Introduction

The report entails on analyzing the climate change indicators using the statistical methods and time series analysis. The dataset is retrieved from the world-bank site using the API key and the python module "wbgapi". The statistical analysis as well as the time series plot is captured in this report. The climate change indicator of only 10 countries have been selected using the pandas library (Lemenkova, 2019). The count of climate change indicators are 5. The data points for the indicators are collected between the periods 2016 to 2020. The dataset is directly collected from world-bank site and the data of different country is selected by using the pandas data-frame and in similar way the indicators are also selected.

Data Collection and Preparation

The dataset is collected by running the module "wbgapi". Originally the dataset includes all the development indicators including all countries. Using the Pandas data-frame the observations of the selected indicators for the ten countries are extracted (Ülker, et al 2018). The country code for the selected country and the climate change indicators are shown below.

```
country_codes = ["GBR","FRA","HUN","PAK","SDN","SMR","THA","TSS","AGO","AFW"] # United Kingdom and France
```

Search for identifiers:

```
wb.search("Climate change")
```

Series

ID	Name	Field	Value
AG.LND.ARBL.HA	Arable land (hectares)	Developmentrelevance	...are intrinsically linked to global challenges of food insecurity and poverty, climate change adaptation and mitigation, as well as degradation and depletion of natural...
AG.LND.ARBL.HA.PC	Arable land (hectares per person)	Developmentrelevance	...are intrinsically linked to global challenges of food insecurity and poverty, climate change adaptation and mitigation, as well as degradation and depletion of natural...
AG.LND.ARBL.ZS	Arable land (% of land area)	Developmentrelevance	...are intrinsically linked to global challenges of food insecurity and poverty, climate change adaptation and mitigation, as well as degradation and depletion of natural...
AG.LND.CROP.ZS	Permanent cropland (% of land area)	Developmentrelevance	...are intrinsically linked to global challenges of food insecurity and poverty, climate change adaptation and mitigation, as well as degradation and depletion of natural...
AG.LND.EL5M.RU.ZS	Rural land area where elevation is below 5 meters (% of total land area)	Developmentrelevance	...Scientists use the terms climate change and global warming to refer to the gradual increase in the Earth's surface...

Figure 1: Selected Country and Climate Change Indicators

Among all the climate change attribute, only five significant attributes are selected for the time series analysis and statistical analysis. The indicators and their codes are shown in the picture below.

```
wb.series.info(indicator_ids)
```

id	value
EG.ELC.ACCS.ZS	Access to electricity (% of population)
AG.LND.IRIG.AG.ZS	Agricultural irrigated land (% of total agricultural land)
NV.AGR.TOTL.ZS	Agriculture, forestry, and fishing, value added (% of GDP)
SP.URB.TOTL	Urban population
SP.URB.TOTL.IN.ZS	Urban population (% of total population)
	5 elements

Figure 2: Chosen Indicators

economy	series	YR2016	YR2017	YR2018	YR2019	YR2020
AFW	AG.LND.IRIG.AG.ZS	NaN	NaN	NaN	NaN	NaN
	EG.ELC.ACCS.ZS	5.094894e+01	4.884820e+01	5.125325e+01	5.134142e+01	NaN
	NV.AGR.TOTL.ZS	2.100622e+01	2.080529e+01	2.093141e+01	2.125716e+01	2.300483e+01
	SP.URB.TOTL	1.873058e+08	1.950161e+08	2.029611e+08	2.111338e+08	2.195312e+08
	SP.URB.TOTL.IN.ZS	4.540181e+01	4.601933e+01	4.663314e+01	4.724285e+01	4.784863e+01
AGO	AG.LND.IRIG.AG.ZS	NaN	NaN	NaN	NaN	NaN
	EG.ELC.ACCS.ZS	4.179738e+01	4.300161e+01	4.529000e+01	4.567031e+01	NaN
	NV.AGR.TOTL.ZS	9.831169e+00	1.001700e+01	8.607742e+00	6.660704e+00	9.492693e+00
	SP.URB.TOTL	1.850216e+07	1.933290e+07	2.018472e+07	2.106103e+07	2.196288e+07
	SP.URB.TOTL.IN.ZS	6.414900e+01	6.483900e+01	6.551400e+01	6.617700e+01	6.682500e+01
FRA	AG.LND.IRIG.AG.ZS	NaN	NaN	NaN	NaN	NaN
	EG.ELC.ACCS.ZS	1.000000e+02	1.000000e+02	1.000000e+02	1.000000e+02	NaN
	NV.AGR.TOTL.ZS	1.437115e+00	1.542415e+00	1.648877e+00	1.522459e+00	1.596840e+00
	SP.URB.TOTL	5.332390e+07	5.365487e+07	5.397948e+07	5.427594e+07	5.457033e+07
	SP.URB.TOTL.IN.ZS	7.991700e+01	8.018000e+01	8.044400e+01	8.070900e+01	8.097500e+01
GBR	AG.LND.IRIG.AG.ZS	NaN	NaN	4.139051e-01	NaN	NaN
	EG.ELC.ACCS.ZS	1.000000e+02	1.000000e+02	1.000000e+02	1.000000e+02	NaN
	NV.AGR.TOTL.ZS	5.668345e-01	5.933787e-01	5.766241e-01	6.119853e-01	5.817956e-01
	SP.URB.TOTL	5.438282e+07	5.492332e+07	5.542660e+07	5.590992e+07	5.639565e+07
	SP.URB.TOTL.IN.ZS	8.288600e+01	8.314300e+01	8.339800e+01	8.365200e+01	8.390300e+01
HUN	AG.LND.IRIG.AG.ZS	1.849678e+00	1.912125e+00	1.623867e+00	NaN	NaN
	EG.ELC.ACCS.ZS	1.000000e+02	1.000000e+02	1.000000e+02	1.000000e+02	NaN
	NV.AGR.TOTL.ZS	3.889340e+00	3.753567e+00	3.485912e+00	3.342482e+00	3.377607e+00

Figure 3: Dataset Preview

The final dataset preview is shown in above picture. The NaN values are also present in the dataset. The data points for each indicator is shown year-wise as well as country wise.

Results and Findings

The time series plot is captured for the access of electricity and percentage of available agricultural land. Some of the countries in the selected set of country has similar access of electricity from 2016 to 2020. However, for some countries such as India, a positive linear trend line is obtained. The agricultural land for the Sub-Saharan country (TSS) has increased during this period.

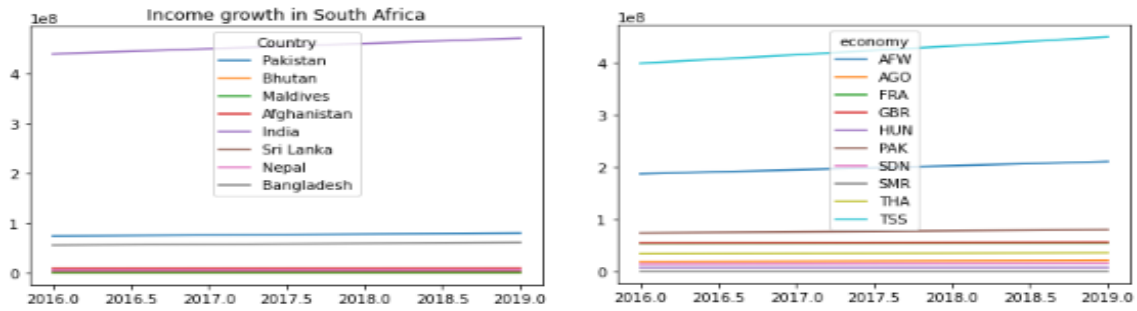

Figure 4: Time series Plot for the Indicators

series	count	mean	std	min	25%	50%	75%	max
AG.LND.IRIG.AG.ZS	2.0	2.620206e+01	3.443947e+01	1.849678	1.402587e+01	2.620206e+01	3.837825e+01	5.055444e+01
EG.ELC.ACCS.ZS	10.0	7.564660e+01	2.684547e+01	41.797379	4.936042e+01	8.571872e+01	1.000000e+02	1.000000e+02
NV.AGR.TOTL.ZS	10.0	1.078668e+01	9.436051e+00	0.013624	2.050171e+00	9.154623e+00	1.986758e+01	2.321520e+01
SP.URB.TOTL	10.0	8.412643e+07	1.234811e+08	32468.000000	1.482280e+07	4.336956e+07	6.893355e+07	3.999755e+08
SP.URB.TOTL.IN.ZS	10.0	5.979621e+01	2.219365e+01	34.121000	4.068764e+01	5.629850e+01	7.763250e+01	9.691000e+01

Figure 5: Summary Statistics for the Indicators

The summary statistics table depicts the average, standard deviation, minimum, first quartile and 3rd quartile are shown in the above table. The average value recorded for the access of electricity is 75.64% and the average percentage of urban population is 59.79% (Byers, et al 2018). On an average, 10.7 hectare land is available for the agriculture.

	NV.AGR.TOTL.ZS	SP.URB.TOTL	SP.URB.TOTL.IN.ZS	SP.POP.TOTL	EN.POP.EL5M.UR.ZS
NV.AGR.TOTL.ZS	1.000000	0.999983	0.999934	0.999855	0.999750
SP.URB.TOTL	0.999983	1.000000	0.999984	0.999937	0.999863
SP.URB.TOTL.IN.ZS	0.999934	0.999984	1.000000	0.999985	0.999941
SP.POP.TOTL	0.999855	0.999937	0.999985	1.000000	0.999986
EN.POP.EL5M.UR.ZS	0.999750	0.999863	0.999941	0.999986	1.000000

Figure 6: Table of Correlation Coefficient

The correlation table is derived including all the indicators in the dataset. The value of correlation coefficient is shown in the above table. The degree of association between each indicator is 0.9.

Conclusion

The report entails on analyzing the climate change indicators using the statistical methods and time series analysis. The dataset is retrieved from the world-bank site using the API key and the python module “wbgapi”. The climate change indicator of only 10 countries have been selected using the pandas library. The count of climate change indicators are 5. The data points for the indicators are collected between the periods 2016 to 2020. For some countries such as India, a positive linear trend line is obtained. The agricultural land for the Sub-Saharan country (TSS) has increased during this period. The average value recorded for the access of electricity is 75.64% and the average percentage of urban population is 59.79%. On an average, 10.7 hectare land is available for the agriculture.