GDP_GreengasEmissions

October 11, 2020

1 Crude Oil Production & GDP Impact on Climate Change

1.0.1 Importing library packages

New Packages **altair,math & vega_datasets** used for Plotting.

[2]:
```
# initial imports
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import hvplot.pandas
import plotly.express as px
import panel as pn
from panel.interact import interact
from panel import widgets
from pathlib import Path
from dotenv import load_dotenv
import requests
import altair as alt
from vega_datasets import data
import matplotlib.pyplot as plt
import numpy.random as nrand
import math
import seaborn as sns


%matplotlib inline
```

1.1 Reading data using Pandas

1.1.1 Data Sources

https://databank.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators#

[3]:

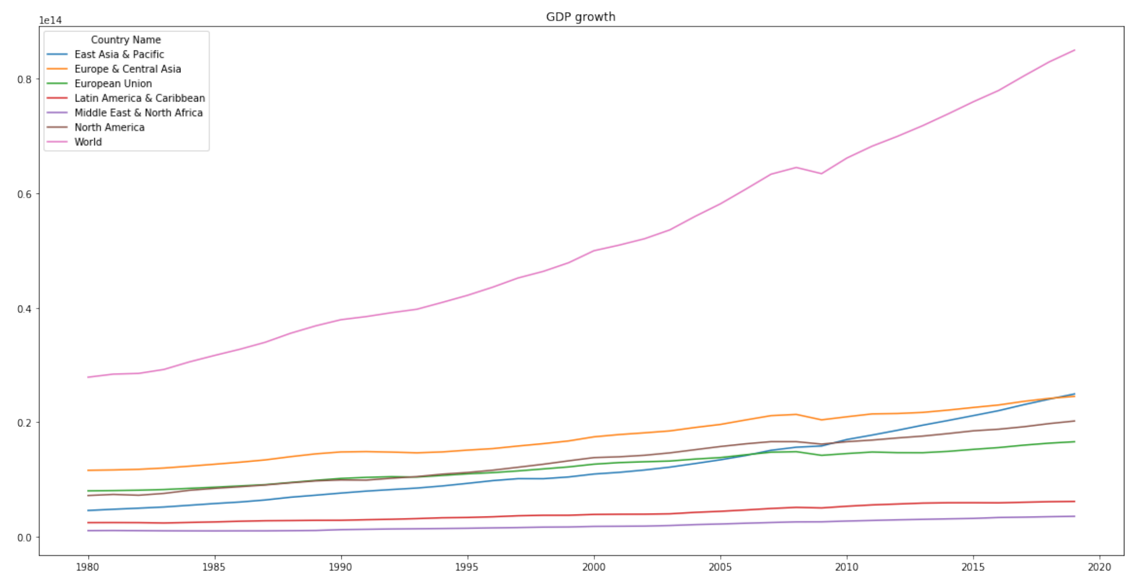
```
#df = pd.read_excel ("C:
↪\\Users\\16177\\Documents\\FinTech\\Project1\\project_one\\Book.xlsx",␣
↪index_col="Country Name")
#df.head()
df = pd.read_excel ("C:
↪\\Users\\vinot\\Fintech\\Boot_Camp_Projects\\Project_01\\project_one\\Book.
↪xlsx", index_col="Country Name")
df.head()
```

[3]:

```
                                   1980          1981          1982  \
Country Name
East Asia & Pacific        4.610634e+12  4.821441e+12  5.010653e+12
Europe & Central Asia      1.162316e+13  1.168270e+13  1.179325e+13
European Union             8.037742e+12  8.078099e+12  8.144008e+12
Latin America & Caribbean  2.491509e+12  2.501017e+12  2.490058e+12
Middle East & North Africa 1.096173e+12  1.112135e+12  1.090403e+12

                                   1983          1984          1985  \
Country Name
East Asia & Pacific        5.215578e+12  5.515624e+12  5.818843e+12
Europe & Central Asia      1.201923e+13  1.233933e+13  1.268005e+13
European Union             8.261338e+12  8.466644e+12  8.665661e+12
Latin America & Caribbean  2.427307e+12  2.519847e+12  2.611752e+12
Middle East & North Africa 1.061780e+12  1.049167e+12  1.042661e+12

                                   1986          1987          1988  \
Country Name
East Asia & Pacific        6.083839e+12  6.441710e+12  6.920498e+12
Europe & Central Asia      1.303132e+13  1.342920e+13  1.399150e+13
European Union             8.889776e+12  9.114453e+12  9.494393e+12
Latin America & Caribbean  2.729115e+12  2.820882e+12  2.850012e+12
Middle East & North Africa 1.052692e+12  1.054766e+12  1.087020e+12

                                   1989  …          2010          2011  \
Country Name                             …
East Asia & Pacific        7.273687e+12  …  1.698858e+13  1.777184e+13
Europe & Central Asia      1.448845e+13  …  2.095923e+13  2.146323e+13
European Union             9.866972e+12  …  1.454039e+13  1.480797e+13
Latin America & Caribbean  2.888749e+12  …  5.348215e+12  5.581710e+12
Middle East & North Africa 1.117554e+12  …  2.766778e+12  2.868623e+12

                                   2012          2013          2014  \
Country Name
East Asia & Pacific        1.860607e+13  1.949355e+13  2.031030e+13
Europe & Central Asia      2.153157e+13  2.172539e+13  2.212354e+13
European Union             1.469796e+13  1.468951e+13  1.492192e+13
Latin America & Caribbean  5.737113e+12  5.896884e+12  5.955304e+12
```

```
Middle East & North Africa  2.980196e+12  3.060890e+12  3.149823e+12

                                    2015          2016          2017  \
Country Name
East Asia & Pacific         2.116328e+13  2.202916e+13  2.307768e+13
Europe & Central Asia       2.258278e+13  2.301664e+13  2.365531e+13
European Union              1.527357e+13  1.558674e+13  1.601169e+13
Latin America & Caribbean   5.960669e+12  5.940599e+12  6.045888e+12
Middle East & North Africa  3.224644e+12  3.384665e+12  3.442755e+12

                                    2018          2019
Country Name
East Asia & Pacific         2.404002e+13  2.494473e+13
Europe & Central Asia       2.416814e+13  2.453180e+13
European Union              1.635542e+13  1.660450e+13
Latin America & Caribbean   6.140871e+12  6.191944e+12
Middle East & North Africa  3.524700e+12  3.588456e+12

[5 rows x 40 columns]
```

[4]:
```
yearly_GDP = df.T
yearly_GDP.head()

yearly_GDP.plot(figsize=(20, 10), title="GDP growth");
```



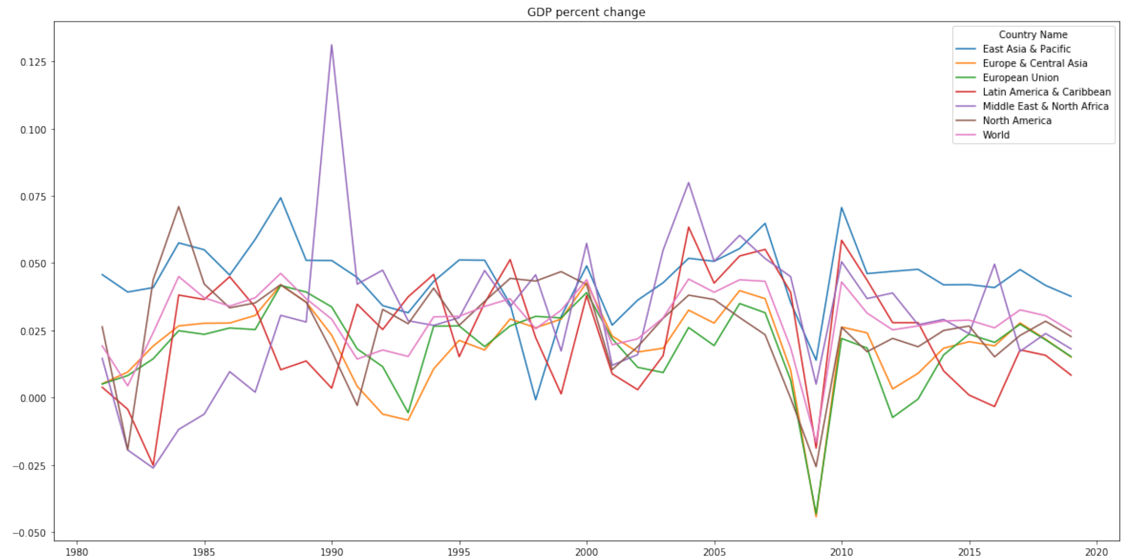
[5]:
```
GDP_pct_change = yearly_GDP.pct_change(fill_method='ffill')
GDP_pct_change.head()
```

[5]:
```
Country Name  East Asia & Pacific  Europe & Central Asia  European Union  \
1980                          NaN                    NaN             NaN
1981                     0.045722               0.005123        0.005021
1982                     0.039244               0.009463        0.008159
1983                     0.040898               0.019162        0.014407
1984                     0.057529               0.026632        0.024851

Country Name  Latin America & Caribbean  Middle East & North Africa  \
1980                                NaN                         NaN
1981                           0.003816                    0.014561
1982                          -0.004382                   -0.019541
1983                          -0.025201                   -0.026250
1984                           0.038125                   -0.011879

Country Name  North America     World
1980                    NaN       NaN
1981               0.026310  0.019217
1982              -0.019436  0.004322
1983               0.043860  0.024131
1984               0.071041  0.045019
```

[6]:
```
GDP_growth = GDP_pct_change.dropna()
GDP_growth.head()
```

[6]:
```
Country Name  East Asia & Pacific  Europe & Central Asia  European Union  \
1981                     0.045722               0.005123        0.005021
1982                     0.039244               0.009463        0.008159
1983                     0.040898               0.019162        0.014407
1984                     0.057529               0.026632        0.024851
1985                     0.054975               0.027612        0.023506

Country Name  Latin America & Caribbean  Middle East & North Africa  \
1981                           0.003816                    0.014561
1982                          -0.004382                   -0.019541
1983                          -0.025201                   -0.026250
1984                           0.038125                   -0.011879
1985                           0.036473                   -0.006201

Country Name  North America     World
1981               0.026310  0.019217
1982              -0.019436  0.004322
1983               0.043860  0.024131
1984               0.071041  0.045019
1985               0.042219  0.037107
```

[7]:
```
GDP_growth.plot(figsize=(20, 10), title="GDP percent change");
```

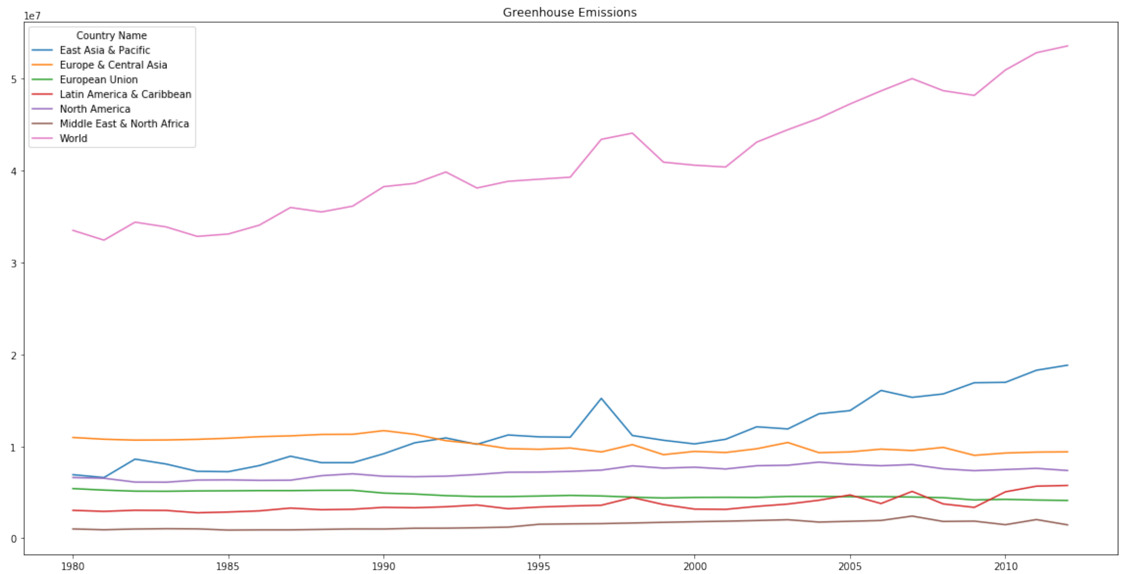


[8]:
```
#Emissions_df = pd.read_excel ("C:
↪\\Users\\16177\\Documents\\FinTech\\Project1\\project_one\\Greenhouse_Emissions1.
↪xlsx", index_col="Country Name")
#Emissions_df.head()
Emissions_df= pd.read_excel ("C:
↪\\Users\\vinot\\Fintech\\Boot_Camp_Projects\\Project_01\\project_one\\Greenhouse_Emissions1
↪xlsx", index_col="Country Name")
Emissions_df.head()
```

[8]:
```
                                  1980          1981          1982  \
Country Name
East Asia & Pacific       6.918674e+06  6.608208e+06  8.611438e+06
Europe & Central Asia     1.096177e+07  1.077144e+07  1.067643e+07
European Union            5.406309e+06  5.240913e+06  5.125474e+06
Latin America & Caribbean 3.040379e+06  2.928972e+06  3.049425e+06
North America             6.608491e+06  6.530407e+06  6.111326e+06

                                  1983          1984          1985  \
Country Name
East Asia & Pacific       8.075198e+06  7.284011e+06  7.245164e+06
Europe & Central Asia     1.069261e+07  1.076057e+07  1.087854e+07
European Union            5.113291e+06  5.150577e+06  5.165148e+06
Latin America & Caribbean 3.031186e+06  2.776182e+06  2.857617e+06
North America             6.098981e+06  6.331563e+06  6.354321e+06

                                  1986          1987          1988  \
Country Name
East Asia & Pacific       7.910650e+06  8.925836e+06  8.221051e+06
```

```
Europe & Central Asia      1.104853e+07  1.113713e+07  1.129018e+07
European Union             5.188641e+06  5.187987e+06  5.217134e+06
Latin America & Caribbean  2.982879e+06  3.287881e+06  3.106320e+06
North America              6.297473e+06  6.315319e+06  6.809717e+06

                                   1989  …          2003          2004  \
Country Name                             …
East Asia & Pacific        8.223285e+06  …  1.189064e+07  1.353511e+07
Europe & Central Asia      1.130625e+07  …  1.041647e+07  9.309385e+06
European Union             5.220880e+06  …  4.552726e+06  4.556117e+06
Latin America & Caribbean  3.158259e+06  …  3.722931e+06  4.136822e+06
North America              7.016379e+06  …  7.943171e+06  8.285000e+06

                                   2005          2006          2007  \
Country Name
East Asia & Pacific        1.388218e+07  1.607667e+07  1.532388e+07
Europe & Central Asia      9.393741e+06  9.694909e+06  9.541145e+06
European Union             4.524825e+06  4.528050e+06  4.487310e+06
Latin America & Caribbean  4.714765e+06  3.779499e+06  5.097240e+06
North America              8.033192e+06  7.889610e+06  8.021019e+06

                                   2008          2009          2010  \
Country Name
East Asia & Pacific        1.569545e+07  1.691575e+07  1.695599e+07
Europe & Central Asia      9.884411e+06  9.020107e+06  9.271013e+06
European Union             4.418217e+06  4.173804e+06  4.237720e+06
Latin America & Caribbean  3.739498e+06  3.362268e+06  5.052728e+06
North America              7.557917e+06  7.354494e+06  7.478081e+06

                                   2011          2012
Country Name
East Asia & Pacific        1.827284e+07  1.882291e+07
Europe & Central Asia      9.372189e+06  9.398207e+06
European Union             4.160116e+06  4.116310e+06
Latin America & Caribbean  5.667496e+06  5.746908e+06
North America              7.605751e+06  7.371537e+06

[5 rows x 33 columns]
```

[9]:
```
yearly_Emissions = Emissions_df.T
yearly_Emissions.head()

yearly_Emissions.plot(figsize=(20, 10), title="Greenhouse Emissions");
```



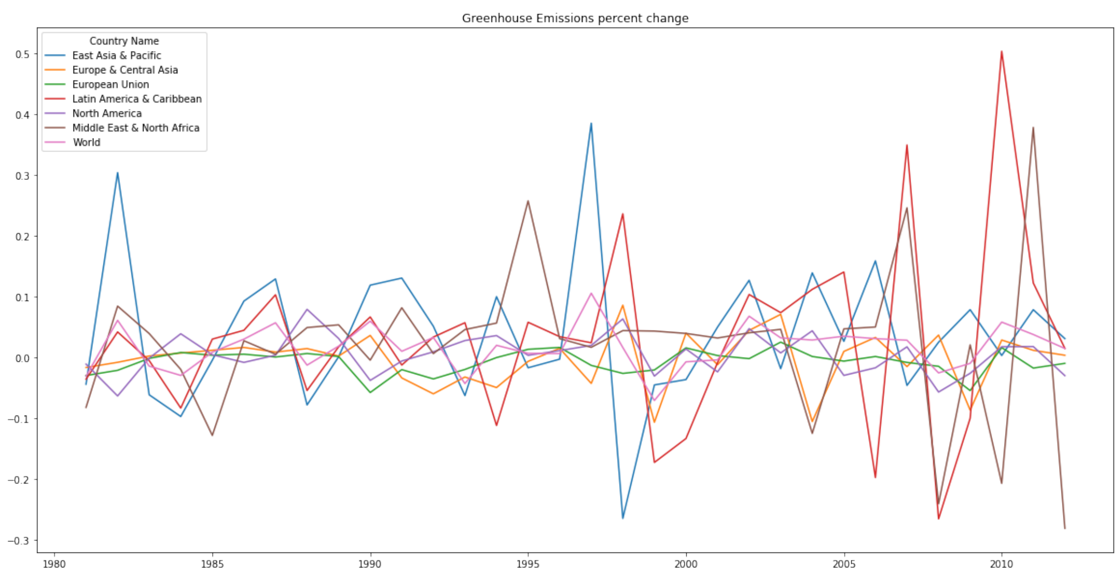
[10]:
```
Emissions_pct_change = yearly_Emissions.pct_change(fill_method='ffill')
Emissions_pct_change.head()
```

[10]:
```
Country Name  East Asia & Pacific  Europe & Central Asia  European Union  \
1980                          NaN                    NaN             NaN
1981                    -0.044874              -0.017364       -0.030593
1982                     0.303143              -0.008821       -0.022027
1983                    -0.062271               0.001516       -0.002377
1984                    -0.097977               0.006356        0.007292

Country Name  Latin America & Caribbean  North America  \
1980                                NaN            NaN
1981                          -0.036643      -0.011816
1982                           0.041125      -0.064174
1983                          -0.005981      -0.002020
1984                          -0.084127       0.038135

Country Name  Middle East & North Africa     World
1980                                 NaN       NaN
1981                           -0.083007 -0.031729
1982                            0.083625  0.060216
1983                            0.038500 -0.015067
1984                           -0.020541 -0.030405
```

[11]:
```
Emissions_growth = Emissions_pct_change.dropna()
Emissions_growth.head()
```

[11]:
```
Country Name  East Asia & Pacific  Europe & Central Asia  European Union  \
1981                    -0.044874              -0.017364       -0.030593
1982                     0.303143              -0.008821       -0.022027
1983                    -0.062271               0.001516       -0.002377
1984                    -0.097977               0.006356        0.007292
1985                    -0.005333               0.010963        0.002829

Country Name  Latin America & Caribbean  North America  \
1981                          -0.036643      -0.011816
1982                           0.041125      -0.064174
1983                          -0.005981      -0.002020
1984                          -0.084127       0.038135
1985                           0.029333       0.003594

Country Name  Middle East & North Africa     World
1981                           -0.083007 -0.031729
1982                            0.083625  0.060216
1983                            0.038500 -0.015067
1984                           -0.020541 -0.030405
1985                           -0.129118  0.007850
```

[12]:
```
Emissions_growth.plot(figsize=(20, 10), title="Greenhouse Emissions percent␣
↪change");
```



1.1.2 START OF ICE MELT DATA

[13]:
```
# Setting path to CSV
csv_data = Path("glacier_data.csv")

# Reading in CSV file
glacier_data = pd.read_csv(csv_data, index_col="Year",␣
↪infer_datetime_format=True).dropna()
glacier_data.drop(columns=["Number of observations"],inplace=True)
glacier_data.head()
```

[13]:
```
      Mean cumulative mass balance
Year
1946                        -0.540
1947                        -2.420
1948                        -2.710
1949                        -3.140
1950                        -4.145
```

Data Sources - https://www.epa.gov/climate-indicators/climate-change-indicators-glaciers - https://www.epa.gov/climate-indicators/climate-change-indicators-arctic-sea-ice - https://nsidc.org/data/glacier_inventory/query.html - https://www.epa.gov/climate-indicators/climate-change-indicators-antarctic-sea-ice

[14]:
```
# Plot showing glacier deterioration.

glacier_data.hvplot(
    title="Glacier Deterioration Based on Cumulative Balance: 1946 - 2015",
    ylabel= "Mean Cumulative Mass Balance",
    height=400,
    width=700)
```

[14]:
```
:Curve   [Year]   (Mean cumulative mass balance)
```

[15]:
```
# Setting path to CSV - Arctic Sea Ice
csv_data = Path("arctic_sea_ice.csv")

# Reading in CSV file
arctic_sea_ice = pd.read_csv(csv_data, index_col="Year")
arctic_sea_ice.head()
```

[15]:
```
      September     March
Year
1980   3.034763  6.258716
1981   2.799241  6.061804
1982   2.876461  6.266438
1983   2.911210  6.247133
1984   2.745186  6.065665
```

[16]:
```
arctic_sea_ice.hvplot(
    title="Arctic Sea Ice Deterioration from 1980 - 2015",
    ylabel="Sea Ice Amount (million square miles)",
    height=400,
    width=700,
    rot=45,
)
```

[16]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

[17]:
```
# Setting path to CSV - Antarctic Sea Ice
csv_data = Path("antarctic_sea_ice.csv")

# Reading in CSV file
antarctic_sea_ice = pd.read_csv(csv_data, index_col="Year")
antarctic_sea_ice.head()
```

[17]:

	February	September
Year		
1980	1.100391	7.370690
1981	1.111974	7.305053
1982	1.208500	7.200805
1983	1.185334	7.285748
1984	1.057920	7.208527

[18]:
```
antarctic_sea_ice.hvplot(
    title="Antarctic Sea Ice Deterioration from 1980 - 2015",
    ylabel="Sea Ice Amount (million square miles)",
    height=400,
    width=700,
    rot=45,
)
```

[18]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

1.1.3 Start of Continental Ice Sheet Mapping

[19]:
```
# Setting path to CSV - Continental Ice Sheets
csv_data = Path("continental_ice_sheets.csv")

# Reading in CSV file
continental_ice_sheets = pd.read_csv(csv_data)
continental_ice_sheets.head()
```

[19]:
```
  wgi_glacier_id  glacier_name    lat    lon   total_area  mean_elev  \
0   GL2U1AG05001                61.41 -45.38       166.08
1   GL2U1AG07008                61.45 -45.13       100.49
2   GL2U1AG07024                61.45 -44.98        63.58
3   GL2U1AG07027                61.46 -44.90        59.81
4   GL2U1AG07040                61.43 -44.81        61.47

   primary_class
0              1
1              1
2              1
3              1
4              1
```

[20]:
```
# Dropping unneeded columns.
continental_ice_sheets.drop(columns=[" glacier_name", " mean_elev", "␣
↪primary_class "], inplace=True)
```

[21]:
```
continental_ice_sheets.head()
```

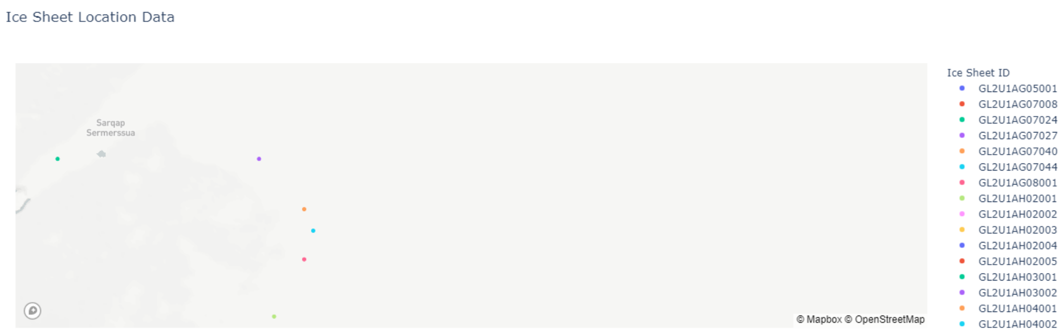
[21]:
```
  wgi_glacier_id    lat    lon   total_area
0   GL2U1AG05001  61.41 -45.38       166.08
1   GL2U1AG07008  61.45 -45.13       100.49
2   GL2U1AG07024  61.45 -44.98        63.58
3   GL2U1AG07027  61.46 -44.90        59.81
4   GL2U1AG07040  61.43 -44.81        61.47
```

[22]:
```
# Change column names.
continental_ice_sheets = continental_ice_sheets.rename(columns={
    "wgi_glacier_id":"Ice Sheet ID",
    " lat":"Latitude",
    " lon":"Longitude",
    " total_area":"Total Area"
})
continental_ice_sheets.head()
```

[22]:
```
   Ice Sheet ID  Latitude  Longitude  Total Area
0  GL2U1AG05001     61.41     -45.38      166.08
1  GL2U1AG07008     61.45     -45.13      100.49
2  GL2U1AG07024     61.45     -44.98       63.58
3  GL2U1AG07027     61.46     -44.90       59.81
4  GL2U1AG07040     61.43     -44.81       61.47
```

[23]:
```
load_dotenv()
mapbox_api_key = os.getenv("MAP_BOX")
```

[24]:
```python
px.set_mapbox_access_token(mapbox_api_key)

ice_sheet_plot = px.scatter_mapbox(
    continental_ice_sheets,
    lat="Latitude",
    lon="Longitude",
    color="Ice Sheet ID",
    color_continuous_scale=px.colors.cyclical.IceFire,
    title="Ice Sheet Location Data",
    height=500,
    width=800
)
ice_sheet_plot.show()
```



1.1.4 Start of Ice Field Mapping

[25]:
```python
# Setting path to CSV - Ice Fields
csv_data = Path("ice_fields.csv")

# Reading in CSV file
ice_fields = pd.read_csv(csv_data)
ice_fields.head()
```

[25]:
```
  wgi_glacier_id        glacier_name     lat      lon  total_area  mean_elev  \
0   ID5A01600001      Northwall Firn  -4.057  137.183       3.608       4620
1   AQ6C20205006  Gourlay Snowfield -60.721  -45.610       0.649        111
2   CA2M001CB051             AUREOLE  49.582 -125.397       0.610
3   CA2M001CC028                      49.458 -125.779       0.160
4   CA2N001AD018                      57.301 -128.266       0.190

  snow_line_date
0
```

```
1
2          19570530
3          19570719
4          19710811
```

[26]:
```
# Dropping unneeded columns.
ice_fields.drop(columns=[" glacier_name", " mean_elev", " snow_line_date "],␣
 ↪inplace=True)
```

[27]:
```
ice_fields.head()
```

[27]:

	wgi_glacier_id	lat	lon	total_area
0	ID5A01600001	-4.057	137.183	3.608
1	AQ6C20205006	-60.721	-45.610	0.649
2	CA2M001CB051	49.582	-125.397	0.610
3	CA2M001CC028	49.458	-125.779	0.160
4	CA2N001AD018	57.301	-128.266	0.190

[28]:
```
# Change column names.
ice_fields = ice_fields.rename(columns={
    "wgi_glacier_id":"Ice Field ID",
    " lat":"Latitude",
    " lon":"Longitude",
    " total_area":"Total Area"
})
ice_fields.head()
```

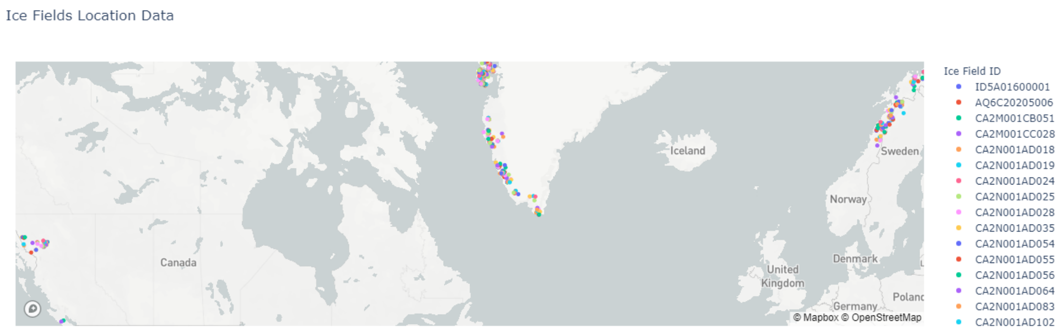
[28]:

	Ice Field ID	Latitude	Longitude	Total Area
0	ID5A01600001	-4.057	137.183	3.608
1	AQ6C20205006	-60.721	-45.610	0.649
2	CA2M001CB051	49.582	-125.397	0.610
3	CA2M001CC028	49.458	-125.779	0.160
4	CA2N001AD018	57.301	-128.266	0.190

[29]:
```
load_dotenv()
mapbox_api_key = os.getenv("MAP_BOX")
```

[30]:
```
px.set_mapbox_access_token(mapbox_api_key)

ice_fields_plot = px.scatter_mapbox(
   ice_fields,
   lat="Latitude",
   lon="Longitude",
   color="Ice Field ID",
   color_continuous_scale=px.colors.cyclical.IceFire,
   title="Ice Fields Location Data",
   height=500,
```

```
    width=800
)
ice_fields_plot.show()
```



1.1.5 Ice Cap Mapping

[31]:
```
# Setting path to CSV - Ice Caps
csv_data = Path("ice_caps.csv")

# Reading in CSV file
ice_caps = pd.read_csv(csv_data)
ice_caps.head()
```

[31]:
```
  wgi_glacier_id  glacier_name    lat    lon  total_area  mean_elev  \
0   SU5X14107189           189  40.91  74.67         0.2       4350
1   SU5X14107194           194  40.91  74.83         0.4       4245
2   SU5X14107198           198  40.94  74.87         0.4       4420
3   SU5X14107199           199  40.94  74.88         1.4       4345
4   SU5X14205025            25  41.98  76.69         0.2       4100

  snow_line_date
0
1
2
3
4       19640000
```

[32]:
```
# Dropping unneeded columns.
ice_caps.drop(columns=[" glacier_name", " mean_elev", " snow_line_date "],␣
↪inplace=True)
```

[33]:
```
ice_caps.head()
```

[33]:

	wgi_glacier_id	lat	lon	total_area
0	SU5X14107189	40.91	74.67	0.2
1	SU5X14107194	40.91	74.83	0.4
2	SU5X14107198	40.94	74.87	0.4
3	SU5X14107199	40.94	74.88	1.4
4	SU5X14205025	41.98	76.69	0.2

[34]:

```
# Change column names.
ice_caps = ice_caps.rename(columns={
    "wgi_glacier_id":"Ice Field ID",
    " lat":"Latitude",
    " lon":"Longitude",
    " total_area":"Total Area"
})
ice_caps.head()
```

[34]:

	Ice Field ID	Latitude	Longitude	Total Area
0	SU5X14107189	40.91	74.67	0.2
1	SU5X14107194	40.91	74.83	0.4
2	SU5X14107198	40.94	74.87	0.4
3	SU5X14107199	40.94	74.88	1.4
4	SU5X14205025	41.98	76.69	0.2

[35]:

```
load_dotenv()
mapbox_api_key = os.getenv("MAP_BOX")
```

[36]:

```
px.set_mapbox_access_token(mapbox_api_key)

ice_caps_plot = px.scatter_mapbox(
   ice_caps,
   lat="Latitude",
   lon="Longitude",
   color="Total Area",
   color_continuous_scale=px.colors.cyclical.IceFire,
   title="Ice Caps Location Data",
   height=500,
   width=800
)
ice_caps_plot.show()
```

Ice Caps Location Data

1.1.6 Altair Map

[37]:
```python
glacier_data = glacier_data.reset_index()
glacier_data.head()
```

[37]:

	Year	Mean cumulative mass balance
0	1946	-0.540
1	1947	-2.420
2	1948	-2.710
3	1949	-3.140
4	1950	-4.145

[38]:
```python
alt.Chart(glacier_data).mark_square().encode(
    alt.X("Year", scale=alt.Scale(domain=(1946, 2020))),
    alt.Y("Mean cumulative mass balance")
)
#https://www.datacamp.com/community/tutorials/altair-in-python
```

[38]: alt.Chart(…)

1.1.7 MC Simulation for Artic Sea Ice

[39]:
```python
arctic_sea_ice.head()
```

[39]:

	September	March
Year		
1980	3.034763	6.258716
1981	2.799241	6.061804
1982	2.876461	6.266438
1983	2.911210	6.247133
1984	2.745186	6.065665

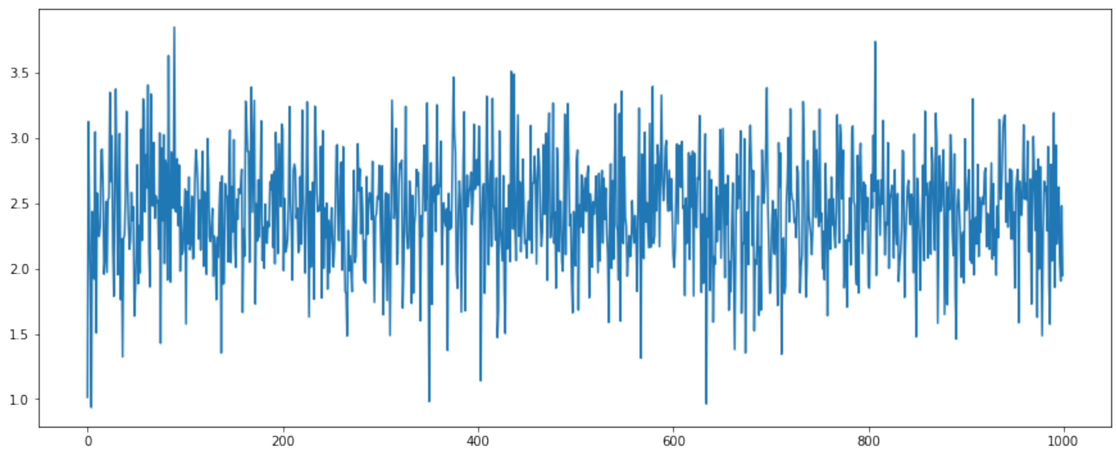
[40]:
```
september_arctic = arctic_sea_ice.drop(columns=["March"])
september_arctic.tail()
```

[40]:

	September
Year	
2011	1.787653
2012	1.401551
2013	2.065647
2014	2.042480
2015	1.806958

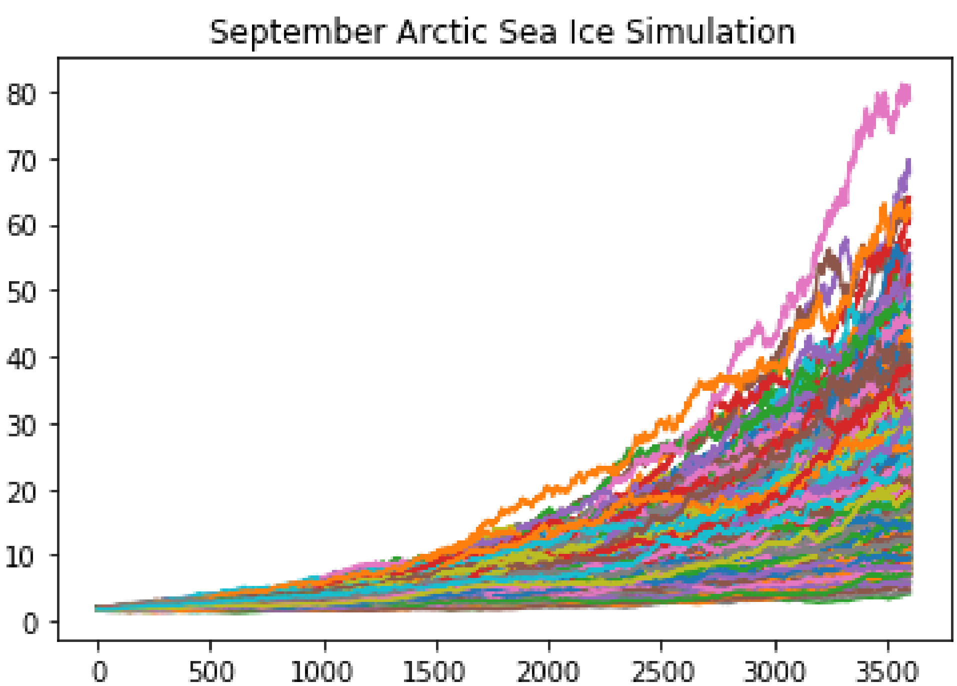
[41]:
```
# Getting mean and standard deviation for September arctic data
september_arctic_mean = september_arctic.mean()
september_arctic_std = september_arctic.std()
```

[42]:
```
# Running simulations on September arctic data
iterations=1000
september_arctic_plot = np.random.
↪normal(september_arctic_mean,september_arctic_std,iterations)
plt.figure(figsize=(15,6))
plt.plot(september_arctic_plot)
plt.show()
```



[43]:
```
# Define all variables and run MC simulation
start = 1.8
time = 3600
mean = september_arctic_mean
std = september_arctic_std


result = []
```

```
for i in range(1000):
    changes = np.random.normal(mean/time,std/math.sqrt(time),time)+1

    check_list = [start]

    for x in changes:
        check_list.append(check_list[-1]*x)
    result.append(check_list[-1])

    plt.plot(check_list)
plt.title("September Arctic Sea Ice Simulation")
plt.show()
```



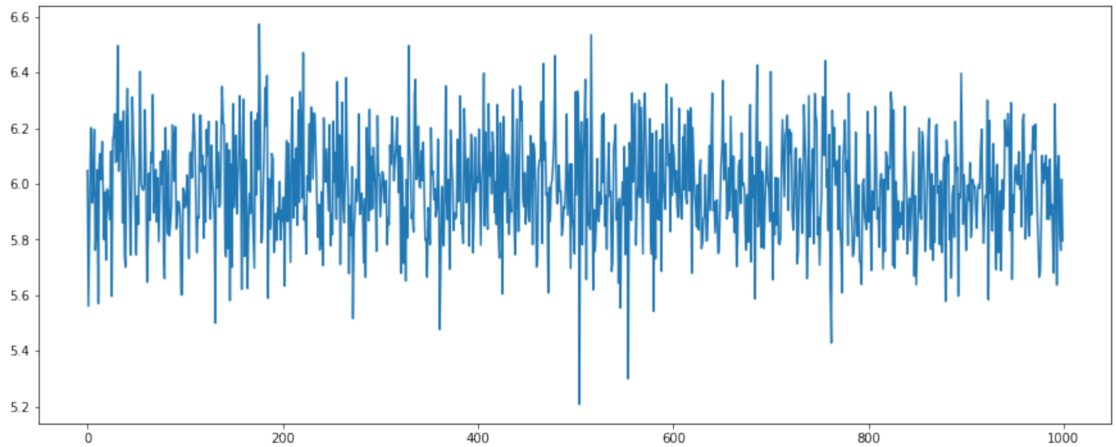
[44]:
```
march_arctic = arctic_sea_ice.drop(columns=["September"])
march_arctic.tail()
```

[44]:

	March
Year	
2011	5.664119
2012	5.911224
2013	5.853309
2014	5.741339
2015	5.594620

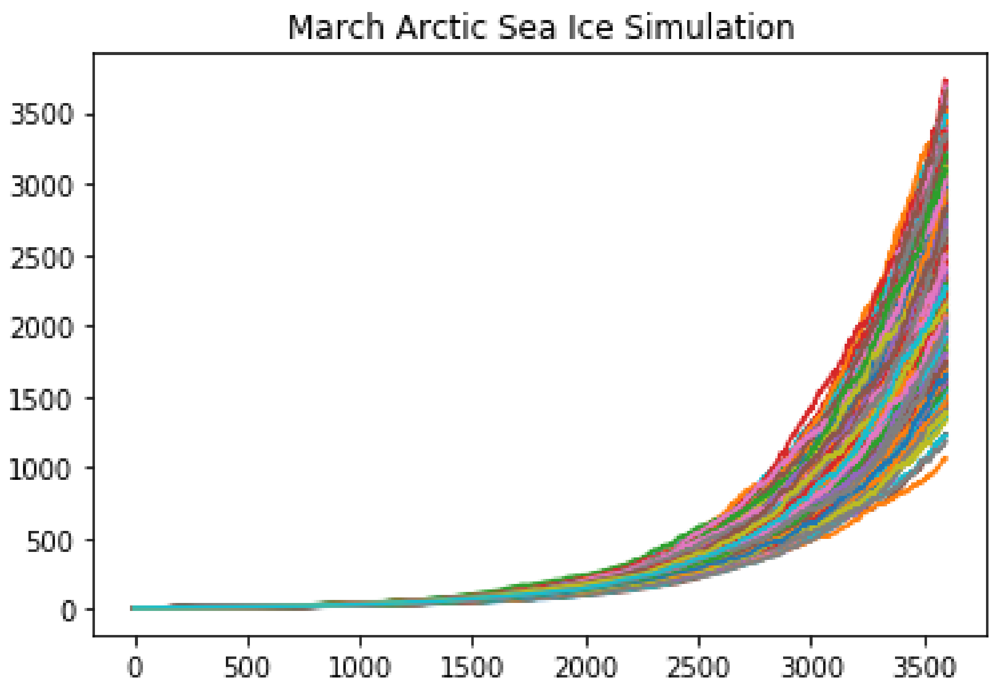
[45]:
```python
# Getting mean and standard deviation for March arctic data
march_arctic_mean = march_arctic.mean()
march_arctic_std = march_arctic.std()
```

[46]:
```python
# Running simulations on March arctic data
iterations=1000
march_arctic_plot = np.random.
 ↪normal(march_arctic_mean,march_arctic_std,iterations)
plt.figure(figsize=(15,6))
plt.plot(march_arctic_plot)
plt.show()
```



[47]:
```python
# Define all variables and run MC simulation
start = 5.6
time = 3600
mean = march_arctic_mean
std = march_arctic_std


result = []
for i in range(1000):
    changes = np.random.normal(mean/time,std/math.sqrt(time),time)+1

    check_list = [start]

    for x in changes:
        check_list.append(check_list[-1]*x)
    result.append(check_list[-1])

    plt.plot(check_list)
plt.title("March Arctic Sea Ice Simulation")
```

```
plt.show()
```



1.1.8 MC Simulation for Antartic Sea Ice

[48]:
```
antarctic_sea_ice.head()
```

[48]:

Year	February	September
1980	1.100391	7.370690
1981	1.111974	7.305053
1982	1.208500	7.200805
1983	1.185334	7.285748
1984	1.057920	7.208527

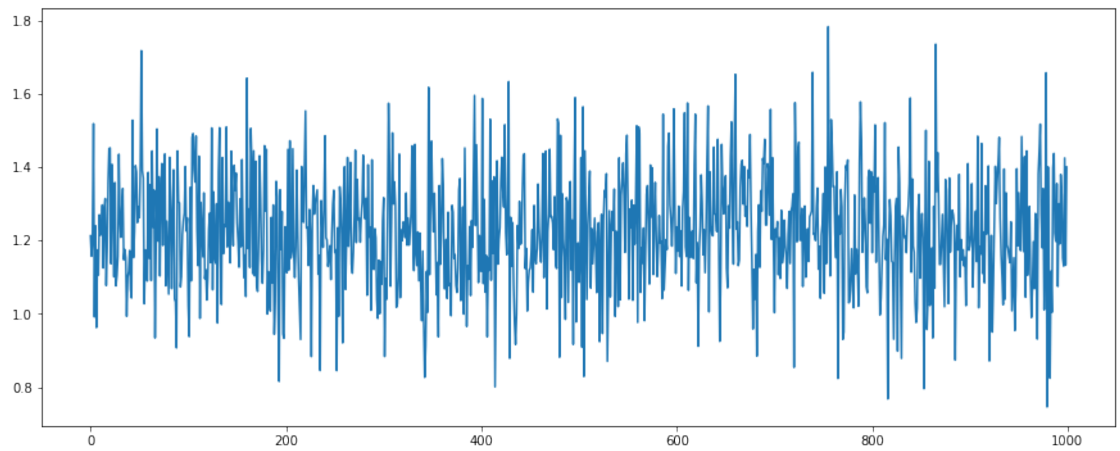
[49]:
```
february_antarctic = antarctic_sea_ice.drop(columns=["September"])
february_antarctic.tail()
```

[49]:

Year	February
2011	0.972977
2012	1.393829
2013	1.509659
2014	1.505798
2015	1.455605

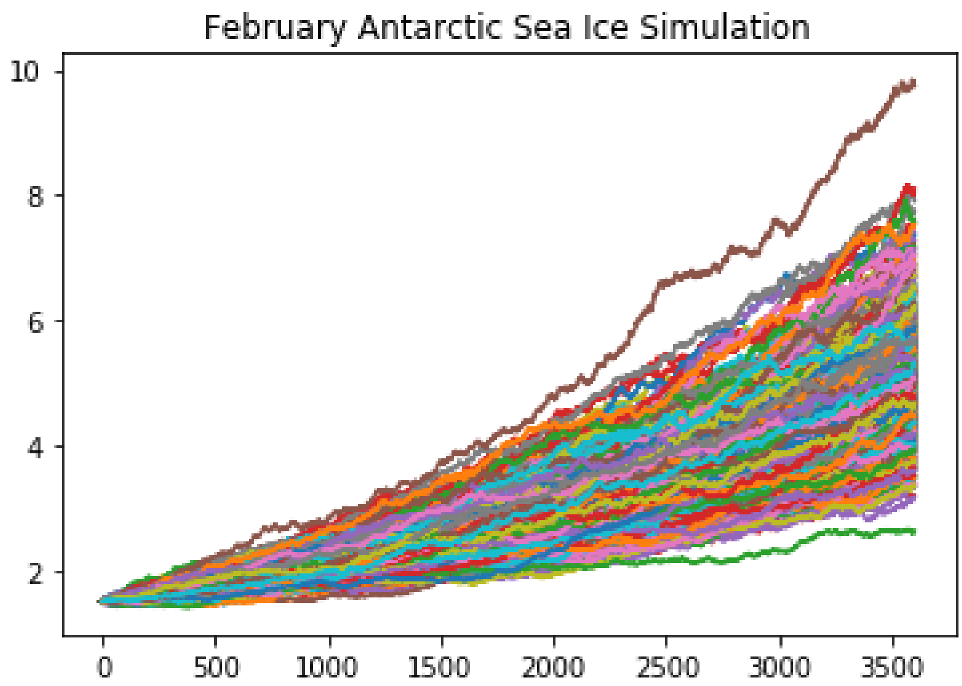
[50]:
```python
# Getting mean and standard deviation for February antarctic data
february_antarctic_mean = february_antarctic.mean()
february_antarctic_std = february_antarctic.std()
```

[51]:
```python
# Running simulations on February antarctic data
iterations=1000
february_antarctic_plot = np.random.normal(
    february_antarctic_mean,february_antarctic_std,iterations)
plt.figure(figsize=(15,6))
plt.plot(february_antarctic_plot)
plt.show()
```



[52]:
```python
# Define all variables and run MC simulation
start = 1.5
time = 3600
mean = february_antarctic_mean
std = february_antarctic_std


result = []
for i in range(1000):
    changes = np.random.normal(mean/time,std/math.sqrt(time),time)+1

    check_list = [start]

    for x in changes:
        check_list.append(check_list[-1]*x)
    result.append(check_list[-1])

    plt.plot(check_list)
plt.title("February Antarctic Sea Ice Simulation")
```

```
plt.show()
```



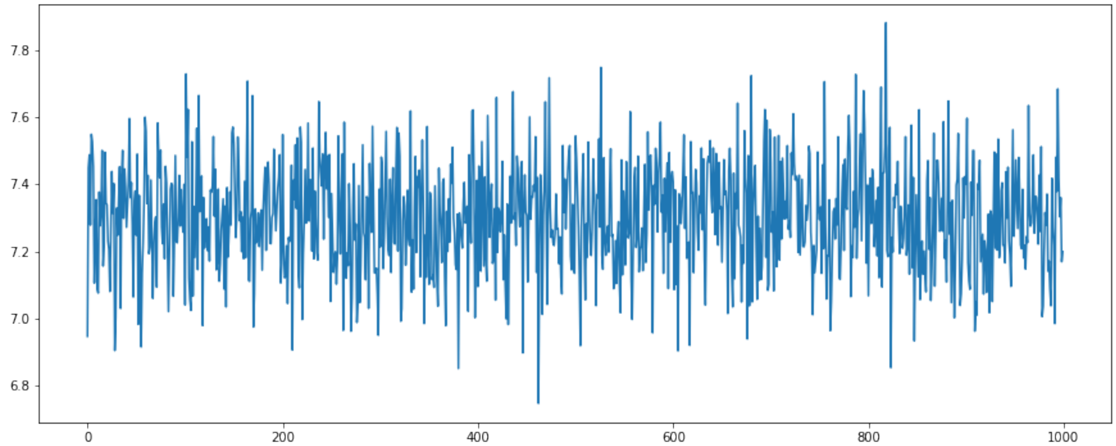
[53]:
```
september_antarctic = antarctic_sea_ice.drop(columns=["February"])
september_antarctic.tail()
```

[53]:

	September
Year	
2011	7.324358
2012	7.505826
2013	7.656406
2014	7.768375
2015	7.243277

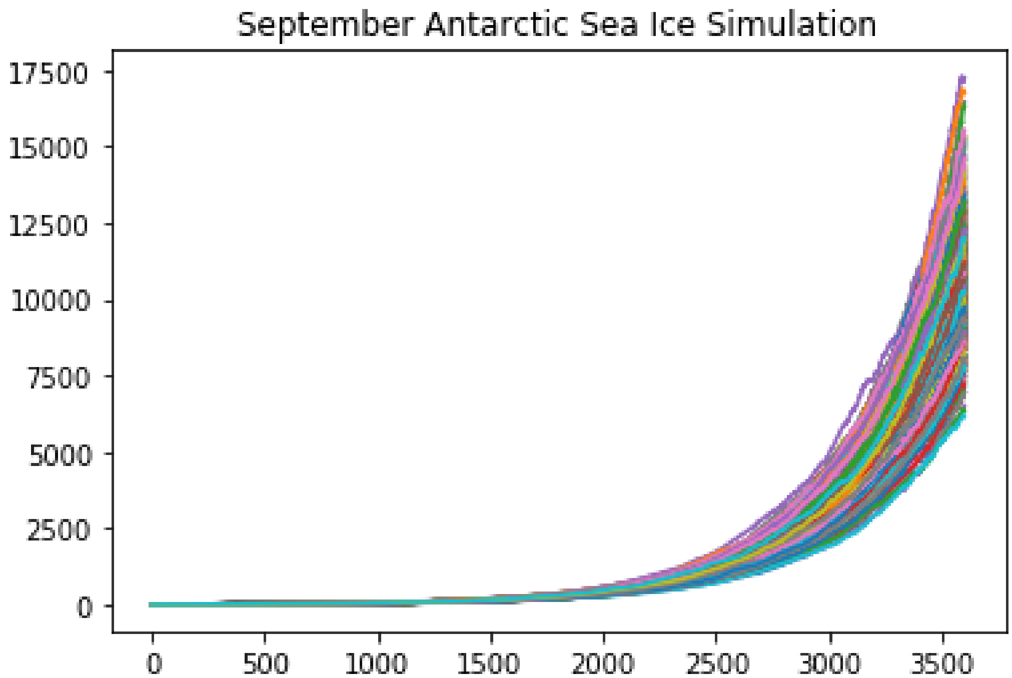
[54]:
```
# Getting mean and standard deviation for September antarctic data
september_antarctic_mean = september_antarctic.mean()
september_antarctic_std = september_antarctic.std()
```

[55]:
```
# Running simulations on September antarctic data
iterations=1000
september_antarctic_plot = np.random.normal(
    september_antarctic_mean,september_antarctic_std,iterations)
plt.figure(figsize=(15,6))
plt.plot(september_antarctic_plot)
plt.show()
```



[56]:

```
# Define all variables and run MC simulation
start = 7.2
time = 3600
mean = september_antarctic_mean
std = september_antarctic_std


result = []
for i in range(1000):
    changes = np.random.normal(mean/time,std/math.sqrt(time),time)+1

    check_list = [start]

    for x in changes:
        check_list.append(check_list[-1]*x)
    result.append(check_list[-1])

    plt.plot(check_list)
plt.title("September Antarctic Sea Ice Simulation")
plt.show()
```



1.2 Global Temperature,Crude Oil Production & World GDP

Global Temperature Source : https://data.giss.nasa.gov/gistemp/

[57]:
```
temp=pd.read_excel("C:
↪\\Users\\vinot\\Fintech\\Projects\\Project_01\\Temp_Data_01.xlsx")
```

Dataset Cleaning

[58]:
```
temp.set_index(temp["Year"],inplace=True)
```

[59]:
```
temp.drop(columns=["Year","Lowess(5)"],inplace=True)
```

[60]:
```
temp.rename(columns={"Smoothing":"Temp"},inplace=True)
```

[61]:
```
temp.hvplot()
```

[61]: :Curve [Year] (Temp)

Crude Oil Production

[62]:
```
URL = "https://www.indexmundi.com/energy/?product=oil&graph=production"
source_data = pd.read_html(URL)
```

Dataset Cleaning

[63]:
```
crude_oil=source_data[5]
```

[64]:
```
crude_oil.set_index(crude_oil["year"],inplace=True)
```

[65]:
```
crude_oil.drop(columns=["year","change"],inplace=True)
```

[66]:
```
crude_oil.rename(columns={"production":"oil_production"},inplace=True)
```

[67]:
```
crude_oil.head()
```

[67]:
```
      oil_production
year
1980         59463.8
1981         55958.4
1982         53367.3
1983         53166.6
1984         54417.6
```

[68]:
```
oil_prcnt_chng=crude_oil.pct_change()
oil_prcnt_chng.head()
```

[68]:
```
      oil_production
year
1980             NaN
1981       -0.058950
1982       -0.046304
1983       -0.003761
1984        0.023530
```

[69]:
```
crude_oil.hvplot()
```

[69]:
```
:Curve   [year]   (oil_production)
```

Global_GDP Data

[70]:
```
world_gdp=pd.read_excel("C:
↪\\Users\\vinot\\Fintech\\Boot_Camp_Projects\\Project_01\\project_one\\World_GDP.
↪xlsx",index_col="year")
```

[71]:
```
world_gdp.head()
```

[71]:
```
         world_GDP
year
1980  2.787057e+13
1981  2.840614e+13
1982  2.852892e+13
1983  2.921735e+13
```

```
1984  3.053268e+13
```

[72]:
```
world_gdp.hvplot()
```

[72]:
```
:Curve   [year]   (world_GDP)
```

[73]:
```
world_gdp_pct=world_gdp.pct_change()
```

[74]:
```
world_gdp_pct.head()
```

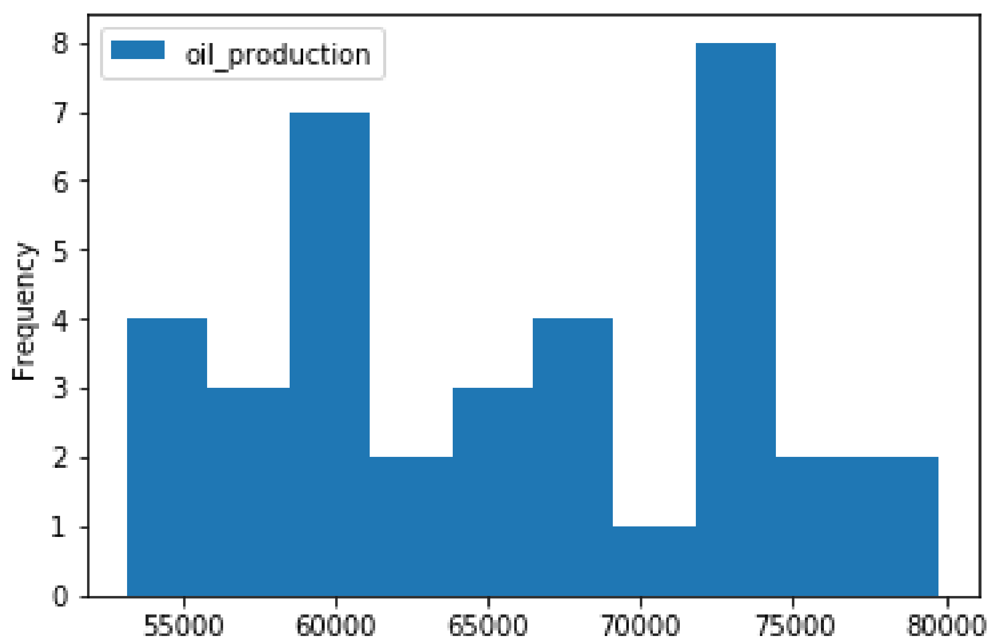
[74]:
```
      world_GDP
year
1980        NaN
1981   0.019217
1982   0.004322
1983   0.024131
1984   0.045019
```

[75]:
```
world_gdp_pct.hvplot()
```

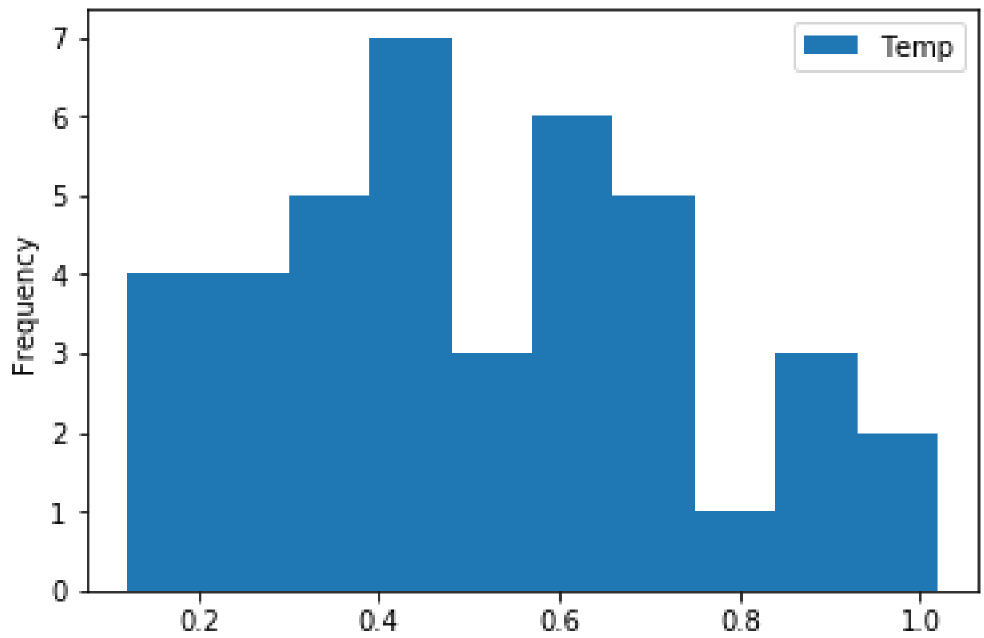
[75]:
```
:Curve   [year]   (world_GDP)
```

Crude Oil & Global Temperature Density plotting

[76]:
```
crude_oil.plot.hist(alpha=1);
```



[77]:
```
temp.plot.hist(alpha=1);
```



Rename the columns for the Arctic and Antarctic Ice level data

[78]:
```
arctic_sea_ice.head()
```

[78]:

Year	September	March
1980	3.034763	6.258716
1981	2.799241	6.061804
1982	2.876461	6.266438
1983	2.911210	6.247133
1984	2.745186	6.065665

[79]:
```
arctic_mar=arctic_sea_ice.drop(columns=["September"])
arctic_mar.head()
```

[79]:

Year	March
1980	6.258716
1981	6.061804
1982	6.266438
1983	6.247133
1984	6.065665

[80]:
```
arctic_mar.rename(columns={"March":"artic_mar"},inplace=True)
arctic_mar.head()
```

[80]:
```
      artic_mar
Year
1980   6.258716
1981   6.061804
1982   6.266438
1983   6.247133
1984   6.065665
```

[81]:
```
arctic_sep=arctic_sea_ice.drop(columns=["March"])
arctic_sep.head()
```

[81]:
```
      September
Year
1980   3.034763
1981   2.799241
1982   2.876461
1983   2.911210
1984   2.745186
```

[82]:
```
arctic_sep.rename(columns={"September":"artic_sep"},inplace=True)
arctic_sep.head()
```

[82]:
```
      artic_sep
Year
1980   3.034763
1981   2.799241
1982   2.876461
1983   2.911210
1984   2.745186
```

[83]:
```
antarctic_sea_ice.head()
```

[83]:
```
      February  September
Year
1980  1.100391   7.370690
1981  1.111974   7.305053
1982  1.208500   7.200805
1983  1.185334   7.285748
1984  1.057920   7.208527
```

[84]:
```
antarctic_feb=antarctic_sea_ice.drop(columns=["September"])
antarctic_feb.head()
```

[84]:
```
      February
Year
1980  1.100391
1981  1.111974
1982  1.208500
1983  1.185334
1984  1.057920
```

[85]:
```
antarctic_feb.rename(columns={"February":"antarctic_feb"},inplace=True)
antarctic_feb.head()
```

[85]:
```
      antarctic_feb
Year
1980       1.100391
1981       1.111974
1982       1.208500
1983       1.185334
1984       1.057920
```

[86]:
```
antarctic_sep=antarctic_sea_ice.drop(columns=["February"])
antarctic_sep.head()
```

[86]:
```
      September
Year
1980   7.370690
1981   7.305053
1982   7.200805
1983   7.285748
1984   7.208527
```

[87]:
```
antarctic_sep.rename(columns={"September":"antarctic_sep"},inplace=True)
antarctic_sep.head()
```

[87]:
```
      antarctic_sep
Year
1980       7.370690
1981       7.305053
1982       7.200805
1983       7.285748
1984       7.208527
```

Dataframe 1:Concatenate Crude oil and Global Temperature This combines World Temperature Data and World Oil Production data

[88]:
```
combined_df_1=pd.concat([temp,crude_oil],axis="columns",join="inner")
```

[89]:
```
combined_df_1.head()
```

[89]:
```
      Temp  oil_production
1980  0.26         59463.8
1981  0.32         55958.4
1982  0.14         53367.3
1983  0.31         53166.6
1984  0.16         54417.6
```

[90]:
```
combined_df_1.hvplot()
```

[90]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 2: Concatenate with Percentage change in Oil Production & Global Temperature This combines World Temperature Data and Percentage change World Oil Production

[91]:
```
pct_combined_df_2=pd.concat([temp,oil_prcnt_chng],axis="columns",join="inner")
pct_combined_df_2.head()
```

[91]:
```
      Temp  oil_production
1980  0.26             NaN
1981  0.32       -0.058950
1982  0.14       -0.046304
1983  0.31       -0.003761
1984  0.16        0.023530
```

[92]:
```
pct_combined_df_2.hvplot(figsize=(20,15))
```

[92]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 3:Concatenate with Percentage change in Oil Production & Percentage change in World GDP This combines Percentage change in World Oil Production and Percentage change in World GDP

[93]:
```
pct_combined_df_3=pd.
 ↪concat([oil_prcnt_chng,world_gdp_pct],axis="columns",join="inner")
pct_combined_df_3.head()
```

[93]:
```
      oil_production  world_GDP
year
1980             NaN        NaN
1981       -0.058950   0.019217
1982       -0.046304   0.004322
1983       -0.003761   0.024131
1984        0.023530   0.045019
```

[94]:
```
pct_combined_df_3.hvplot()
```

[94]:
```
:NdOverlay   [Variable]
   :Curve   [year]   (value)
```

Dataframe 4:Concatenate with Temperature and Arctic Ice level in March This combines World Temperature and Arctic Ice level in March

[95]:
```
temp_artic_march_df_4=pd.concat([temp,arctic_mar],axis="columns",join="inner")
temp_artic_march_df_4.head()
```

[95]:

	Temp	artic_mar
Year		
1980	0.26	6.258716
1981	0.32	6.061804
1982	0.14	6.266438
1983	0.31	6.247133
1984	0.16	6.065665

[96]:
```
temp_artic_march_df_4.hvplot()
```

[96]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

Dataframe 5:Concatenate with Temperature and Arctic Ice level in September This combines World Temperature and Arctic Ice level in September

[97]:
```
temp_artic_sep_5=pd.concat([temp,arctic_sep],axis="columns",join="inner")
temp_artic_sep_5.head()
```

[97]:

	Temp	artic_sep
Year		
1980	0.26	3.034763
1981	0.32	2.799241
1982	0.14	2.876461
1983	0.31	2.911210
1984	0.16	2.745186

[98]:
```
temp_artic_sep_5.hvplot()
```

[98]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

Dataframe 6:Concatenate with Temperature and Antarctic Ice level in February This combines World Temperature and Antarctic Ice level in February

[99]:
```
temp_antartic_feb_6=pd.concat([temp,antarctic_feb],axis="columns",join="inner")
temp_antartic_feb_6.head()
```

[99]:
```
      Temp  antarctic_feb
Year
1980  0.26       1.100391
1981  0.32       1.111974
1982  0.14       1.208500
1983  0.31       1.185334
1984  0.16       1.057920
```

[100]:
```
temp_antartic_feb_6.hvplot()
```

[100]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

Dataframe 7:Concatenate with Temperature and Antarctic Ice level in September This combines World Temperature and Antarctic Ice level in September

[101]:
```
temp_antartic_sep_7=pd.concat([temp,antarctic_sep],axis="columns",join="inner")
temp_antartic_sep_7.head()
```

[101]:
```
      Temp  antarctic_sep
Year
1980  0.26       7.370690
1981  0.32       7.305053
1982  0.14       7.200805
1983  0.31       7.285748
1984  0.16       7.208527
```

[102]:
```
temp_antartic_sep_7.hvplot()
```

[102]:
```
:NdOverlay   [Variable]
   :Curve   [Year]   (value)
```

Dataframe 8:Concatenate Temperature Data, oil__pct__change,World__GDP__pct__change & Sea Ice levels of Arctic and Antarctic This combines Temperature Data,World Oil Production percentage change,World GDP percentage change and Sea Ice Levels

[103]:
```
overall_combined_df_8=pd.
 ↪concat([temp,oil_prcnt_chng,world_gdp_pct,arctic_mar,arctic_sep,antarctic_feb,antarctic_sep
overall_combined_df_8.head()
```

[103]:
```
      Temp  oil_production  world_GDP  artic_mar  artic_sep  antarctic_feb  \
1980  0.26             NaN        NaN   6.258716   3.034763       1.100391
1981  0.32       -0.058950   0.019217   6.061804   2.799241       1.111974
1982  0.14       -0.046304   0.004322   6.266438   2.876461       1.208500
```

```
1983  0.31       -0.003761   0.024131   6.247133   2.911210       1.185334
1984  0.16        0.023530   0.045019   6.065665   2.745186       1.057920

      antarctic_sep
1980       7.370690
1981       7.305053
1982       7.200805
1983       7.285748
1984       7.208527
```

[104]:
```
overall_combined_df_8.hvplot()
```

[104]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 9:Concatenate with oil production and Arctic Ice level in March This combines World Oil production and Arctic Ice level in March

[105]:
```
oil_arctic_mar_9=pd.concat([crude_oil,arctic_mar],axis="columns",join="inner")
oil_arctic_mar_9.head()
```

[105]:
```
      oil_production  artic_mar
1980         59463.8   6.258716
1981         55958.4   6.061804
1982         53367.3   6.266438
1983         53166.6   6.247133
1984         54417.6   6.065665
```

[106]:
```
oil_arctic_mar_9.hvplot()
```

[106]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 10:Concatenate with oil production and Arctic Ice level in September This combines World Oil production and Arctic Ice level in September

[107]:
```
oil_arctic_sep_10=pd.concat([crude_oil,arctic_sep],axis="columns",join="inner")
oil_arctic_sep_10.head()
```

[107]:
```
      oil_production  artic_sep
1980         59463.8   3.034763
1981         55958.4   2.799241
1982         53367.3   2.876461
1983         53166.6   2.911210
1984         54417.6   2.745186
```

[108]:
```
oil_arctic_sep_10.hvplot()
```

[108]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 11:Concatenate with oil production and Antarctic Ice level in Feb This combines World Oil production and Antarctic Ice level in Feb

[109]:
```
oil_antarctic_feb_11=pd.
 ↪concat([crude_oil,antarctic_feb],axis="columns",join="inner")
oil_antarctic_feb_11.head()
```

[109]:

	oil_production	antarctic_feb
1980	59463.8	1.100391
1981	55958.4	1.111974
1982	53367.3	1.208500
1983	53166.6	1.185334
1984	54417.6	1.057920

[110]:
```
oil_antarctic_feb_11.hvplot()
```

[110]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

Dataframe 12:Concatenate with oil production and Antarctic Ice level in Sep This combines World Oil production and Antarctic Ice level in Sep

[111]:
```
oil_antarctic_sep_12=pd.
 ↪concat([crude_oil,antarctic_sep],axis="columns",join="inner")
oil_antarctic_sep_12.head()
```

[111]:

	oil_production	antarctic_sep
1980	59463.8	7.370690
1981	55958.4	7.305053
1982	53367.3	7.200805
1983	53166.6	7.285748
1984	54417.6	7.208527

[112]:
```
oil_antarctic_sep_12.hvplot()
```

[112]:
```
:NdOverlay   [Variable]
   :Curve   [index]   (value)
```

1.3 Correlation Calculations

Calculate Correlation between Temperature and Crude Oil Production

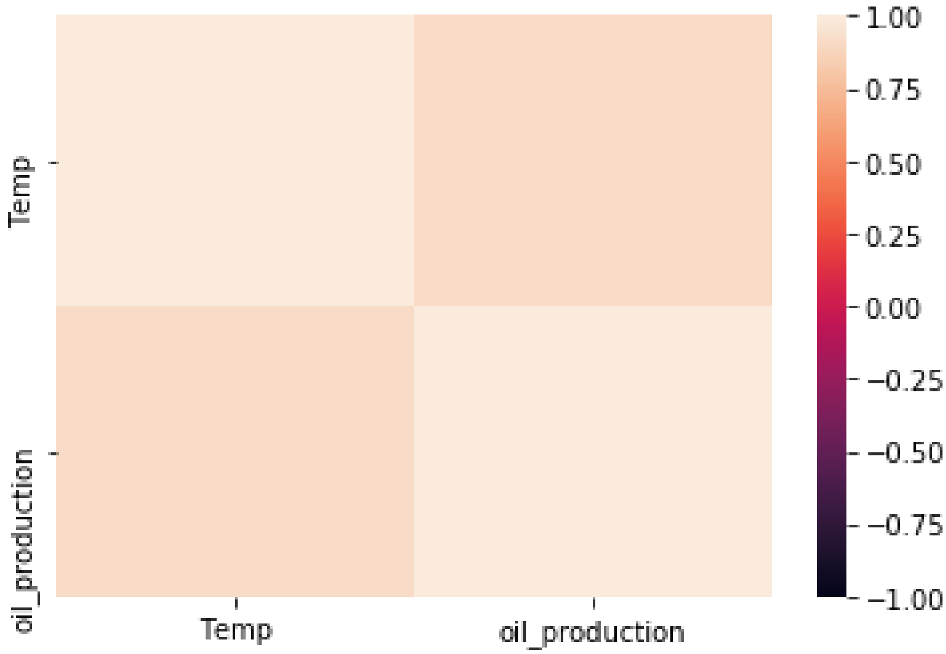
[113]:
```
oil_temp_correlation = combined_df_1.corr()
oil_temp_correlation
```

[113]:

	Temp	oil_production
Temp	1.000000	0.919934
oil_production	0.919934	1.000000

[114]:
```
sns.heatmap(oil_temp_correlation, vmin=-1, vmax=1)
```

[114]: <matplotlib.axes._subplots.AxesSubplot at 0x15c18eda408>



Calculate the Correlation between World Temperature and Percentage change in oil production

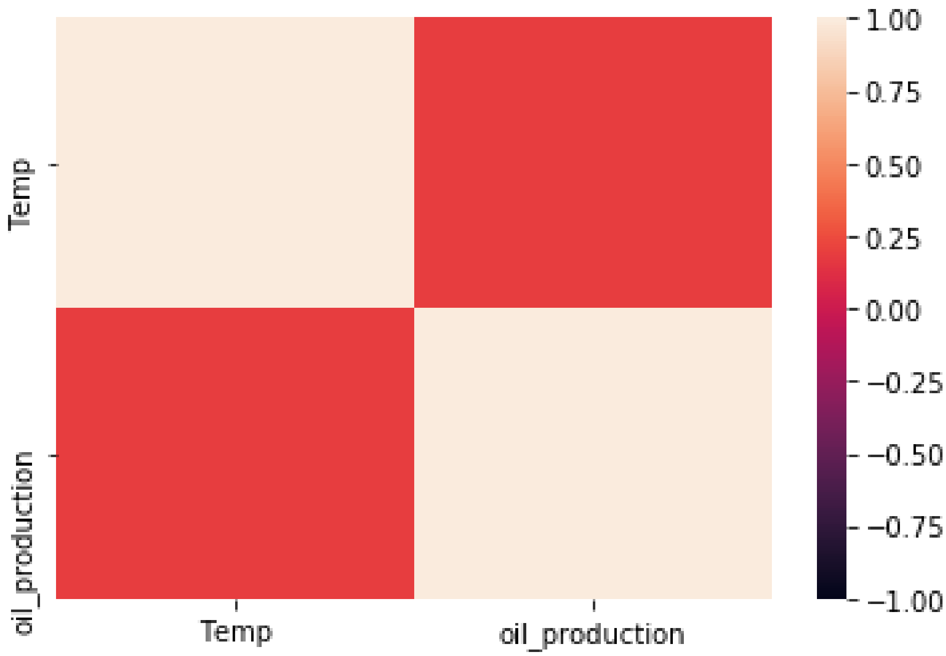
[115]:
```
pct_oil_temp_correlation = pct_combined_df_2.corr()
pct_oil_temp_correlation
```

[115]:

	Temp	oil_production
Temp	1.000000	0.190769
oil_production	0.190769	1.000000

[116]:
```
sns.heatmap(pct_oil_temp_correlation, vmin=-1, vmax=1)
```

[116]: <matplotlib.axes._subplots.AxesSubplot at 0x15c1ab59448>



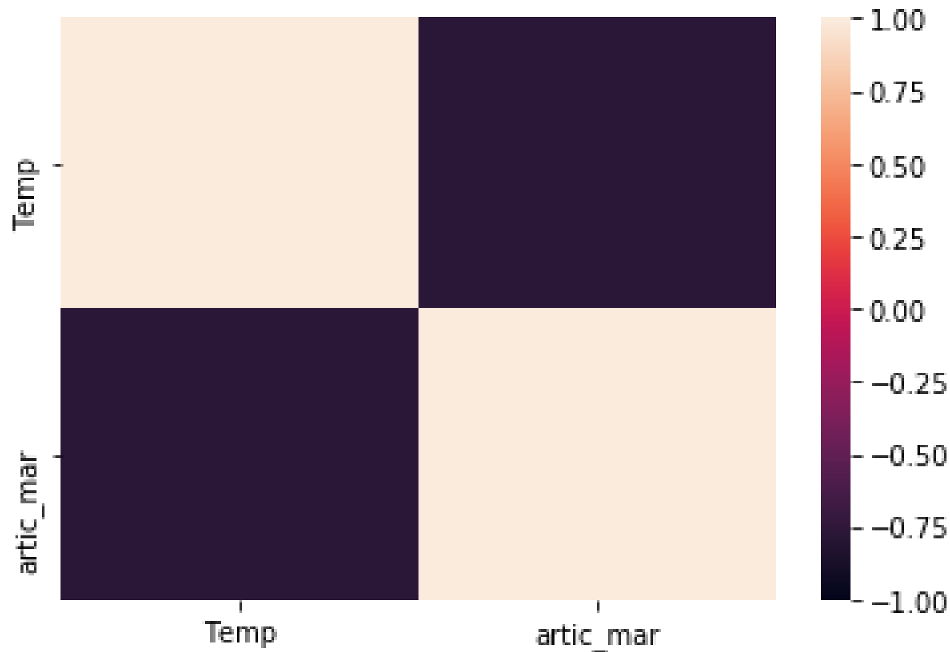
Calculate the Correlation between World Temperature and Arctic ice Sheet of March

[117]:
```
wrld_arctic_ice_mar_correlation = temp_artic_march_df_4.corr()
wrld_arctic_ice_mar_correlation
```

[117]:
```
                Temp  artic_mar
Temp        1.000000  -0.778812
artic_mar  -0.778812   1.000000
```

[118]:
```
sns.heatmap(wrld_arctic_ice_mar_correlation, vmin=-1, vmax=1)
```

[118]: <matplotlib.axes._subplots.AxesSubplot at 0x15c1970e0c8>



Calculate the Correlation between World Temperature and Arctic ice Sheet of September

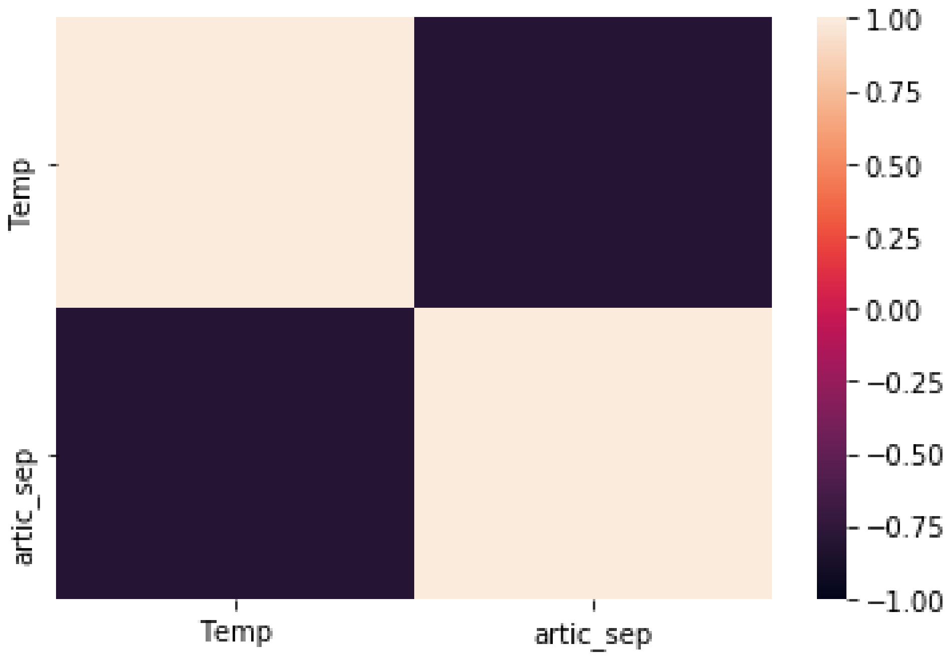
[119]:
```
wrld_arctic_ice_sep_correlation = temp_artic_sep_5.corr()
wrld_arctic_ice_sep_correlation
```

[119]:

	Temp	artic_sep
Temp	1.00000	-0.80378
artic_sep	-0.80378	1.00000

[120]:
```
sns.heatmap(wrld_arctic_ice_sep_correlation, vmin=-1, vmax=1)
```

[120]: <matplotlib.axes._subplots.AxesSubplot at 0x15c18fedbc8>



Calculate the Correlation between World Temperature and Antarctic ice Sheet of Feb

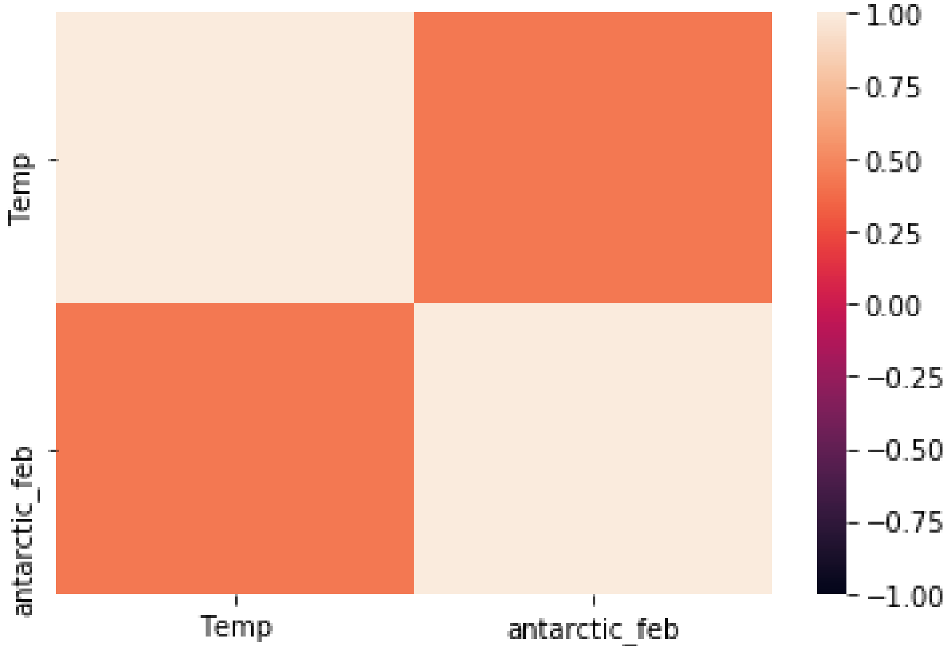
[121]:
```
wrld_antarctic_ice_feb_correlation = temp_antartic_feb_6.corr()
wrld_antarctic_ice_feb_correlation
```

[121]:

	Temp	antarctic_feb
Temp	1.000000	0.436462
antarctic_feb	0.436462	1.000000

[122]:
```
sns.heatmap(wrld_antarctic_ice_feb_correlation, vmin=-1, vmax=1)
```

[122]: <matplotlib.axes._subplots.AxesSubplot at 0x15c3768b608>



Calculate the Correlation between World Temperature and Antarctic ice Sheet of Sep

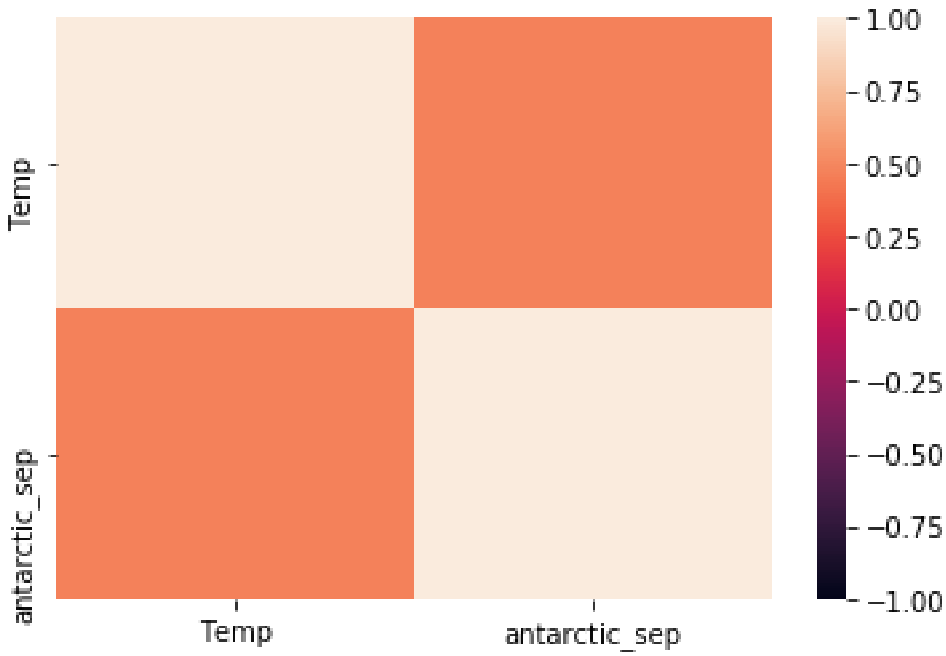
[123]:
```
wrld_antarctic_ice_sep_correlation = temp_antartic_sep_7.corr()
wrld_antarctic_ice_sep_correlation
```

[123]:

	Temp	antarctic_sep
Temp	1.000000	0.472121
antarctic_sep	0.472121	1.000000

[124]:
```
sns.heatmap(wrld_antarctic_ice_sep_correlation, vmin=-1, vmax=1)
```

[124]: <matplotlib.axes._subplots.AxesSubplot at 0x15c27ba9288>



Calculate Correlation between Percentage change in oil production and World GDP.

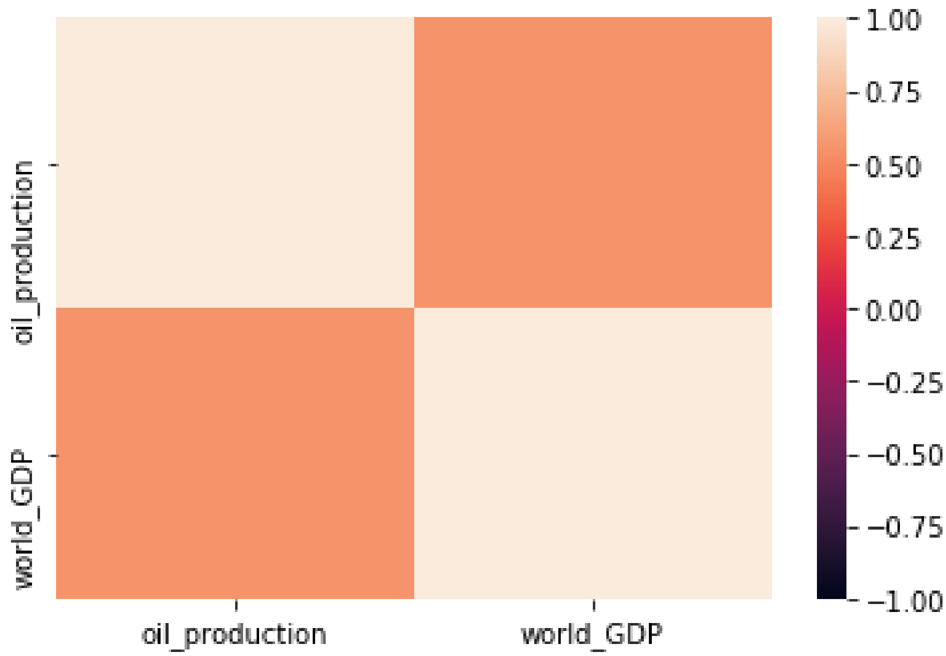
[125]:
```
pct_oil_gdp_correlation = pct_combined_df_3.corr()
pct_oil_gdp_correlation
```

[125]:

	oil_production	world_GDP
oil_production	1.000000	0.557318
world_GDP	0.557318	1.000000

[126]:
```
sns.heatmap(pct_oil_gdp_correlation, vmin=-1, vmax=1)
```

[126]: <matplotlib.axes._subplots.AxesSubplot at 0x15c1a7b8f48>



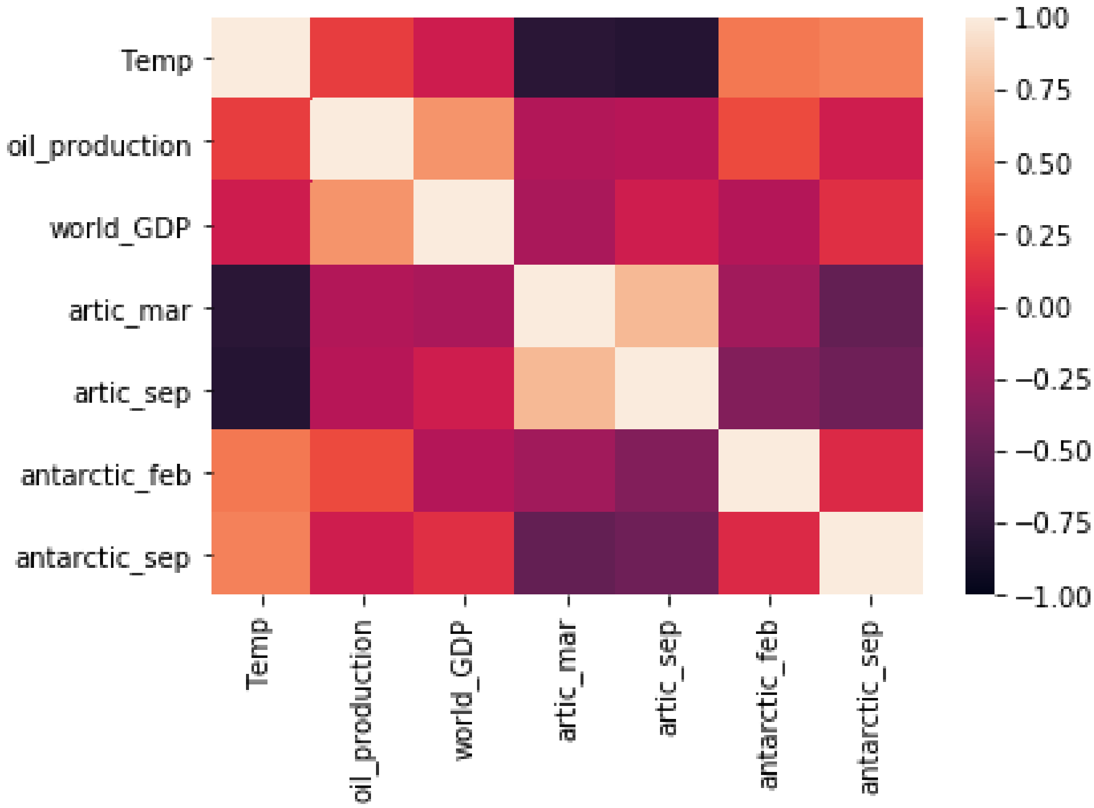
Calculate Correlation between all data sets Temperature,oil Percentage change, World GDP change and Ice Sheets

[127]:
```
overall_correlation = overall_combined_df_8.corr()
overall_correlation
```

[127]:
```
                    Temp  oil_production  world_GDP  artic_mar  artic_sep  \
Temp            1.000000        0.190769   0.012613  -0.778812  -0.803780
oil_production  0.190769        1.000000   0.557318  -0.122032  -0.100705
world_GDP       0.012613        0.557318   1.000000  -0.156737   0.020292
artic_mar      -0.778812       -0.122032  -0.156737   1.000000   0.740986
artic_sep      -0.803780       -0.100705   0.020292   0.740986   1.000000
antarctic_feb   0.436462        0.242743  -0.112935  -0.200698  -0.341239
antarctic_sep   0.472121        0.018551   0.130839  -0.487288  -0.434131

                antarctic_feb  antarctic_sep
Temp                 0.436462       0.472121
oil_production       0.242743       0.018551
world_GDP           -0.112935       0.130839
artic_mar           -0.200698      -0.487288
artic_sep           -0.341239      -0.434131
antarctic_feb        1.000000       0.101289
antarctic_sep        0.101289       1.000000
```

[128]:
```
sns.heatmap(overall_correlation, vmin=-1, vmax=1)
```

[128]: <matplotlib.axes._subplots.AxesSubplot at 0x15c1fc170c8>



Calculate Correlation between oil production and Arctic March Ice Sheet levels

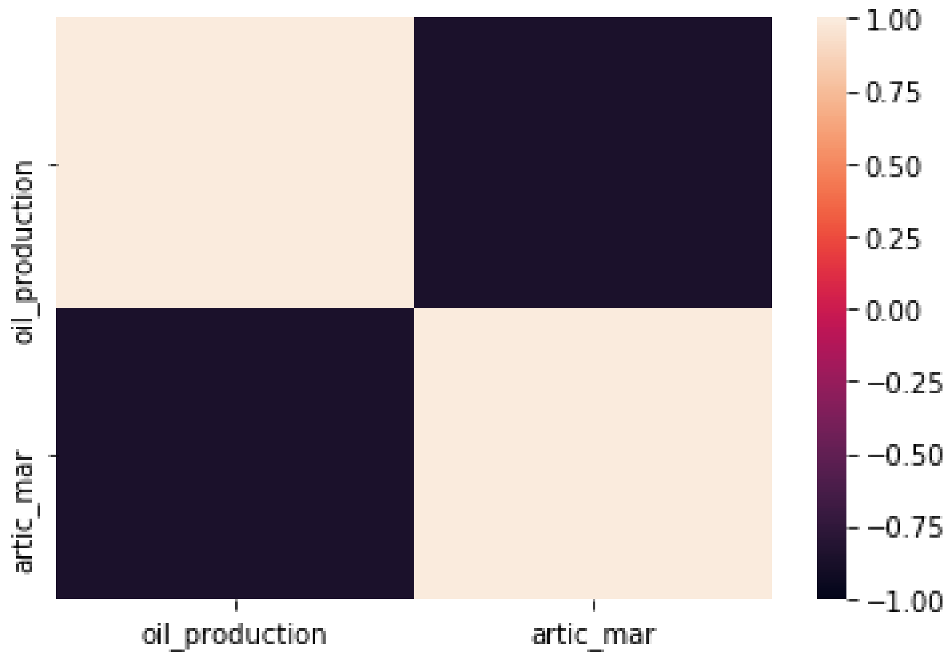
[129]:
```
oil_arctic_mar_correlation = oil_arctic_mar_9.corr()
oil_arctic_mar_correlation
```

[129]:

	oil_production	artic_mar
oil_production	1.000000	-0.856603
artic_mar	-0.856603	1.000000

[130]:
```
sns.heatmap(oil_arctic_mar_correlation, vmin=-1, vmax=1)
```

[130]: <matplotlib.axes._subplots.AxesSubplot at 0x15c19735408>



Calculate Correlation between oil production and Arctic September Ice Sheet levels

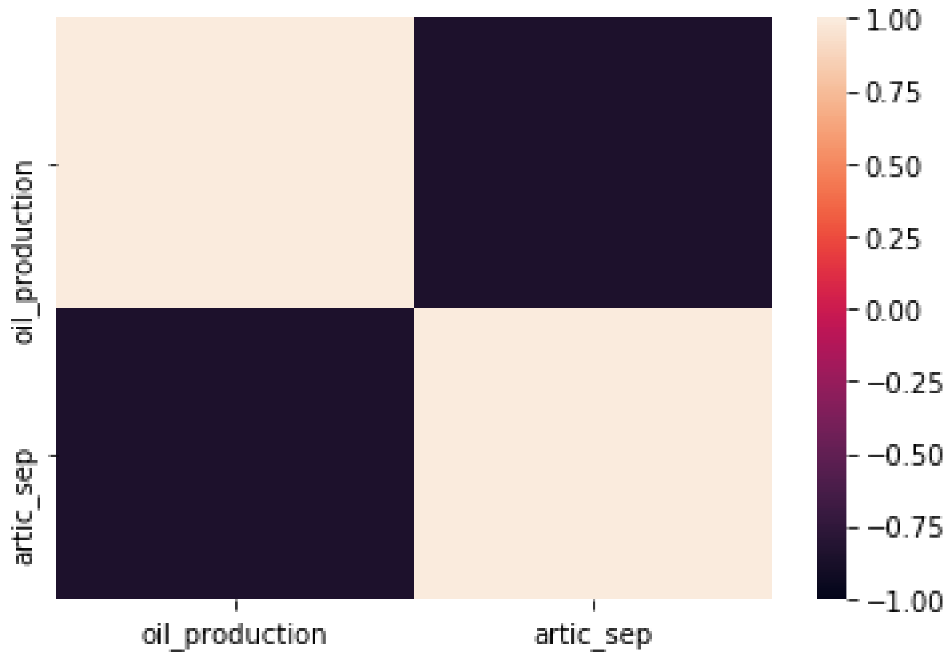
[131]:
```
oil_arctic_sep_correlation = oil_arctic_sep_10.corr()
oil_arctic_sep_correlation
```

[131]:

	oil_production	artic_sep
oil_production	1.000000	-0.848173
artic_sep	-0.848173	1.000000

[132]:
```
sns.heatmap(oil_arctic_sep_correlation, vmin=-1, vmax=1)
```

[132]: <matplotlib.axes._subplots.AxesSubplot at 0x15c28cf0cc8>



Calculate Correlation between oil production and Antarctic Feb Ice Sheet levels

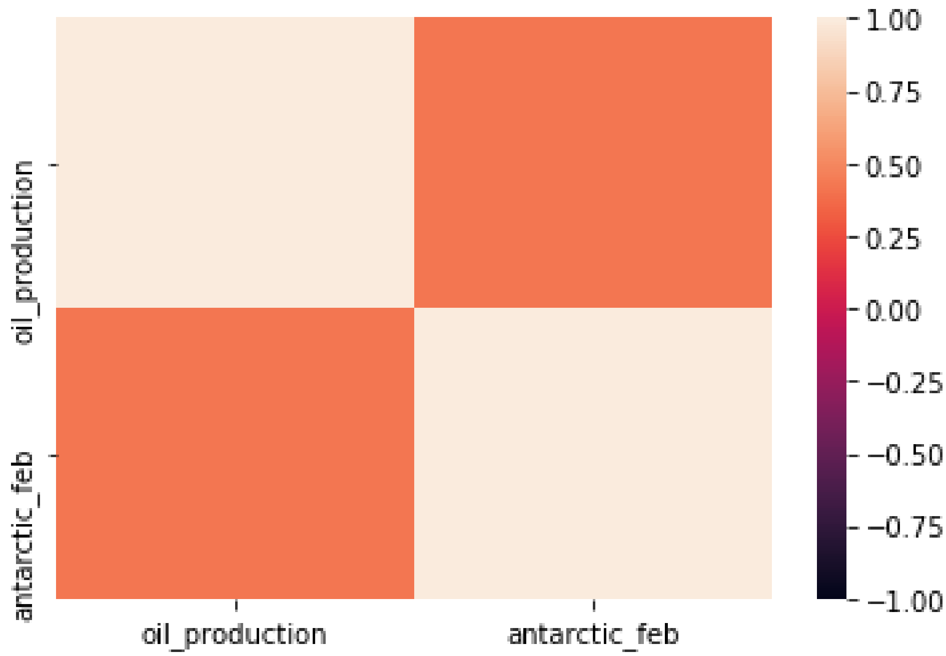
[133]:
```
oil_antarctic_feb_correlation = oil_antarctic_feb_11.corr()
oil_antarctic_feb_correlation
```

[133]:

	oil_production	antarctic_feb
oil_production	1.000000	0.428639
antarctic_feb	0.428639	1.000000

[134]:
```
sns.heatmap(oil_antarctic_feb_correlation, vmin=-1, vmax=1)
```

[134]: <matplotlib.axes._subplots.AxesSubplot at 0x15c28dbec08>



Calculate Correlation between oil production and Antarctic Sep Ice Sheet levels

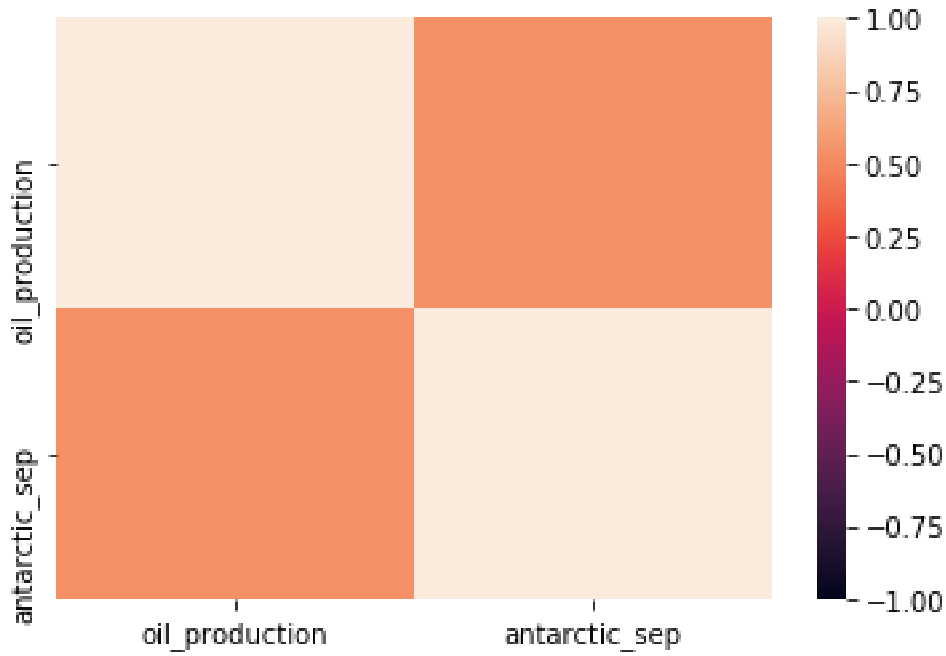
[135]:
```
oil_antarctic_sep_correlation = oil_antarctic_sep_12.corr()
oil_antarctic_sep_correlation
```

[135]:

	oil_production	antarctic_sep
oil_production	1.000000	0.544617
antarctic_sep	0.544617	1.000000

[136]:
```
sns.heatmap(oil_antarctic_sep_correlation, vmin=-1, vmax=1)
```

[136]: <matplotlib.axes._subplots.AxesSubplot at 0x15c28e4aac8>



1.3.1 Dataframe Plotting using Altair

Plot diagram for combined data frame_1,which contains Temperature and oil production data

[137]:
```
alt.Chart(combined_df_1).mark_area(filled=True).encode(
alt.X('oil_production'),
    alt.Y('Temp'),
    alt.Size('Temp'),
    alt.Color('Temp'),
    alt.OpacityValue(1.0),
    tooltip=[alt.Tooltip('oil_production:Q'),
            alt.Tooltip('Temp:Q')]
).interactive()
```

[137]:
```
alt.Chart(…)
```

1.4 Random Number Validation & Monte Carlo simulation for Temperature

Calculating Mean and Std for the simulation

[138]:
```
temp_mean=temp.mean()
temp_mean
```

[138]:
```
Temp    0.5085
dtype: float64
```

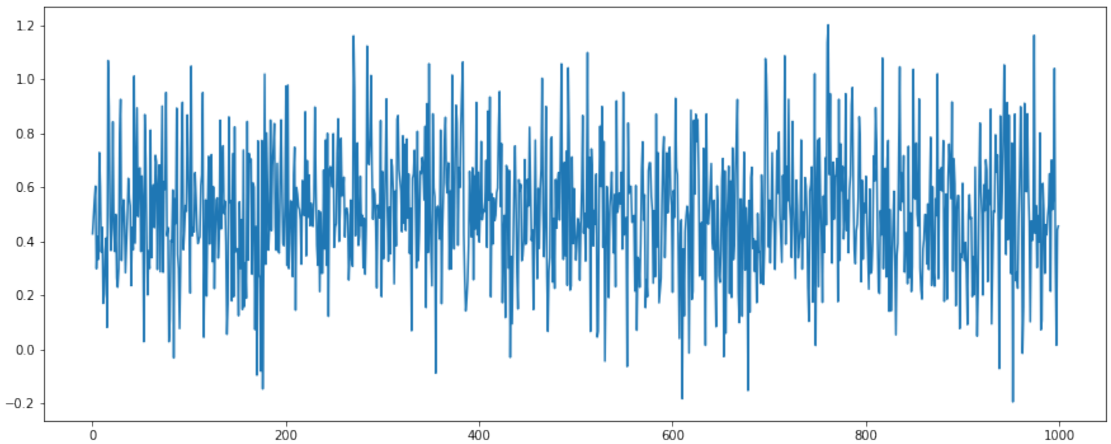
[139]:
```
temp_std=temp.std()
temp_std
```

[139]:
```
Temp    0.240422
dtype: float64
```

Possible Temperature forcast for 1000 Iterations

[140]:
```
iterations=1000
rev=np.random.normal(temp_mean,temp_std,iterations)
```

[141]:
```
plt.figure(figsize=(15,6))
plt.plot(rev)
plt.show()
```

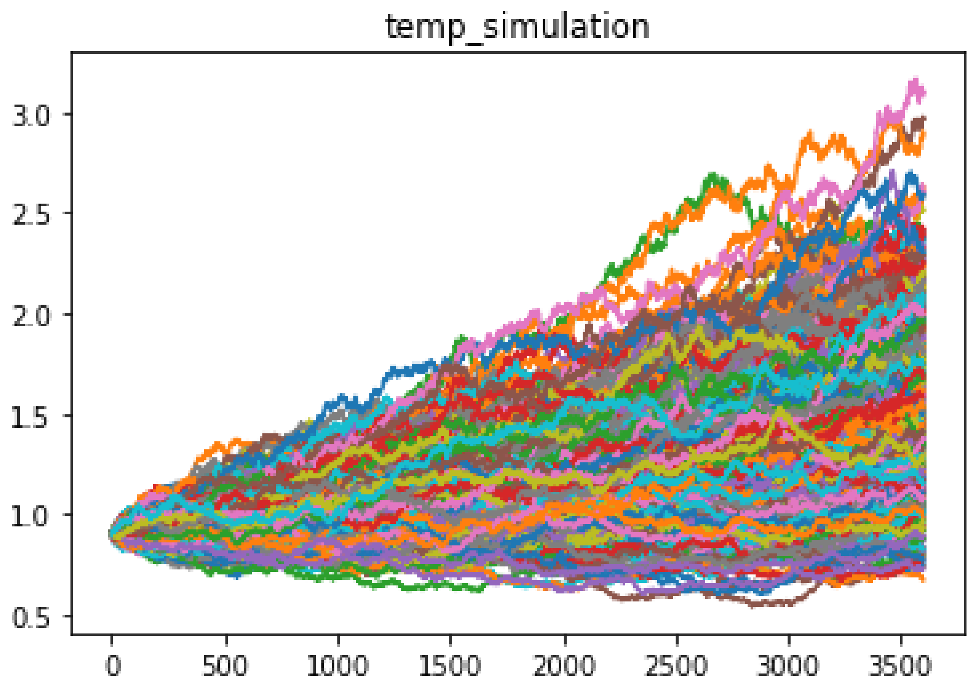


Monte Carlo Simulation

- S=Last Recorded Temperature
- T=Number of Iterations
- mu=Temperature Mean
- vol=Temperature Standard Deviation

[142]:
```
S = 0.90
T = 3600
mu = temp_mean
vol = temp_std

result = []
for i in range(1000):
    changes = np.random.normal(mu/T,vol/math.sqrt(T),T)+1

    check_list = [S]
```

```
    for x in changes:
        check_list.append(check_list[-1]*x)
    result.append(check_list[-1])

    plt.plot(check_list)
plt.title('temp_simulation')
plt.show()
```




```
[ ]:
```