Created by: Team Extra Mile

Team Member

- Animesh Parikshya
- Dr. Anshika Sharma
- Tanisha Jain
- Arpit Dhawan

Task - Prediction of Market Share of ChemX Pharma in current Pandamic

Given Problem Statement - 1a)

- A. What will be the market Share of Chem-X and the top 10 companies in 2021?

Note:

- i. The top 10 companies will individually lose 2.2% of its revenue generated in 2020. The half (50%) of the lost revenue will go to ‘Chem-X’ and the rest to the others.
- ii. The revenue generated by a company is proportional to its market share.

Solution

Step 1 : Importing required libraries

In [1]:

```
import os
import pandas as pd
import numpy as np
from pylab import rcParams
import warnings
import itertools
import matplotlib.pyplot as plt
warnings.filterwarnings("ignore")
plt.style.use('fivethirtyeight')
import statsmodels.api as sm
import matplotlib
matplotlib.rcParams['axes.labelsize'] = 14
matplotlib.rcParams['xtick.labelsize'] = 12
matplotlib.rcParams['ytick.labelsize'] = 12
matplotlib.rcParams['text.color'] = 'k'
```

Step 2 : Reading the dataset into a Pandas Dataframe

In [2]:

```
data_dir='C:/Users/Animesh.Parikshya/Documents/IIM Classes/Data sets'
os.chdir(data_dir)
```

In [3]:

```
#Reading the data
dat=pd.read_csv("Market_Share.csv")
dat
```

Out[3]:

	Pharma Companies	Market Share (In 2020) (In percentage)	Revenue Generated 2 (Billion INR)
0	Sun Pharmaceutical Industries Limited	6.84	273.28
1	Dr. Reddy's Laboratories	5.50	219.74
2	Glenmark Pharma Limited	4.43	176.99
3	Cadila Healthcare Limited	4.88	194.97
4	Lupin Limited	6.10	243.71
5	Mankind Pharma Limited	3.93	157.02
6	Intas Pharmaceuticals Limited	4.67	186.58
7	Cipla Limited	5.95	237.72
8	Aurobindo Pharma Limited	6.45	257.70
9	Torrent Pharmaceuticals Limited	4.25	169.80
10	Others	45.00	1877.80
11	Chem-x	2.00	79.90

In [4]:

```
#Renaming column name for easement
dat=dat.rename(columns={'Pharma Companies':'PC','Market Share (In 2020) (In percentage)':'M
```

In [5]:

```
dat
```

Out[5]:

	PC	MS_2020	Rev_2020
0	Sun Pharmaceutical Industries Limited	6.84	273.28
1	Dr. Reddy's Laboratories	5.50	219.74
2	Glenmark Pharma Limited	4.43	176.99
3	Cadila Healthcare Limited	4.88	194.97
4	Lupin Limited	6.10	243.71
5	Mankind Pharma Limited	3.93	157.02
6	Intas Pharmaceuticals Limited	4.67	186.58
7	Cipla Limited	5.95	237.72
8	Aurobindo Pharma Limited	6.45	257.70
9	Torrent Pharmaceuticals Limited	4.25	169.80
10	Others	45.00	1877.80
11	Chem-x	2.00	79.90

In [6]:

```
# making a copy only for top 10 company
dat_Top10 = dat[0:10].copy()
dat_Top10
```

Out[6]:

	PC	MS_2020	Rev_2020
0	Sun Pharmaceutical Industries Limited	6.84	273.28
1	Dr. Reddy's Laboratories	5.50	219.74
2	Glenmark Pharma Limited	4.43	176.99
3	Cadila Healthcare Limited	4.88	194.97
4	Lupin Limited	6.10	243.71
5	Mankind Pharma Limited	3.93	157.02
6	Intas Pharmaceuticals Limited	4.67	186.58
7	Cipla Limited	5.95	237.72
8	Aurobindo Pharma Limited	6.45	257.70
9	Torrent Pharmaceuticals Limited	4.25	169.80

Step 3 : Exploratory Data Analysis

Shape of data

In [7]:

```
dat_Top10.shape
```

Out[7]:

```
(10, 3)
```

Checking datatype of each column

In [8]:

```
dat_Top10.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   PC        10 non-null     object 
 1   MS_2020   10 non-null     float64
 2   Rev_2020  10 non-null     float64
dtypes: float64(2), object(1)
memory usage: 368.0+ bytes
```

Null Values in data

In [9]:

```
dat_Top10.isnull().sum()
```

Out[9]:

```
PC          0
MS_2020     0
Rev_2020    0
dtype: int64
```

Step 4: Solutions

In [10]:

```
# adding a new column with the revenue loss of 2.2%
dat_Top10["RevLoss"] = dat_Top10.Rev_2020 * 0.022
dat_Top10
```

Out[10]:

	PC	MS_2020	Rev_2020	RevLoss
0	Sun Pharmaceutical Industries Limited	6.84	273.28	6.01216
1	Dr. Reddy's Laboratories	5.50	219.74	4.83428
2	Glenmark Pharma Limited	4.43	176.99	3.89378
3	Cadila Healthcare Limited	4.88	194.97	4.28934
4	Lupin Limited	6.10	243.71	5.36162
5	Mankind Pharma Limited	3.93	157.02	3.45444
6	Intas Pharmaceuticals Limited	4.67	186.58	4.10476
7	Cipla Limited	5.95	237.72	5.22984
8	Aurobindo Pharma Limited	6.45	257.70	5.66940
9	Torrent Pharmaceuticals Limited	4.25	169.80	3.73560

In [11]:

```
# adding a new column with new revenue
dat_Top10["Rev_New"] = dat_Top10.Rev_2020 - dat_Top10.RevLoss
dat_Top10
```

Out[11]:

	PC	MS_2020	Rev_2020	RevLoss	Rev_New
0	Sun Pharmaceutical Industries Limited	6.84	273.28	6.01216	267.26784
1	Dr. Reddy's Laboratories	5.50	219.74	4.83428	214.90572
2	Glenmark Pharma Limited	4.43	176.99	3.89378	173.09622
3	Cadila Healthcare Limited	4.88	194.97	4.28934	190.68066
4	Lupin Limited	6.10	243.71	5.36162	238.34838
5	Mankind Pharma Limited	3.93	157.02	3.45444	153.56556
6	Intas Pharmaceuticals Limited	4.67	186.58	4.10476	182.47524
7	Cipla Limited	5.95	237.72	5.22984	232.49016
8	Aurobindo Pharma Limited	6.45	257.70	5.66940	252.03060
9	Torrent Pharmaceuticals Limited	4.25	169.80	3.73560	166.06440

In [12]:

```
# Checking total Revenue loss from top 10 Company
lostRev = round(dat_Top10.RevLoss.sum(),2)
lostRev
```

Out[12]:

46.59

In [13]:

```
# Making a new copy to add ChemX and others company
dat_New = dat_Top10.copy()
# Adding others company
df2 = {'PC': 'others', 'MS_2020': dat.iloc[10]['MS_2020'], 'Rev_2020': dat.iloc[10]['Rev_20
dat_New = dat_New.append(df2 , ignore_index=True)
# adding ChemX
df3 = {'PC': 'Chem-x', 'MS_2020': dat.iloc[11]['MS_2020'], 'Rev_2020': dat.iloc[11]['Rev_20
dat_New = dat_New.append(df3 , ignore_index=True)
```

In [14]:

```
# Adding new column with new Market Share
dat_New['MS_New'] = (dat_New.Rev_New/dat_New.Rev_New.sum()) * 100
dat_New
```

Out[14]:

	PC	MS_2020	Rev_2020	RevLoss	Rev_New	MS_New
0	Sun Pharmaceutical Industries Limited	6.84	273.28	6.01216	267.26784	6.558374
1	Dr. Reddy's Laboratories	5.50	219.74	4.83428	214.90572	5.273482
2	Glenmark Pharma Limited	4.43	176.99	3.89378	173.09622	4.247536
3	Cadila Healthcare Limited	4.88	194.97	4.28934	190.68066	4.679033
4	Lupin Limited	6.10	243.71	5.36162	238.34838	5.848732
5	Mankind Pharma Limited	3.93	157.02	3.45444	153.56556	3.768281
6	Intas Pharmaceuticals Limited	4.67	186.58	4.10476	182.47524	4.477684
7	Cipla Limited	5.95	237.72	5.22984	232.49016	5.704979
8	Aurobindo Pharma Limited	6.45	257.70	5.66940	252.03060	6.184474
9	Torrent Pharmaceuticals Limited	4.25	169.80	3.73560	166.06440	4.074985
10	others	45.00	1877.80	0.00000	1901.09500	46.650179
11	Chem-x	2.00	79.90	0.00000	103.19500	2.532259

In [15]:

```
#Dropping the row with "Others" companies data as question asked only for Market share of C
dat_MS_ChemX_andTop10 = dat_New.drop(10)
```

In [16]:

```
dat_MS_ChemX_andTop10.columns
```

Out[16]:

```
Index(['PC', 'MS_2020', 'Rev_2020', 'RevLoss', 'Rev_New', 'MS_New'], dtype
='object')
```

In [17]:

```
dat_MS_ChemX_andTop10 = dat_MS_ChemX_andTop10.drop(['MS_2020', 'Rev_2020', 'RevLoss', 'Rev_
```

1A) Solution: - Market Share of Chem-X and the top 10 companies in 2021

In [18]:

```
dat_MS_ChemX_andTop10
```

Out[18]:

	PC	MS_New
0	Sun Pharmaceutical Industries Limited	6.558374
1	Dr. Reddy's Laboratories	5.273482
2	Glenmark Pharma Limited	4.247536
3	Cadila Healthcare Limited	4.679033
4	Lupin Limited	5.848732
5	Mankind Pharma Limited	3.768281
6	Intas Pharmaceuticals Limited	4.477684
7	Cipla Limited	5.704979
8	Aurobindo Pharma Limited	6.184474
9	Torrent Pharmaceuticals Limited	4.074985
11	Chem-x	2.532259

Given Problem Statement - 1b)

- B. Also calculate the revenue generated by Chem-X in 2021 if the overall revenue generation for individual companies is increased by 5% of that in 2020.

In [19]:

```
overall_Rev_2020 = dat.Rev_2020.sum()
overall_Rev_2020
```

Out[19]:

```
4075.2100000000005
```

In [20]:

```
#Overall Revenue with 5% increase in 2021
overall_Rev_2021 = overall_Rev_2020 + (0.05*overall_Rev_2020)
overall_Rev_2021
```

Out[20]:

```
4278.9705
```

Chem-X revenue in 2021, assuming that the market share have not changed

In [21]:

```
ChemX_rev_2021 = round((dat.iloc[11]['MS_2020']/100) *4278.9705,2)
ChemX_rev_2021
```

Out[21]:

```
85.58
```

Chem-X revenue in 2021, assuming that the market share have changed as per question 1A above.

In [22]:

```
ChemX_rev_2021 = round((dat_MS_ChemX_andTop10.iloc[10]['MS_New']/100) *4278.9705,2)
ChemX_rev_2021
```

Out[22]:

```
108.35
```

Given Problem Statement - 2)

- There was another competitor (Medical MoJo) which was established in 2010 and had the same profile and outlook as Chem-X.
- How much revenue ChemX will be able to generate in 2031, considering ChemX grows at an average growth rate (across 10 years) as Medical MoJo.

Note:

- 1. The revenue for ChemX for 2021 to be leveraged from Question-1.1.
- 2. We expect a higher uptake (about 1.5) in the average growth from 2026, (not for subsequent years).
- 3. Another major competitor launch is planned for 2029 which leads to an expected slowdown in growth for ChemX and revenue is expected to become stagnant from 2028 onwards.

In [23]:

```
growth_rate=pd.read_csv("Growth_Rate_Medical_Mojo.csv")
growth_rate
```

Out[23]:

	Year	Growth Rate
0	2011	12.32
1	2012	10.44
2	2013	17.56
3	2014	14.36
4	2015	8.01
5	2016	19.60
6	2017	-9.43
7	2018	4.28
8	2019	8.12
9	2020	2.30

As Medical Mojo and Chem- X have same profile and outlook , we can consider the growth rate as same.

In [24]:

```
growth_rate_ChemX = growth_rate.copy()
```

Adding growth rate of 2021 from Q1A above as suggested in the question

In [25]:

```
# Getting all the data from earlier data frame
dat_New
```

Out[25]:

	PC	MS_2020	Rev_2020	RevLoss	Rev_New	MS_New
0	Sun Pharmaceutical Industries Limited	6.84	273.28	6.01216	267.26784	6.558374
1	Dr. Reddy's Laboratories	5.50	219.74	4.83428	214.90572	5.273482
2	Glenmark Pharma Limited	4.43	176.99	3.89378	173.09622	4.247536
3	Cadila Healthcare Limited	4.88	194.97	4.28934	190.68066	4.679033
4	Lupin Limited	6.10	243.71	5.36162	238.34838	5.848732
5	Mankind Pharma Limited	3.93	157.02	3.45444	153.56556	3.768281
6	Intas Pharmaceuticals Limited	4.67	186.58	4.10476	182.47524	4.477684
7	Cipla Limited	5.95	237.72	5.22984	232.49016	5.704979
8	Aurobindo Pharma Limited	6.45	257.70	5.66940	252.03060	6.184474
9	Torrent Pharmaceuticals Limited	4.25	169.80	3.73560	166.06440	4.074985
10	others	45.00	1877.80	0.00000	1901.09500	46.650179
11	Chem-x	2.00	79.90	0.00000	103.19500	2.532259

In [26]:

```
# Getting Revenue of 2020
dat_New.iloc[11]['Rev_2020']
```

Out[26]:

```
79.9
```

In [27]:

```
# Getting Revenue of 2020
dat_New.iloc[11]['Rev_New']
```

Out[27]:

```
103.19500000000001
```

In [28]:

```
growth_2021 = round(((dat_New.iloc[11]['Rev_New'] - dat_New.iloc[11]['Rev_2020'])/ dat_New.
growth_2021
```

Out[28]:

```
29.16
```

In [29]:

```
df_Growth2021 = {'Year': 2021, 'Growth Rate': growth_2021  }
growth_rate_ChemX = growth_rate_ChemX.append(df_Growth2021 , ignore_index=True)
growth_rate_ChemX
```

Out[29]:

	Year	Growth Rate
0	2011.0	12.32
1	2012.0	10.44
2	2013.0	17.56
3	2014.0	14.36
4	2015.0	8.01
5	2016.0	19.60
6	2017.0	-9.43
7	2018.0	4.28
8	2019.0	8.12
9	2020.0	2.30
10	2021.0	29.16

In [30]:

```
growth_rate_ChemX.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11 entries, 0 to 10
Data columns (total 2 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Year         11 non-null     float64
 1   Growth Rate  11 non-null     float64
dtypes: float64(2)
memory usage: 304.0 bytes
```

In [31]:

```
growth_rate_ChemX_original = growth_rate_ChemX.copy()
```

In [32]:

```
growth_rate_ChemX.Year = growth_rate_ChemX.Year.astype(int)
growth_rate_ChemX.Year = growth_rate_ChemX.Year.astype(str)
growth_rate_ChemX
```

Out[32]:

	Year	Growth Rate
0	2011	12.32
1	2012	10.44
2	2013	17.56
3	2014	14.36
4	2015	8.01
5	2016	19.60
6	2017	-9.43
7	2018	4.28
8	2019	8.12
9	2020	2.30
10	2021	29.16

In [33]:

```
growth_rate_ChemX['DateTime'] = '31-Dec-' + growth_rate_ChemX.Year
```

In [34]:

```
growth_rate_ChemX
```

Out[34]:

	Year	Growth Rate	DateTime
0	2011	12.32	31-Dec-2011
1	2012	10.44	31-Dec-2012
2	2013	17.56	31-Dec-2013
3	2014	14.36	31-Dec-2014
4	2015	8.01	31-Dec-2015
5	2016	19.60	31-Dec-2016
6	2017	-9.43	31-Dec-2017
7	2018	4.28	31-Dec-2018
8	2019	8.12	31-Dec-2019
9	2020	2.30	31-Dec-2020
10	2021	29.16	31-Dec-2021

In [35]:

```
growth_rate_ChemX.DateTime = pd.to_datetime(growth_rate_ChemX.DateTime)
growth_rate_ChemX.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11 entries, 0 to 10
Data columns (total 3 columns):
 #   Column       Non-Null Count  Dtype         
---  ------       --------------  -----         
 0   Year         11 non-null     object        
 1   Growth Rate  11 non-null     float64       
 2   DateTime     11 non-null     datetime64[ns]
dtypes: datetime64[ns](1), float64(1), object(1)
memory usage: 392.0+ bytes
```

In [36]:

```
growth_rate_ChemX_TS = growth_rate_ChemX
```

In [37]:

```
growth_rate_ChemX_TS = growth_rate_ChemX_TS.drop(['Year'], axis=1)
```

In [38]:

```
growth_rate_ChemX_TS = growth_rate_ChemX_TS[['DateTime', 'Growth Rate']]
growth_rate_ChemX_TS
```

Out[38]:

	DateTime	Growth Rate
0	2011-12-31	12.32
1	2012-12-31	10.44
2	2013-12-31	17.56
3	2014-12-31	14.36
4	2015-12-31	8.01
5	2016-12-31	19.60
6	2017-12-31	-9.43
7	2018-12-31	4.28
8	2019-12-31	8.12
9	2020-12-31	2.30
10	2021-12-31	29.16

In [39]:

```
#growth_rate_ChemX_TS = growth_rate_ChemX_TS.set_index('DateTime')
```

In [40]:

```
growth_rate_ChemX_TS
```

Out[40]:

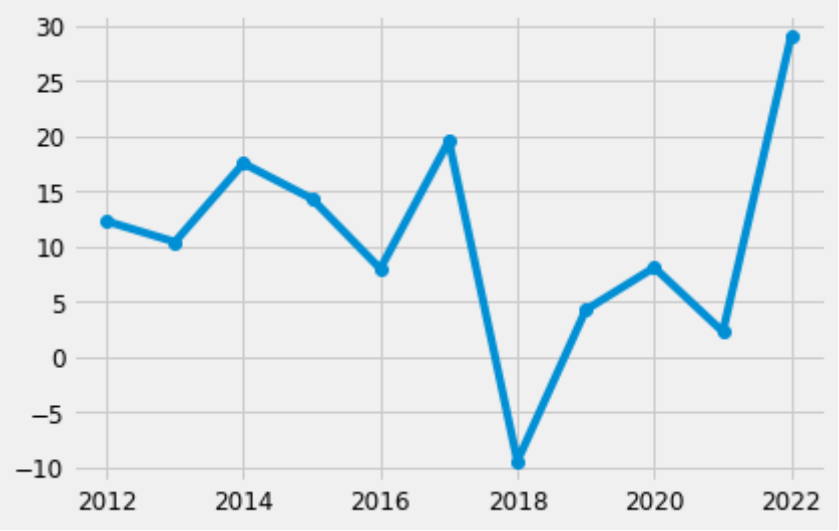
	DateTime	Growth Rate
0	2011-12-31	12.32
1	2012-12-31	10.44
2	2013-12-31	17.56
3	2014-12-31	14.36
4	2015-12-31	8.01
5	2016-12-31	19.60
6	2017-12-31	-9.43
7	2018-12-31	4.28
8	2019-12-31	8.12
9	2020-12-31	2.30
10	2021-12-31	29.16

In [41]:

```
plt.plot_date(growth_rate_ChemX_TS.DateTime, growth_rate_ChemX_TS['Growth Rate'], linestyle
```

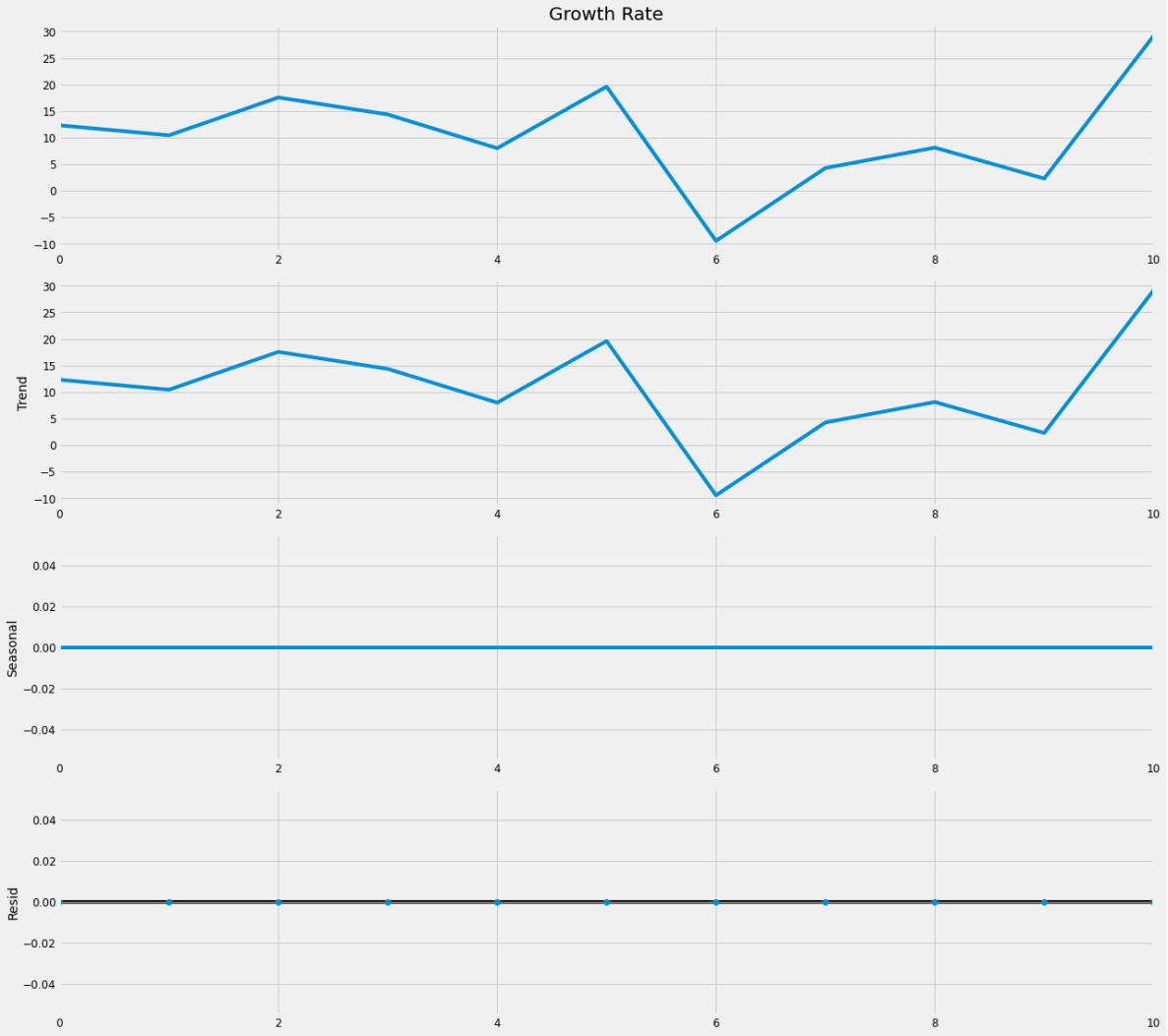
Out[41]:

```
[<matplotlib.lines.Line2D at 0x1867ffcfd60>]
```



In [42]:

```
y = growth_rate_ChemX_TS['Growth Rate']
rcParams['figure.figsize'] = 18, 16
decomposition = sm.tsa.seasonal_decompose(y, model='additive', period=1)
fig = decomposition.plot()
plt.show()
```



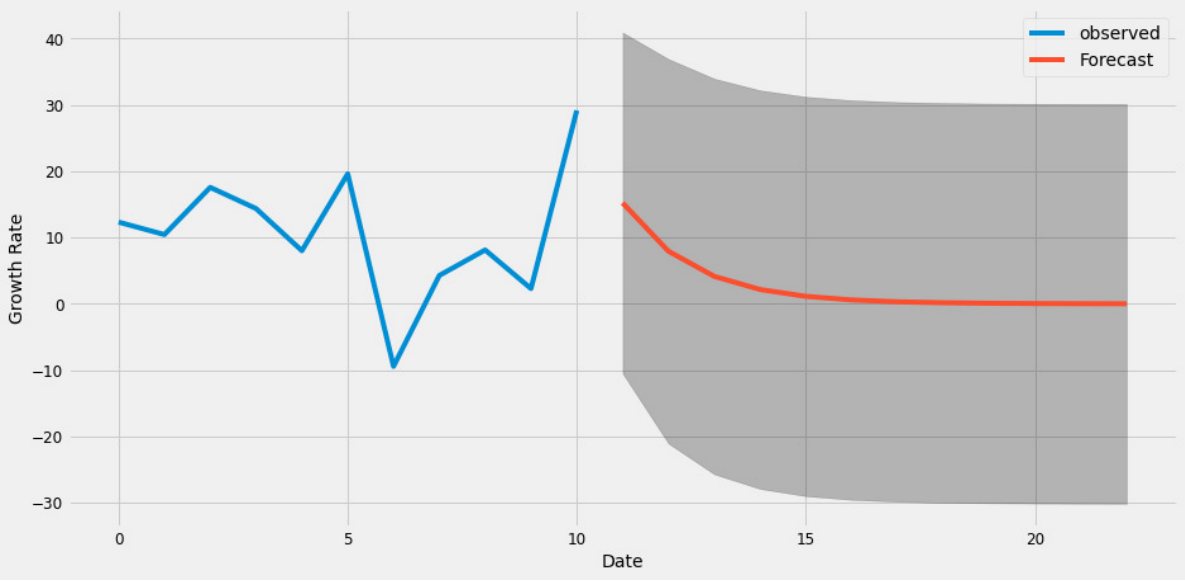
In [43]:

```
mod = sm.tsa.statespace.SARIMAX(y,
                                order=(1, 0, 0),
                                seasonal_order=(0, 0, 0, 12),
                                enforce_stationarity=False,
                                enforce_invertibility=False)
results = mod.fit()
print(results.summary().tables[1])
```

```
==============================================================================
==
                 coef    std err          z      P>|z|      [0.025      0.97
5]
------------------------------------------------------------------------------
--
ar.L1          0.5217      0.387      1.350      0.177      -0.236       1.2
79
sigma2       171.9086     80.578      2.133      0.033      13.978     329.8
39
==============================================================================
==
```

In [44]:

```
pred_uc = results.get_forecast(steps=12)
pred_ci = pred_uc.conf_int()
ax = y.plot(label='observed', figsize=(14, 7))
pred_uc.predicted_mean.plot(ax=ax, label='Forecast')
ax.fill_between(pred_ci.index,
                pred_ci.iloc[:, 0],
                pred_ci.iloc[:, 1], color='k', alpha=.25)
ax.set_xlabel('Date')
ax.set_ylabel('Growth Rate')
plt.legend()
plt.show()
```



In [45]:

```
pred_ci
```

Out[45]:

	lower Growth Rate	upper Growth Rate
11	-10.486169	40.909548
12	-21.048942	36.919689
13	-25.676439	33.955619
14	-27.878909	32.197850
15	-28.972088	31.225119
16	-29.527310	30.702633
17	-29.812863	30.425986
18	-29.960715	30.280558
19	-30.037541	30.204391
20	-30.077536	30.164575
21	-30.098377	30.143783
22	-30.109243	30.132930

In [46]:

```
pred_uc.predicted_mean
```

Out[46]:

```
11    15.211689
12     7.935374
13     4.139590
14     2.159470
15     1.126515
16     0.587661
17     0.306561
18     0.159922
19     0.083425
20     0.043520
21     0.022703
22     0.011843
dtype: float64
```

In [47]:

```
df_pred = pred_uc.predicted_mean.to_frame()
df_pred=df_pred.rename(columns={0:'Growth_Pred'})

df_pred
```

Out[47]:

	Growth_Pred
11	15.211689
12	7.935374
13	4.139590
14	2.159470
15	1.126515
16	0.587661
17	0.306561
18	0.159922
19	0.083425
20	0.043520
21	0.022703
22	0.011843

- We expect a higher uptake (about 1.5) in the average growth from 2026, (not for subsequent years)

In [48]:

```
growthRate_2026_pred = pred_uc.predicted_mean[15]
growthRate_2026_pred
growthRate_2026 = round(growthRate_2026_pred * 1.5, 2)
growthRate_2026
```

Out[48]:

```
1.69
```

In [49]:

```
df_pred.at[15,'Growth_Pred'] = growthRate_2026
df_pred
```

Out[49]:

	Growth_Pred
11	15.211689
12	7.935374
13	4.139590
14	2.159470
15	1.690000
16	0.587661
17	0.306561
18	0.159922
19	0.083425
20	0.043520
21	0.022703
22	0.011843

In [50]:

```
df_pred['Year'] = range(2022, 2022+len(df_pred))
df_pred = df_pred[['Year','Growth_Pred']]
df_pred
```

Out[50]:

	Year	Growth_Pred
11	2022	15.211689
12	2023	7.935374
13	2024	4.139590
14	2025	2.159470
15	2026	1.690000
16	2027	0.587661
17	2028	0.306561
18	2029	0.159922
19	2030	0.083425
20	2031	0.043520
21	2032	0.022703
22	2033	0.011843

- Another major competitor launch is planned for 2029 which leads to an expected slowdown in growth for

ChemX and revenue is expected to become stagnant from 2028 onwards

- So all the Preduction of all year after 2028 is same

In [51]:

```
df_pred.at[18,'Growth_Pred'] = df_pred.at[17,'Growth_Pred']
df_pred.at[19,'Growth_Pred'] = df_pred.at[17,'Growth_Pred']
df_pred.at[20,'Growth_Pred'] = df_pred.at[17,'Growth_Pred']
df_pred.at[21,'Growth_Pred'] = df_pred.at[17,'Growth_Pred']
df_pred.at[22,'Growth_Pred'] = df_pred.at[17,'Growth_Pred']
df_pred.reset_index()
df_pred
```

Out[51]:

	Year	Growth_Pred
11	2022	15.211689
12	2023	7.935374
13	2024	4.139590
14	2025	2.159470
15	2026	1.690000
16	2027	0.587661
17	2028	0.306561
18	2029	0.306561
19	2030	0.306561
20	2031	0.306561
21	2032	0.306561
22	2033	0.306561

In [52]:

```
growthRate_2031_pred = round(df_pred.at[20,'Growth_Pred'],2)
print( 'The predicted Percentage of growth for the year of 2031 is ' + str(growthRate_2031_
```

```
The predicted Percentage of growth for the year of 2031 is 0.31%
```

In [53]:

```
# Merging to see all the data in one Dataframe (Actuals + Predicted)
df_Final = pd.merge(growth_rate_ChemX_original, df_pred, on = 'Year', how='outer')
df_Final
```

Out[53]:

	Year	Growth Rate	Growth_Pred
0	2011.0	12.32	NaN
1	2012.0	10.44	NaN
2	2013.0	17.56	NaN
3	2014.0	14.36	NaN
4	2015.0	8.01	NaN
5	2016.0	19.60	NaN
6	2017.0	-9.43	NaN
7	2018.0	4.28	NaN
8	2019.0	8.12	NaN
9	2020.0	2.30	NaN
10	2021.0	29.16	NaN
11	2022.0	NaN	15.211689
12	2023.0	NaN	7.935374
13	2024.0	NaN	4.139590
14	2025.0	NaN	2.159470
15	2026.0	NaN	1.690000
16	2027.0	NaN	0.587661
17	2028.0	NaN	0.306561
18	2029.0	NaN	0.306561
19	2030.0	NaN	0.306561
20	2031.0	NaN	0.306561
21	2032.0	NaN	0.306561
22	2033.0	NaN	0.306561

In [54]:

```
df_Final['Rev_pred'] = 'NaN'
df_Final.at[9,'Rev_pred'] = dat_New.at[11,'Rev_2020']
df_Final.at[10,'Rev_pred'] = dat_New.at[11,'Rev_New']
df_Final.Year = df_Final.Year.astype(int)
df_Final
```

Out[54]:

	Year	Growth Rate	Growth_Pred	Rev_pred
0	2011	12.32	NaN	NaN
1	2012	10.44	NaN	NaN
2	2013	17.56	NaN	NaN
3	2014	14.36	NaN	NaN
4	2015	8.01	NaN	NaN
5	2016	19.60	NaN	NaN
6	2017	-9.43	NaN	NaN
7	2018	4.28	NaN	NaN
8	2019	8.12	NaN	NaN
9	2020	2.30	NaN	79.9
10	2021	29.16	NaN	103.195
11	2022	NaN	15.211689	NaN
12	2023	NaN	7.935374	NaN
13	2024	NaN	4.139590	NaN
14	2025	NaN	2.159470	NaN
15	2026	NaN	1.690000	NaN
16	2027	NaN	0.587661	NaN
17	2028	NaN	0.306561	NaN
18	2029	NaN	0.306561	NaN
19	2030	NaN	0.306561	NaN
20	2031	NaN	0.306561	NaN
21	2032	NaN	0.306561	NaN
22	2033	NaN	0.306561	NaN

In [55]:

```
for i, row in df_Final.iterrows():
    if i > 10:
        df_Final.at[i,'Rev_pred'] = df_Final.at[i -1,'Rev_pred'] + (df_Final.at[i -1,'Rev_p
```

In [56]:

```
df_Final.Year = df_Final.Year.astype(int)
df_Final
```

Out[56]:

	Year	Growth Rate	Growth_Pred	Rev_pred
0	2011	12.32	NaN	NaN
1	2012	10.44	NaN	NaN
2	2013	17.56	NaN	NaN
3	2014	14.36	NaN	NaN
4	2015	8.01	NaN	NaN
5	2016	19.60	NaN	NaN
6	2017	-9.43	NaN	NaN
7	2018	4.28	NaN	NaN
8	2019	8.12	NaN	NaN
9	2020	2.30	NaN	79.9
10	2021	29.16	NaN	103.195
11	2022	NaN	15.211689	118.893
12	2023	NaN	7.935374	128.327
13	2024	NaN	4.139590	133.64
14	2025	NaN	2.159470	136.525
15	2026	NaN	1.690000	138.833
16	2027	NaN	0.587661	139.649
17	2028	NaN	0.306561	140.077
18	2029	NaN	0.306561	140.506
19	2030	NaN	0.306561	140.937
20	2031	NaN	0.306561	141.369
21	2032	NaN	0.306561	141.802
22	2033	NaN	0.306561	142.237

In [57]:

```
Rev_2031_pred = round(df_Final.at[20,'Rev_pred'],2)
print( 'The predicted Percentage of growth for the year of 2031 is INR ' + str(Rev_2031_pre
```

```
The predicted Percentage of growth for the year of 2031 is INR 141.37 Billio
n
```