0.979466	0.060981	0.999032	0.112537	1.000000

Hypothesis

1. null: Death reported in the last 24 hours are not from cases reported in the last 7 days
2. Alternative: Death reported in the last 24 hours are from cases reported in the last 7 days

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1. null: Death reported in the last 24 hours are not from cases reported in the last 7 days
2. Alternative: Death reported in the last 24 hours are from cases reported in the last 7 days

In [11]:
```
new_file [['Cases(last 7 days)','Deaths - newly reported in last 7 days']].corr()
```

Out[11]:

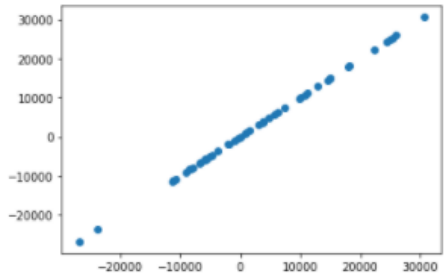
	Cases(last 7 days)	Deaths - newly reported in last 7 days
Cases(last 7 days)	1.000000	0.981895
Deaths - newly reported in last 7 days	0.981895	1.000000

In [12]:
```
# generate related variables
#data1=cases-newly reported in the last 7 days, std 130, mean 4279
#data2=Death-newly reported in the last  24 hours

# generate related variables
#data1=cases in last 7days,std=13082.564441,mean=3215.760000
#data2=deaths in last 24 hours, std=25.245642,mean =8.380000

from numpy import mean
from numpy import std
from numpy.random import randn
from numpy.random import seed
from matplotlib import pyplot
# seed random number generator
seed(1)
# prepare data
data1 = 13082.564441 * randn(50) + 3215.760000
data2 = data1 + (25.245642 * randn(50) + 8.380000)
# summarize
print('data1: mean=%.3f stdv=%.3f' % (mean(data1), std(data1)))
print('data2: mean=%.3f stdv=%.3f' % (mean(data2), std(data2)))
# plot
pyplot.scatter(data1, data2)
pyplot.show()
```

```
data1: mean=2881.960 stdv=12684.714
data2: mean=2894.043 stdv=12684.284
```



Covariance ¶

The calculation of the sample covariance is as follows: cov(X, Y) = (sum (x - mean(X)) * (y - mean(Y))) * 1/(n-1)

In [13]:
```
np. cov(data1, data2)
```

Out[13]:
```
array([[1.64185690e+08, 1.64179925e+08],
       [1.64179925e+08, 1.64174557e+08]])
```

In [14]:
```
# calculate the covariance between two variables
from numpy.random import randn
from numpy.random import seed
from numpy import cov
# seed random number generator
seed(1)
# prepare data
data1 = 13082.564441 * randn(50) + 3215.760000
data2 = data1 + (25.245642 * randn(50) + 8.380000)
# calculate covariance matrix
covariance = cov(data1, data2)
print(covariance)
```

```
[[1.64185690e+08 1.64179925e+08]
 [1.64179925e+08 1.64174557e+08]]
```

In [15]:
```
# calculate the covariance between two variables
from numpy.random import randn
from numpy.random import seed
from numpy import cov
# seed random number generator
seed(1)
# prepare data
data1 = 13082.564441 * randn(50) + 3215.760000
data2 = data1 + (25.245642 * randn(50) + 8.380000)
# calculate covariance matrix
covariance = cov(data1, data2)
print(covariance)
```

```
[[1.64185690e+08 1.64179925e+08]
 [1.64179925e+08 1.64174557e+08]]
```

In [16]:
```
# calculate the Pearson's correlation between two variables
from numpy.random import randn
from numpy.random import seed
from scipy.stats import pearsonr
# seed random number generator
seed(1)
# prepare data
data1 = 13082.564441 * randn(50) + 3215.760000
data2 = data1 + (25.245642 * randn(50) + 8.380000)
# calculate Pearson's correlation
corr, _ = pearsonr(data1, data2)
print('Pearsons correlation: %.3f' % corr)
```

```
Pearsons correlation: 1.000
```

In [17]:
```
import scipy.stats
r,p=scipy.stats.pearsonr(data1, data2)
r
```

Out[17]:
```
0.9999987883025226
```

Decision Tree Classifier Building in Scikit-learn

Importing Required Libraries Let's first load the required libraries

In [18]:
```
# Load libraries
import pandas as pd
from sklearn.tree import DecisionTreeClassifier # Import Decision Tree Classifier
from sklearn.model_selection import train_test_split # Import train_test_split function
from sklearn import metrics #Import scikit-learn metrics module for accuracy calculation
```

In [19]:
```
#split dataset in features and target variable
feature_cols = ['Deaths(Cum.Total)', 'Deaths(Cum.Total) per 100000 population', 'Deaths - newly reported in last 7 days', 'Death
X = new_file[feature_cols] # Features
y = new_file # Target variable
```

Splitting Data To understand model performance, dividing the dataset into a training set and a test set is a good strategy.

Let's split the dataset by using function train_test_split(). You need to pass 3 parameters features, target, and test_set size.

In [20]:
```
# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1) # 70% training and 30% test
```

Splitting Data To understand model performance, dividing the dataset into a training set and a test set is a good strategy.

Let's split the dataset by using function train_test_split(). You need to pass 3 parameters features, target, and test_set size.

Building Decision Tree Model Decision Tree Model using Scikit-learn.

In [21]:
```
# Create Decision Tree classifer object
clf = DecisionTreeClassifier()

# Train Decision Tree Classifer
clf = clf.fit(X_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(X_test)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-21-effc1cc2cd4f> in <module>
      3
```

In [21]:
```
# Create Decision Tree classifer object
clf = DecisionTreeClassifier()

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y_pred = clf.predict(X_test)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-21-effc1cc2cd4f> in <module>
      3
      4 # Train Decision Tree Classifer
----> 5 clf = clf.fit(X_train,y_train)
      6
      7 #Predict the response for test dataset

/srv/conda/envs/notebook/lib/python3.6/site-packages/sklearn/tree/_classes.py in fit(self, X, y, sample_weight, check_input, X_
idx_sorted)
    900             sample_weight=sample_weight,
    901             check_input=check_input,
--> 902             X_idx_sorted=X_idx_sorted)
    903         return self
    904

/srv/conda/envs/notebook/lib/python3.6/site-packages/sklearn/tree/_classes.py in fit(self, X, y, sample_weight, check_input, X_
idx_sorted)
    188
    189         if is_classification:
--> 190             check_classification_targets(y)
    191             y = np.copy(y)
    192

/srv/conda/envs/notebook/lib/python3.6/site-packages/sklearn/utils/multiclass.py in check_classification_targets(y)
    178     y : array-like
    179     """
--> 180     y_type = type_of_target(y)
    181     if y_type not in ['binary', 'multiclass', 'multiclass-multioutput',
    182                       'multilabel-indicator', 'multilabel-sequences']:

/srv/conda/envs/notebook/lib/python3.6/site-packages/sklearn/utils/multiclass.py in type_of_target(y)
    259         raise ValueError("y cannot be class 'SparseSeries' or 'SparseArray'")
    260
--> 261     if is_multilabel(y):
    262         return 'multilabel-indicator'
    263

/srv/conda/envs/notebook/lib/python3.6/site-packages/sklearn/utils/multiclass.py in is_multilabel(y)
    161                 _is_integral_float(np.unique(y.data))))
    162     else:
--> 163         labels = np.unique(y)
    164
    165         return len(labels) < 3 and (y.dtype.kind in 'biu' or  # bool, int, uint

<__array_function__ internals> in unique(*args, **kwargs)

/srv/conda/envs/notebook/lib/python3.6/site-packages/numpy/lib/arraysetops.py in unique(ar, return_index, return_inverse, retur
n_counts, axis)
    259     ar = np.asanyarray(ar)
    260     if axis is None:
```

In [ ]:
```
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

In [ ]:
```
pip install graphviz
```

In [ ]:
```
pip install pydotplus
```

In [ ]:
```
from sklearn.tree import export_graphviz
from sklearn.externals.six import StringIO
from IPython.display import Image
import pydotplus

dot_data = StringIO()
export_graphviz(clf, out_file=dot_data,
                filled=True, rounded=True,
                special_characters=True,feature_names = feature_cols,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png('diabetes.png')
Image(graph.create_png())
```

In [ ]:
```
# Create Decision Tree classifer object
clf = DecisionTreeClassifier(criterion="entropy", max_depth=3)

# Train Decision Tree Classifer
clf = clf.fit(X_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(X_test)

# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

In [ ]:
```
from sklearn.externals.six import StringIO
from IPython.display import Image
from sklearn.tree import export_graphviz
import pydotplus
dot_data = StringIO()
export_graphviz(clf, out_file=dot_data,
                filled=True, rounded=True,
                special_characters=True, feature_names = feature_cols,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png('diabetes.png')
Image(graph.create_png())
```

The End

Analysis by Elisha Nangosha Email: nangoshaelisha@gmail.com Contact: 0777514549