Time series Analysis

In [1]:
```
import pandas as pd
```

In [2]:
```
import pandas as pd
df = pd.read_csv(r"C:\Users\un\Desktop\Case Study\Data_set2.csv")
print(df)
```

```
          date   price  production  exchange_rate  fuel_price  \
0     1/1/2000   26.94    1781.200         73.150        13.2
1     2/1/2000   25.00    1781.200         73.475        16.2
2     3/1/2000   23.09    1781.200         73.750        16.2
3     4/1/2000   22.13    1781.200         74.300        16.2
4     5/1/2000   21.71    1077.600         74.735        16.2
..         ...     ...         ...            ...         ...
271   8/1/2022  239.24    1461.675        357.880       430.0
272   9/1/2022  228.44    1461.675        365.500       430.0
273  10/1/2022  224.78    1931.200        363.000       430.0
274  11/1/2022  222.28    1931.200        368.500       430.0
275  12/1/2022  218.20    1931.200        367.500       420.0

    Poduction Cost (Rs/Hr) Tax rate
0                   12,500      15%
1                   13,200      15%
2                   14,000      15%
3                   11,500      15%
4                   12,000      15%
..                     ...      ...
271                 45,000      15%
272                 46,500      15%
273                 48,000      15%
274                 49,500      15%
275                 51,000      15%

[276 rows x 7 columns]
```

In [3]:
```
#Import libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [4]:
```
#Ignore warnings
import warnings
warnings.filterwarnings('ignore')
```

In [5]:
```
df.head()
```

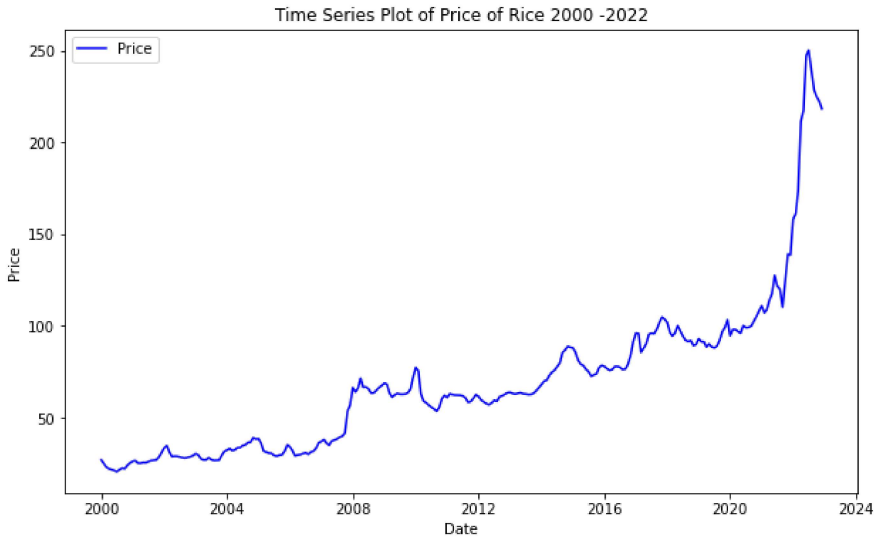
Out[5]:

	date	price	production	exchange_rate	fuel_price	Poduction Cost (Rs/Hr)	Tax rate
0	1/1/2000	26.94	1781.2	73.150	13.2	12,500	15%
1	2/1/2000	25.00	1781.2	73.475	16.2	13,200	15%
2	3/1/2000	23.09	1781.2	73.750	16.2	14,000	15%
3	4/1/2000	22.13	1781.2	74.300	16.2	11,500	15%
4	5/1/2000	21.71	1077.6	74.735	16.2	12,000	15%

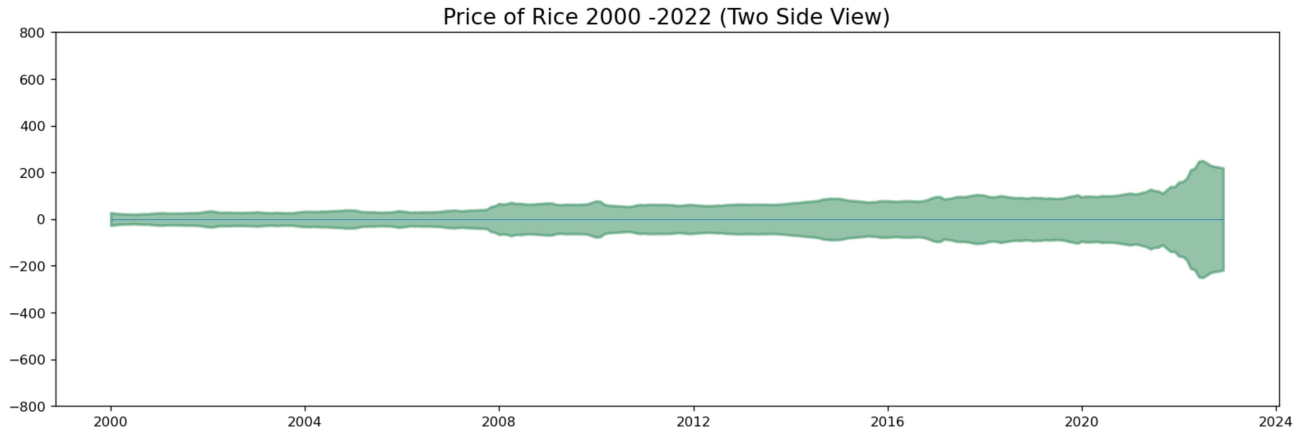
In [18]:
```
df = pd.DataFrame({ 'new_date': df['date'],'new_price': df['price']})
print(new_data)
```

```
      new_date  new_price
0     1/1/2000      26.94
1     2/1/2000      25.00
2     3/1/2000      23.09
3     4/1/2000      22.13
4     5/1/2000      21.71
..         ...        ...
271   8/1/2022     239.24
272   9/1/2022     228.44
273  10/1/2022     224.78
274  11/1/2022     222.28
275  12/1/2022     218.20

[276 rows x 2 columns]
```

In [29]:
```
import matplotlib.pyplot as plt
import pandas as pd

# Assuming 'date' column is not already in datetime format
df['new_date'] = pd.to_datetime(df['new_date'])

# Sort the DataFrame by date if it's not already sorted
df = df.sort_values('new_date')

# Plotting the time series
plt.figure(figsize=(10, 6))
plt.plot(df['new_date'], df['new_price'], label='Price', color='blue')
plt.title('Time Series Plot of Price of Rice 2000 -2022')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.show()
```

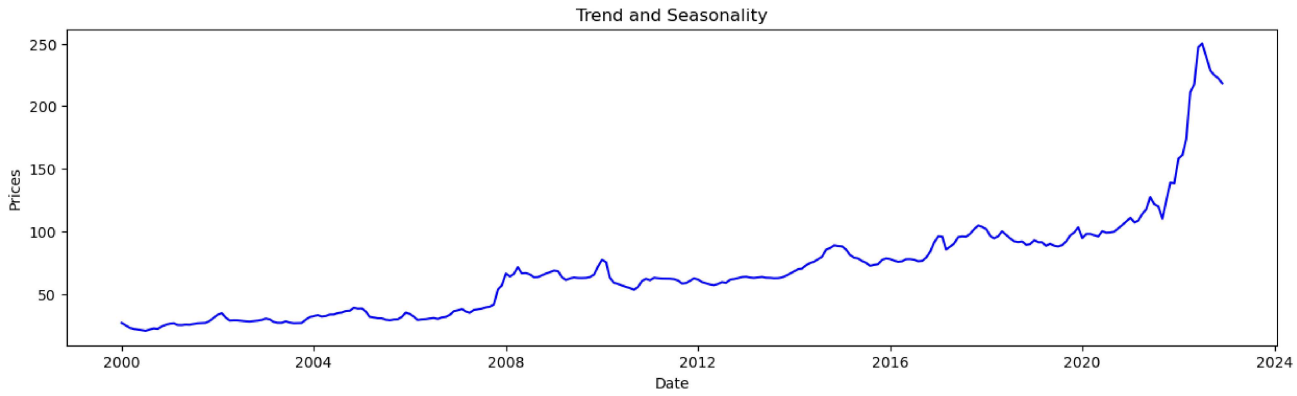


In [31]:
```
x = df['new_date'].values
y1 = df['new_price'].values

# Plot
fig, ax = plt.subplots(1, 1, figsize=(16,5), dpi= 120)
plt.fill_between(x, y1=y1, y2=-y1, alpha=0.5, linewidth=2, color='seagreen')
plt.ylim(-800, 800)
plt.title('Price of Rice 2000 -2022 (Two Side View)', fontsize=16)
plt.hlines(y=0, xmin=np.min(df['new_date']), xmax=np.max(df['new_date']), linewidth=.5)
plt.show()
```

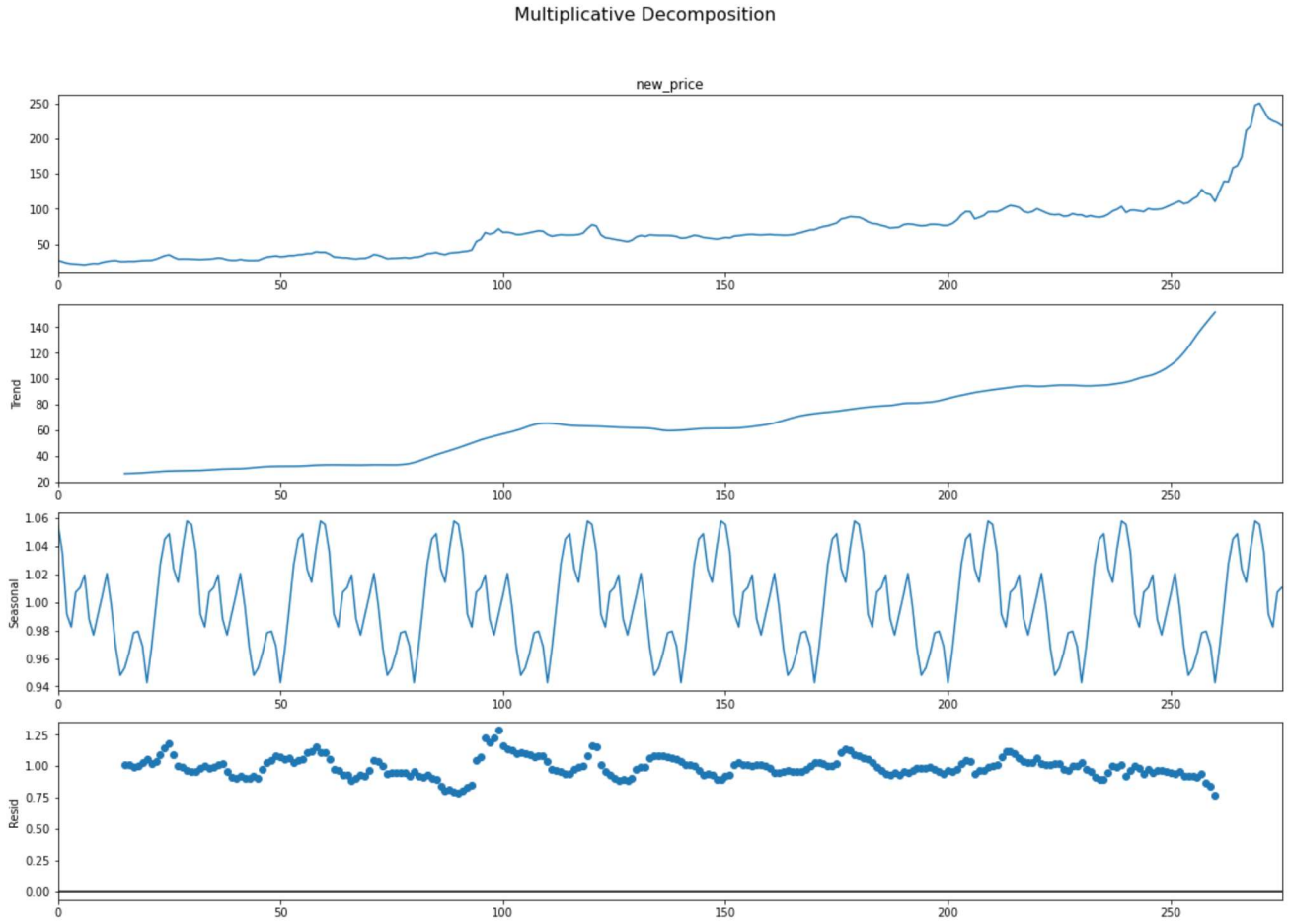


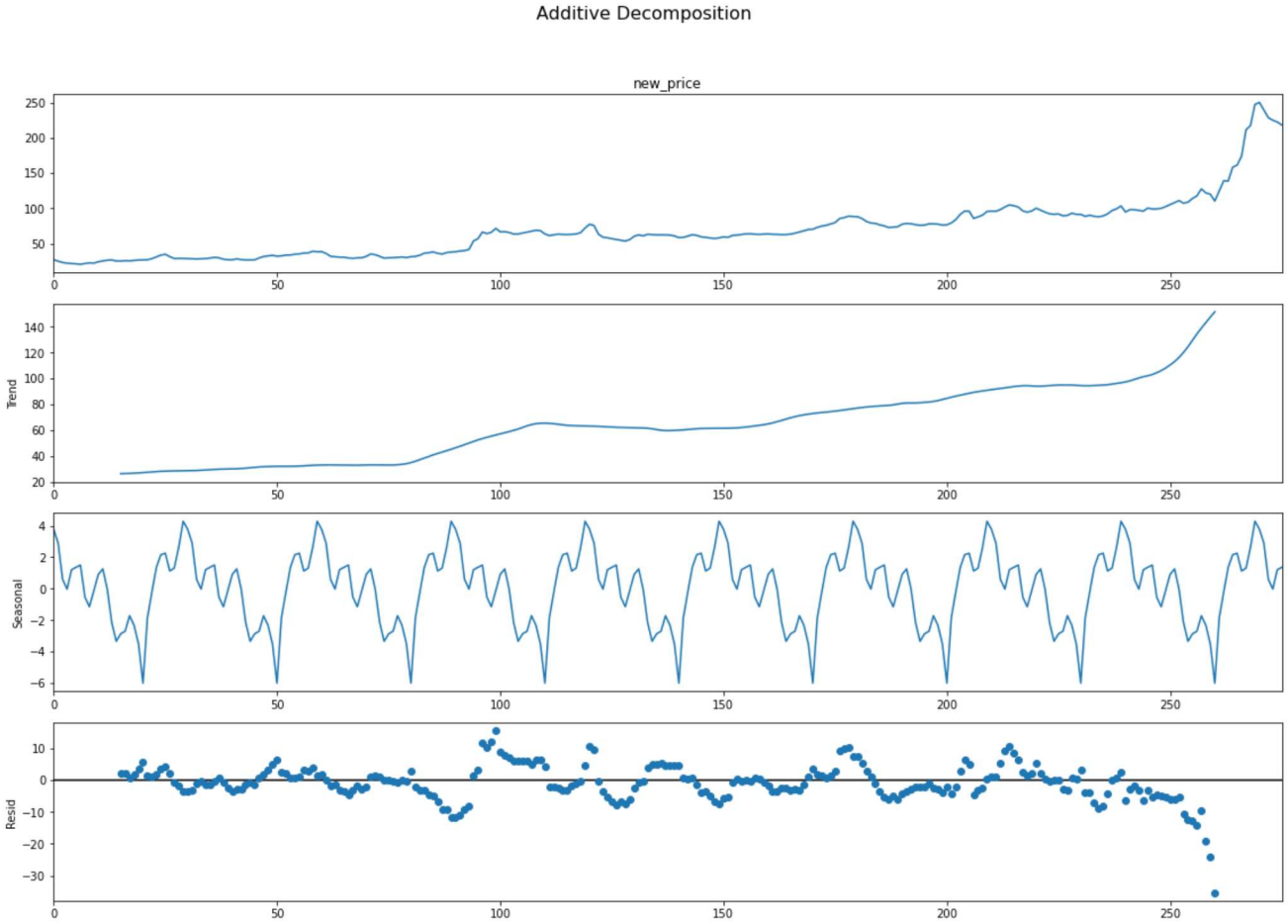
In [ ]:
```
#It can be seen that its a monthly time series and follows a certain repetitive pattern every year. So, we can plot each
```

In [34]:
```
#Seasonality
def plot_df(df, x, y, title="", xlabel='Date', ylabel='Prices', dpi=100):
    plt.figure(figsize=(15,4), dpi=dpi)
    plt.plot(x, y, color='blue')
    plt.gca().set(title=title, xlabel=xlabel, ylabel=ylabel)
    plt.show()


plot_df(df, x=df['new_date'], y=df['new_price'], title='Trend and Seasonality')
```



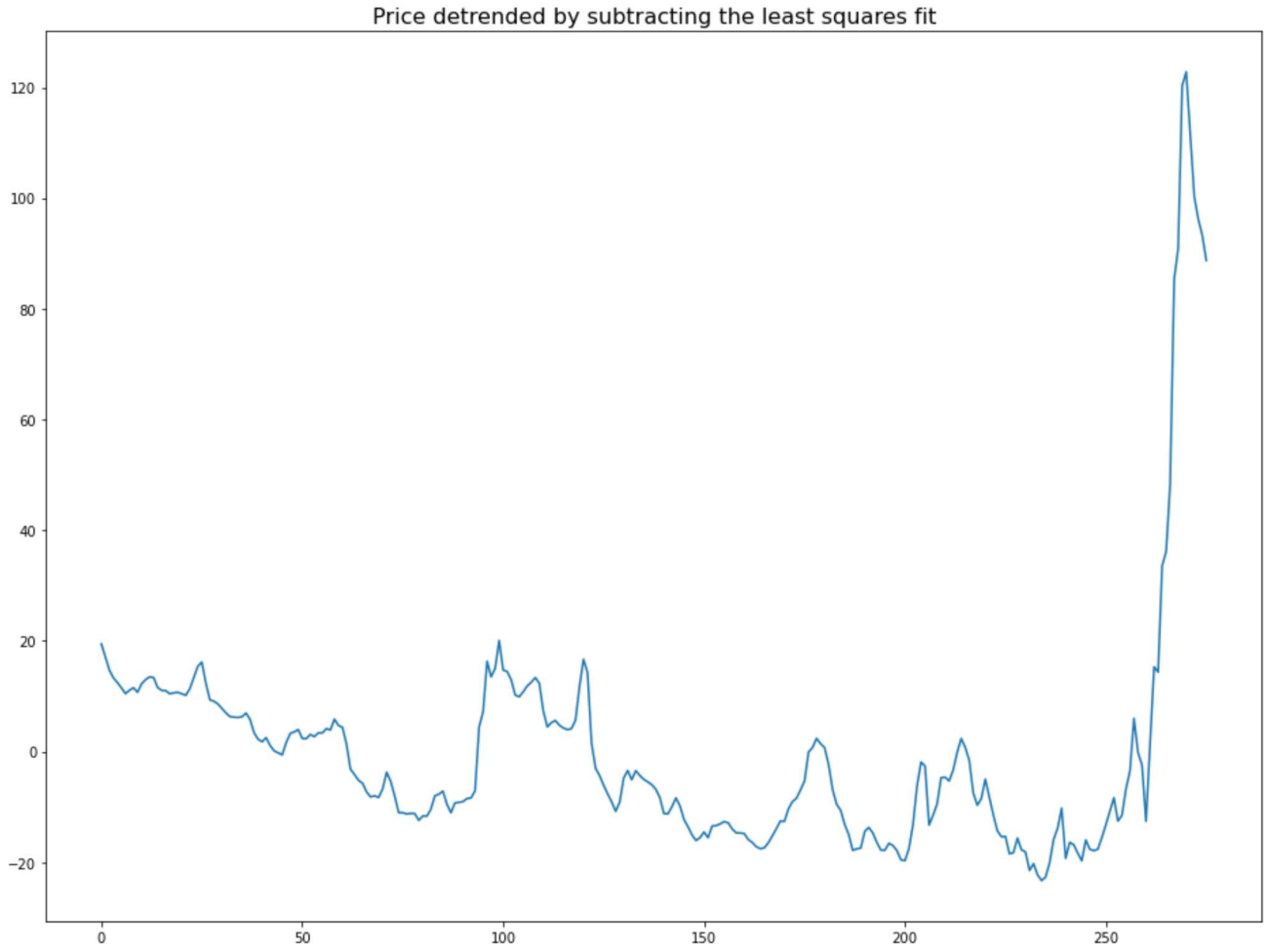
In [35]:
```
from statsmodels.tsa.seasonal import seasonal_decompose
from dateutil.parser import parse


# Multiplicative Decomposition
multiplicative_decomposition = seasonal_decompose(df['new_price'], model='multiplicative', period=30)

# Additive Decomposition
additive_decomposition = seasonal_decompose(df['new_price'], model='additive', period=30)

# Plot
plt.rcParams.update({'figure.figsize': (16,12)})
multiplicative_decomposition.plot().suptitle('Multiplicative Decomposition', fontsize=16)
plt.tight_layout(rect=[0, 0.03, 1, 0.95])

additive_decomposition.plot().suptitle('Additive Decomposition', fontsize=16)
plt.tight_layout(rect=[0, 0.03, 1, 0.95])

plt.show()
```




Additive Decomposition
new_price
Trend
Seasonal
Resid

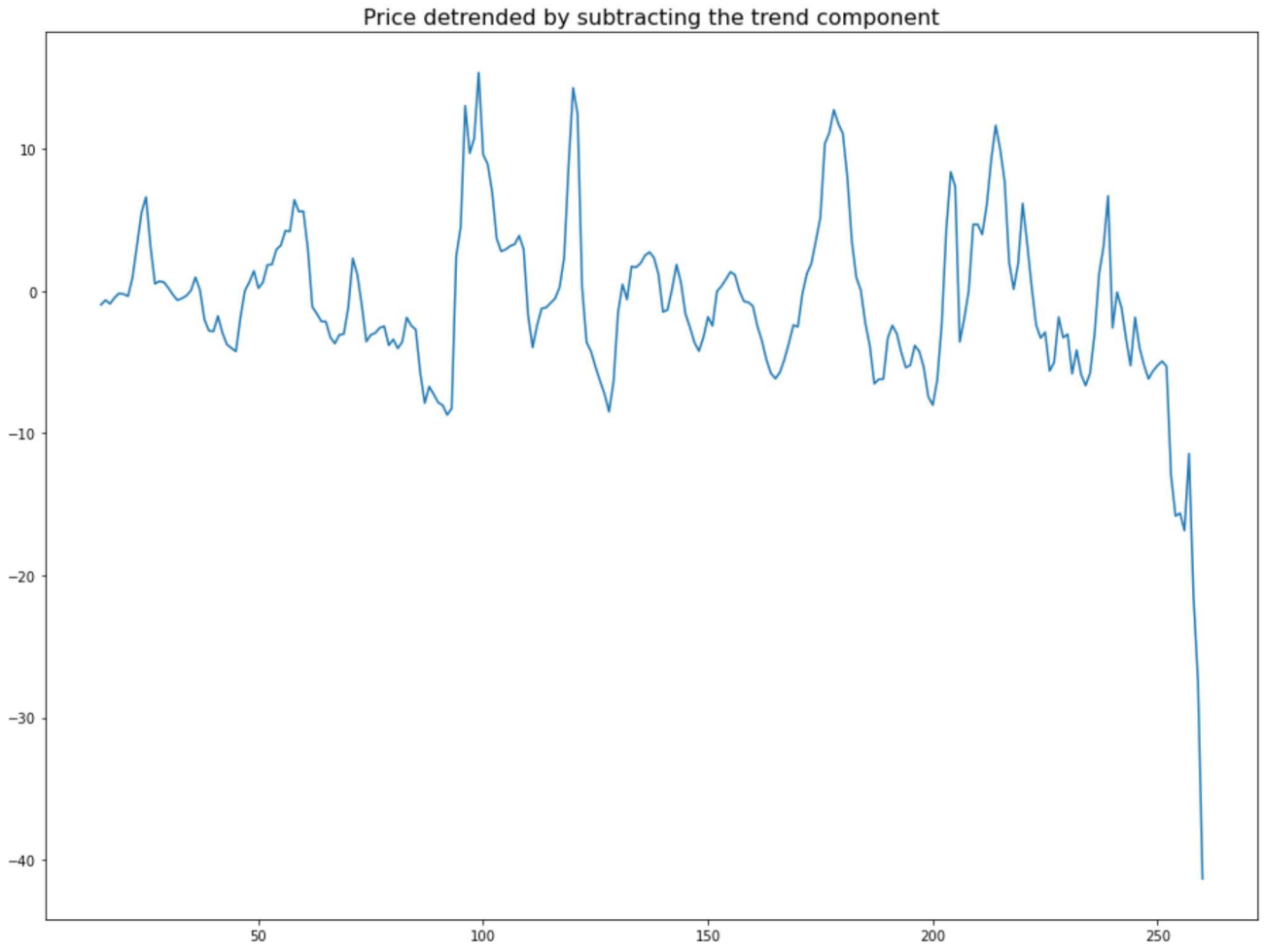
In [36]:
```
# Using scipy: Subtract the line of best fit
from scipy import signal
detrended = signal.detrend(df['new_price'].values)
plt.plot(detrended)
plt.title('Price detrended by subtracting the least squares fit', fontsize=16)
```

Out[36]:
```
Text(0.5, 1.0, 'Price detrended by subtracting the least squares fit')
```



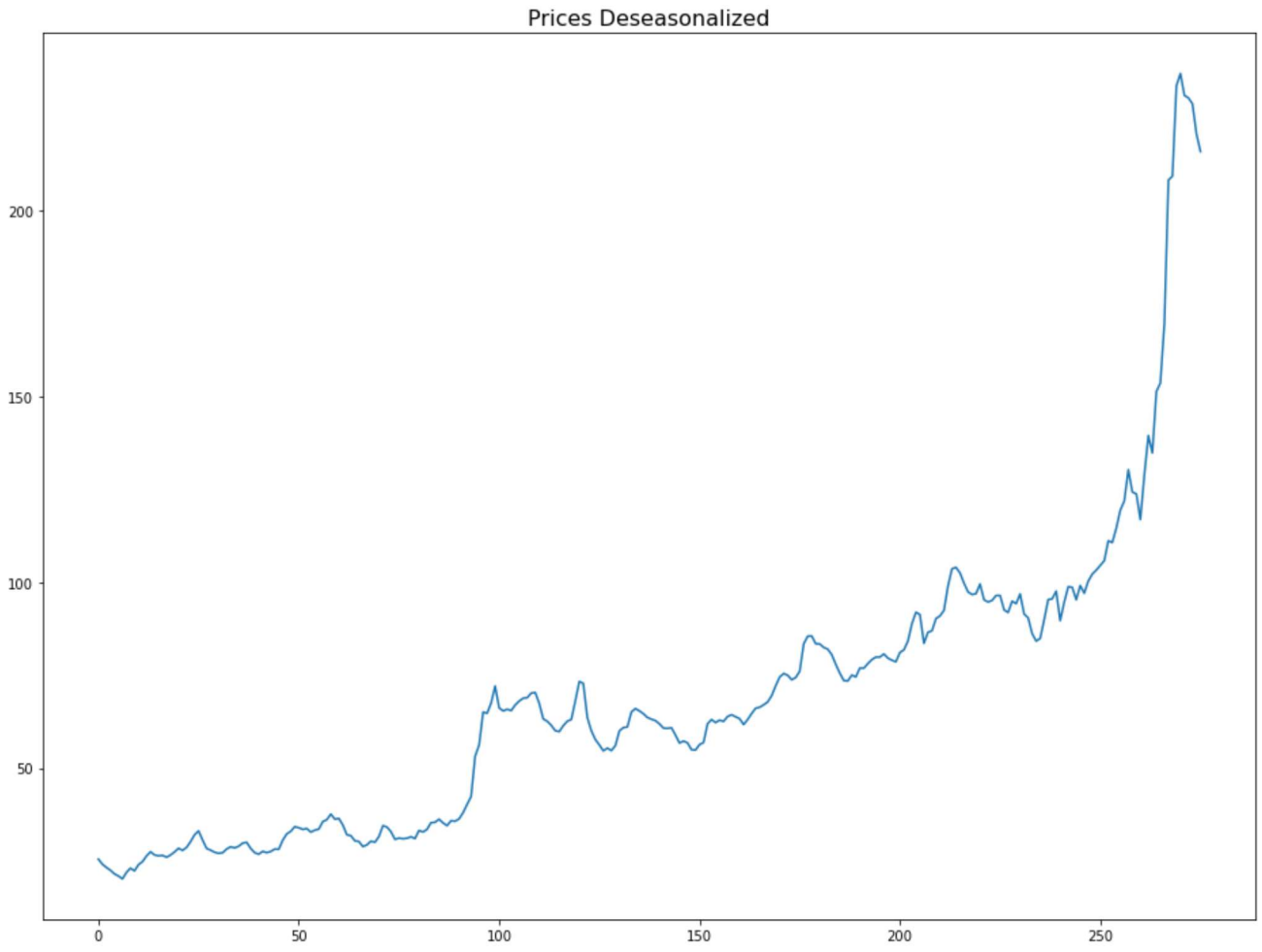
In [38]:
```
# Using statmodels: Subtracting the Trend Component
from statsmodels.tsa.seasonal import seasonal_decompose
result_mul = seasonal_decompose(df['new_price'], model='multiplicative', period=30)
detrended = df['new_price'].values - result_mul.trend
plt.plot(detrended)
plt.title('Price detrended by subtracting the trend component', fontsize=16)
```

Out[38]:
```
Text(0.5, 1.0, 'Price detrended by subtracting the trend component')
```



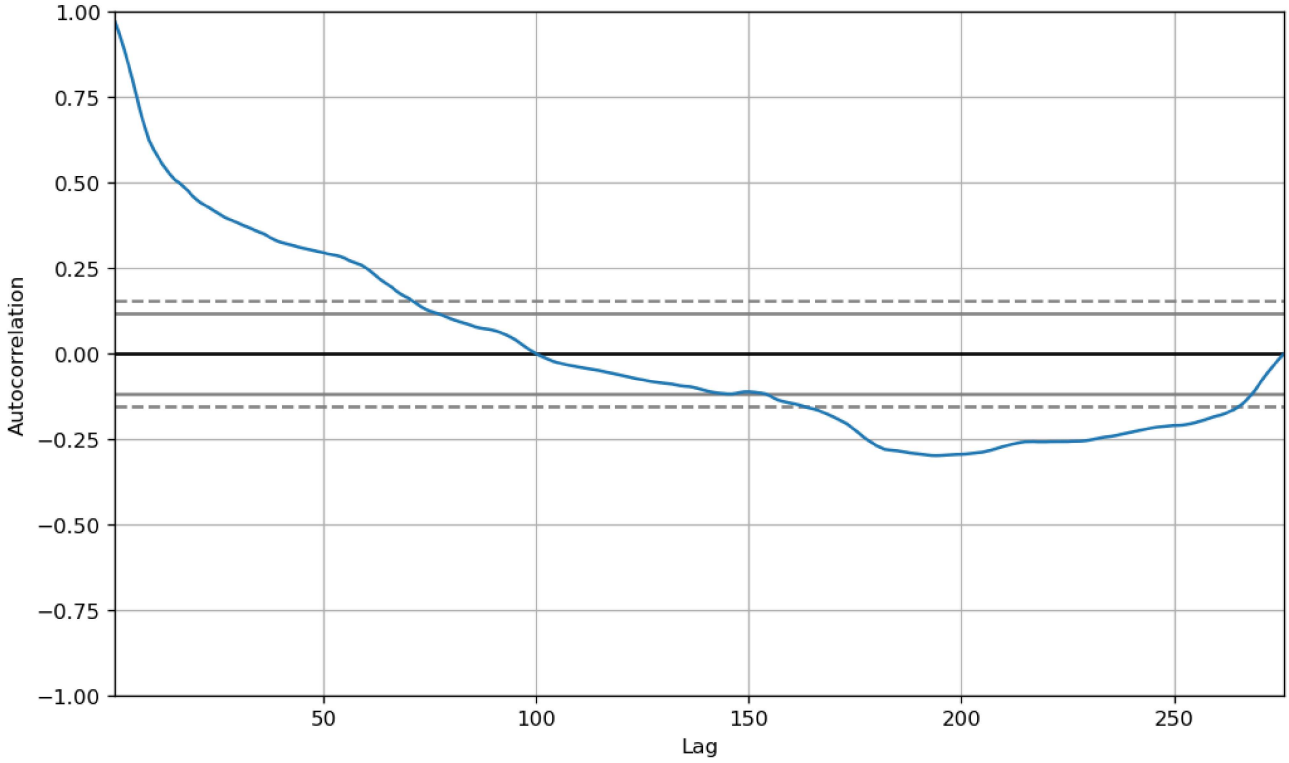
In [40]:
```
# Subtracting the Trend Component

# Time Series Decomposition
result_mul = seasonal_decompose(df['new_price'], model='multiplicative', period=30)


# Deseasonalize
deseasonalized = df['new_price'].values / result_mul.seasonal


# Plot
plt.plot(deseasonalized)
plt.title('Prices Deseasonalized', fontsize=16)
plt.plot()
```

Out[40]: []



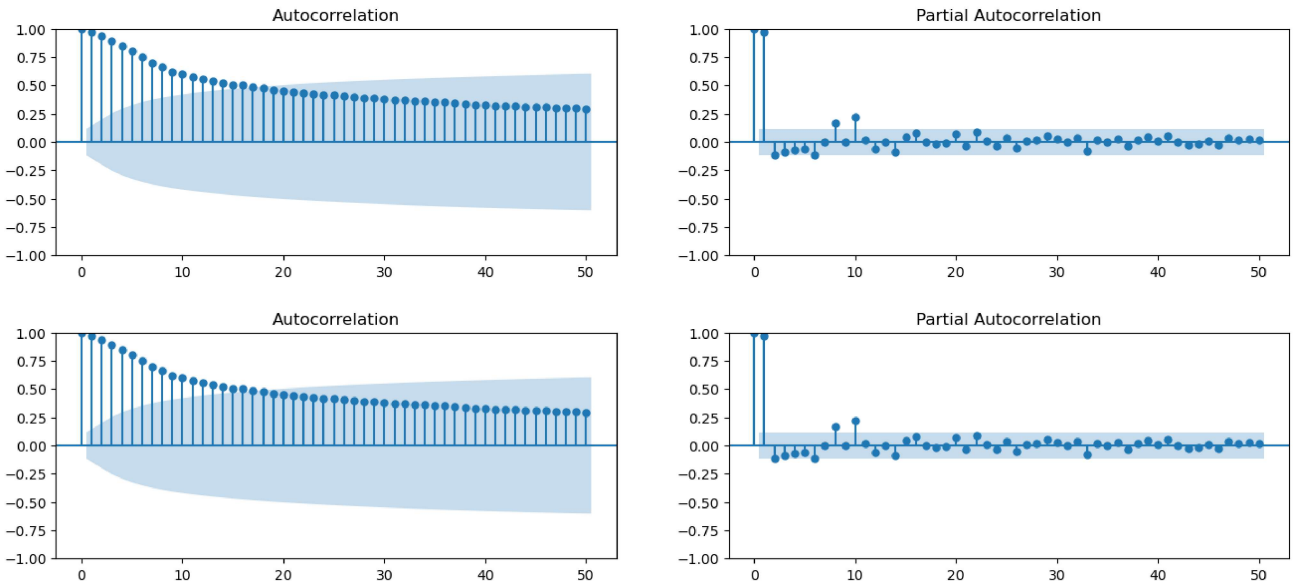
In [41]:
```
# Test for seasonality
from pandas.plotting import autocorrelation_plot

# Draw Plot
plt.rcParams.update({'figure.figsize':(10,6), 'figure.dpi':120})
autocorrelation_plot(df['new_price'].tolist())
```

Out[41]: <AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>

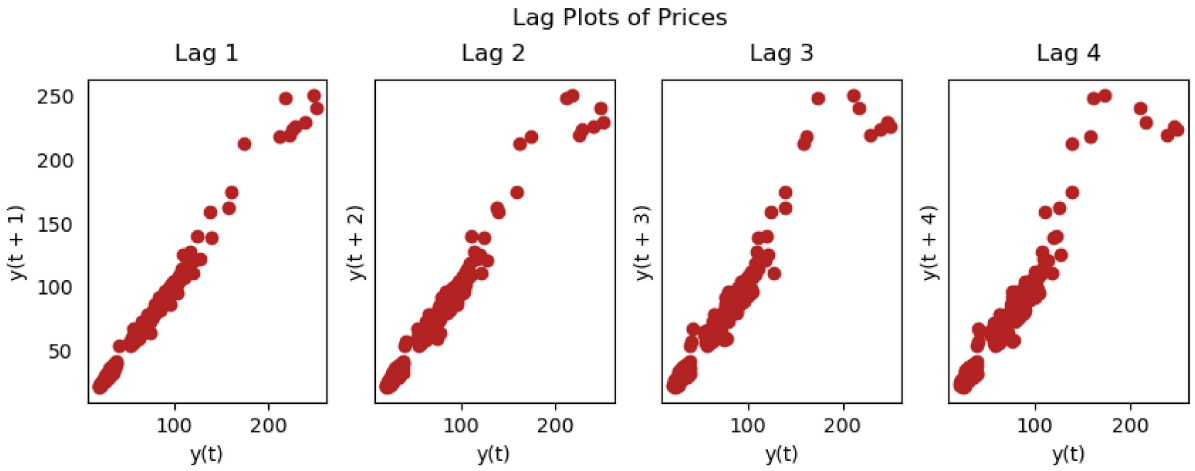


In [43]:
```
from statsmodels.tsa.stattools import acf, pacf
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf

# Draw Plot
fig, axes = plt.subplots(1,2,figsize=(16,3), dpi= 100)
plot_acf(df['new_price'].tolist(), lags=50, ax=axes[0])
plot_pacf(df['new_price'].tolist(), lags=50, ax=axes[1])
```

Out[43]:



In [44]:
```
from pandas.plotting import lag_plot
plt.rcParams.update({'ytick.left' : False, 'axes.titlepad':10})

# Plot
fig, axes = plt.subplots(1, 4, figsize=(10,3), sharex=True, sharey=True, dpi=100)
for i, ax in enumerate(axes.flatten()[:4]):
    lag_plot(df['new_price'], lag=i+1, ax=ax, c='firebrick')
    ax.set_title('Lag ' + str(i+1))

fig.suptitle('Lag Plots of Prices', y=1.05)
plt.show()
```



In [51]:
```
import pandas as pd
from statsmodels.tsa.stattools import grangercausalitytests
import matplotlib.pyplot as plt

# Assuming 'date' column is not already in datetime format
df['new_date'] = pd.to_datetime(df['new_date'])

# Sort the DataFrame by date if it's not already sorted
df = df.sort_values('new_date')

# Perform Granger causality test
max_lag = 5  # You can adjust the lag parameter as needed
test_result = grangercausalitytests(df[['new_price', 'new_date']], max_lag, verbose=True)

# Display the test results
for lag in range(1, max_lag + 1):
    p_value = test_result[lag][0]['ssr_ftest'][1]
    print(f'Lag {lag}: p-value = {p_value}')

# Plotting the time series
plt.figure(figsize=(10, 6))
plt.plot(df['new_date'], df['new_price'], label='Price', color='blue')
plt.plot(df['new_date'], df['some_other_variable'], label='Some Other Variable', color='green')
plt.title('Time Series Plot with Granger Causality Test')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.show()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Input In [51], in <cell line: 13>()
     11 # Perform Granger causality test
     12 max_lag = 5  # You can adjust the lag parameter as needed
---> 13 test_result = grangercausalitytests(df[['new_price', 'new_date']], max_lag, verbose=True)
     15 # Display the test results
     16 for lag in range(1, max_lag + 1):

File ~\anaconda3\lib\site-packages\statsmodels\tsa\stattools.py:1457, in grangercausalitytests(x, maxlag, addconst, ver
bose)
   1388 def grangercausalitytests(x, maxlag, addconst=True, verbose=True):
   1389     """
   1390     Four tests for granger non causality of 2 time series.
   1391
   (...)
   1455     >>> gc_res = grangercausalitytests(data, [4])
   1456     """
-> 1457     x = array_like(x, "x", ndim=2)
   1458     if not np.isfinite(x).all():
   1459         raise ValueError("x contains NaN or inf values.")

File ~\anaconda3\lib\site-packages\statsmodels\tools\validation\validation.py:135, in array_like(obj, name, dtype, ndi
m, maxdim, shape, order, contiguous, optional)
    133 if optional and obj is None:
    134     return None
--> 135 arr = np.asarray(obj, dtype=dtype, order=order)
    136 if maxdim is not None:
    137     if arr.ndim > maxdim:

File ~\anaconda3\lib\site-packages\pandas\core\generic.py:2064, in NDFrame.__array__(self, dtype)
   2063 def __array__(self, dtype: npt.DTypeLike | None = None) -> np.ndarray:
-> 2064     return np.asarray(self._values, dtype=dtype)

TypeError: float() argument must be a string or a number, not 'Timestamp'
```

In [ ]:
```

```