- Compute the seasonal indices for the following time series of sales (in thousand) of a commodity by the ratio to trend method:

In [25]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

In [29]:

```
df=pd.read_csv("C:\\Users\\Lenovo\\OneDrive\\Desktop\\Timeseries_lab\\lab4\\ra
df
```

Out[29]:

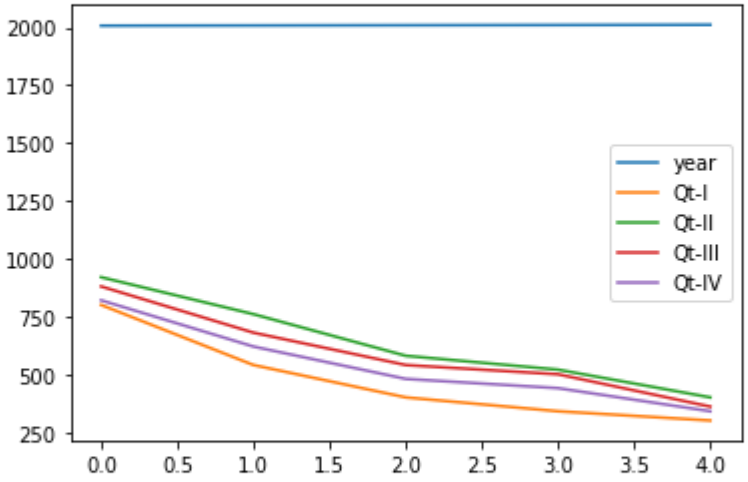
	year	Qt-I	Qt-II	Qt-III	Qt-IV
0	2008	800	920	880	820
1	2009	540	760	680	620
2	2010	400	580	540	480
3	2011	340	520	500	440
4	2012	300	400	360	340

In [31]:

```
df.plot()
```

Out[31]:

```
<AxesSubplot:>
```



In [32]:

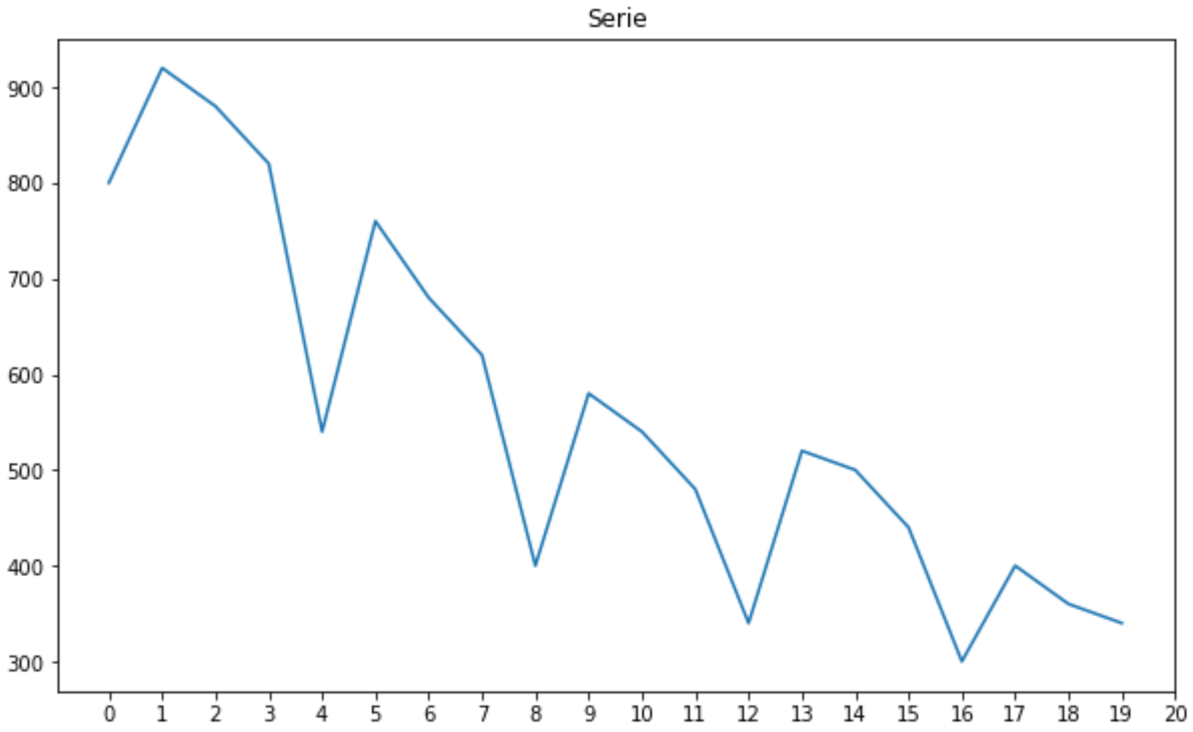
```
# Convert the data frame into numpy one dimentional array
serie = df.iloc[:, 1:]
serie = np.reshape(np.array(serie), 20)
serie
```

Out[32]:

```
array([800, 920, 880, 820, 540, 760, 680, 620, 400, 580, 540, 480, 340,
       520, 500, 440, 300, 400, 360, 340], dtype=int64)
```

In [33]:

```
# Plot the serie's data
plt.figure(figsize=(10, 6))
sns.lineplot(data=serie)
plt.xticks(range(0, 21))
plt.title('Serie')
plt.show()
```



- Interpretation : We can detect an upward trend and seasonality form the given serie

In [34]:

```
# Compute the mean of each year
df['x'] = df.iloc[:, 1:].mean(axis=1)
# Sum of x
sum_x = df['x'].sum()
# Define t value (time parameter)
df['t'] = range(-2, 3)
# Sum of t
sum_t = df['t'].sum()
# Compute t square
df['t2'] = df['t']**2
# sum of t square
sum_t_square = df['t2'].sum()
# Compute the product x into t
df['x*t'] = df['x'] * df['t']
# Compute the sum of x times t
sum_xt = df['x*t'].sum()
```

In [35]:

```
df
```

Out[35]:

	year	Qt-I	Qt-II	Qt-III	Qt-IV	x	t	t2	x*t

	year	Qt-I	Qt-II	Qt-III	Qt-IV	x	t	t2	x*t
0	2008	800	920	880	820	855.0	-2	4	-1710.0
1	2009	540	760	680	620	650.0	-1	1	-650.0
2	2010	400	580	540	480	500.0	0	0	0.0
3	2011	340	520	500	440	450.0	1	1	450.0

- Using the least square method, calculate the regression line for the given data

In [36]:

```
# Equation line is : y = b0 + b1 * t
# In this case the sum of t is equal to 0 so the formula is :
b1 = -(df['x'].size * sum_xt)/ ( -(df['x'].size * sum_t_square))
b0 = df['x'].mean() - df['t'].mean() * b1

print(f'Slope : {b1}\nIntercept : {b0}')
print(f'The line equation is y = {int(b1)}*t + {int(b0)}')
```

```
Slope : -121.0
Intercept : 561.0
The line equation is y = -121*t + 561
```

In [37]:

```
###compute the trend using the equation line
df['trend'] = df['t'].apply(lambda t: -121*t + 561)
df
```

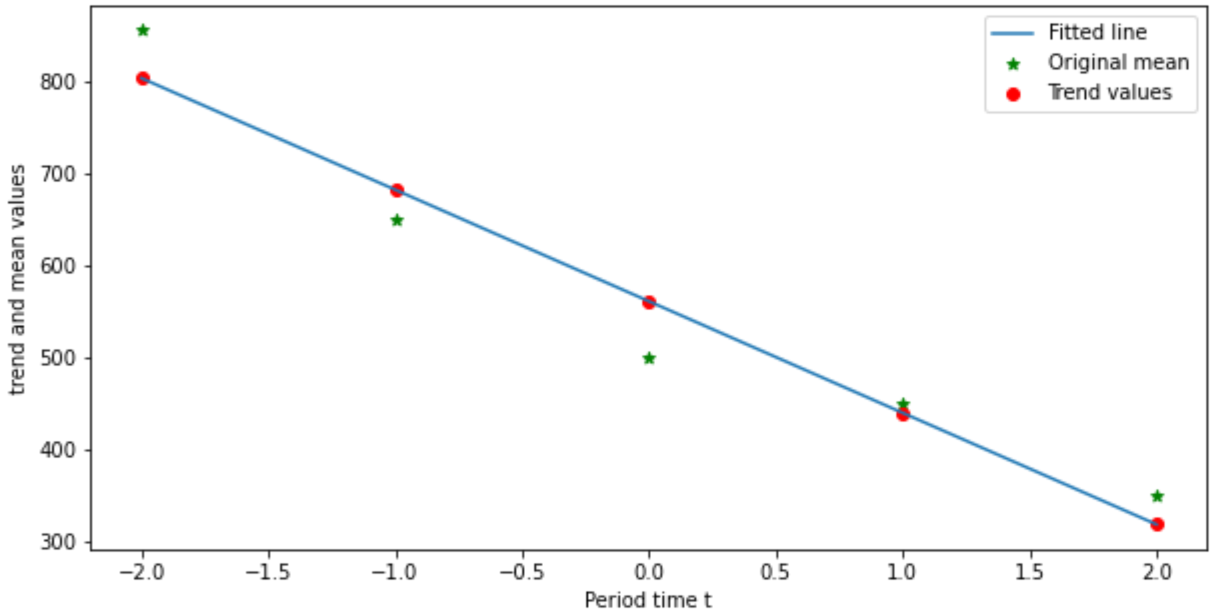
Out[37]:

	year	Qt-I	Qt-II	Qt-III	Qt-IV	x	t	t2	x*t	trend
0	2008	800	920	880	820	855.0	-2	4	-1710.0	803
1	2009	540	760	680	620	650.0	-1	1	-650.0	682
2	2010	400	580	540	480	500.0	0	0	0.0	561
3	2011	340	520	500	440	450.0	1	1	450.0	440
4	2012	300	400	360	340	350.0	2	4	700.0	319

In [38]:

```
### plot the best fit line

plt.figure(figsize=(10, 5))
# Scatter plot of the x
plt.scatter(df['t'], df['x'], marker='*', color='green')
# Plot the fitted line
t = np.arange(-2, 3)
plt.plot(t, -121*t + 561)
# Plot the trend value by using the predicted values
plt.scatter(df['t'], df['trend'], color='red')
# Label axis and legend
plt.xlabel('Period time t')
plt.ylabel('trend and mean values')
plt.legend(['Fitted line', 'Original mean', 'Trend values'], loc='best')
plt.show()
```



In [39]:

```
# Calculate the trend effect for quaters
trend_effect = b1 / 4
print(f'Trend effect for quaters {trend_effect}')
```

```
Trend effect for quaters -30.25
```

In [40]:

```
# Create dictionnay to remove the trend from the data
dict = {
    'year' : df['year'].values,
    'Qt-I' : df['trend'] - trend_effect,
    'Qt-II' : df['trend'] - (trend_effect/2),
    'Qt-III' : df['trend'] + (trend_effect/2),
    'Qt-IV' : df['trend'] + trend_effect
}

# Store into a new dataset
new_data = pd.DataFrame(dict)
new_data
```

Out[40]:

	year	Qt-I	Qt-II	Qt-III	Qt-IV
0	2008	833.25	818.125	787.875	772.75
1	2009	712.25	697.125	666.875	651.75
2	2010	591.25	576.125	545.875	530.75
3	2011	470.25	455.125	424.875	409.75
4	2012	349.25	334.125	303.875	288.75

In [41]:

```
#  Remove the trend from the data Using ratio method
new_data = pd.concat([df.year, df.iloc[:,1:5] / new_data.iloc[:, 1:] * 100],
new_data
```

Out[41]:

	year	Qt-I	Qt-II	Qt-III	Qt-IV
0	2008	96.009601	112.452254	111.692845	106.114526
1	2009	75.816076	109.019186	101.968135	95.128500
2	2010	67.653277	100.672597	98.923746	90.438059
3	2011	72.301967	114.254326	117.681671	107.382550
4	2012	85.898354	119.715675	118.469766	117.748918

Plot the serie after removing the trend from the data

In [42]:

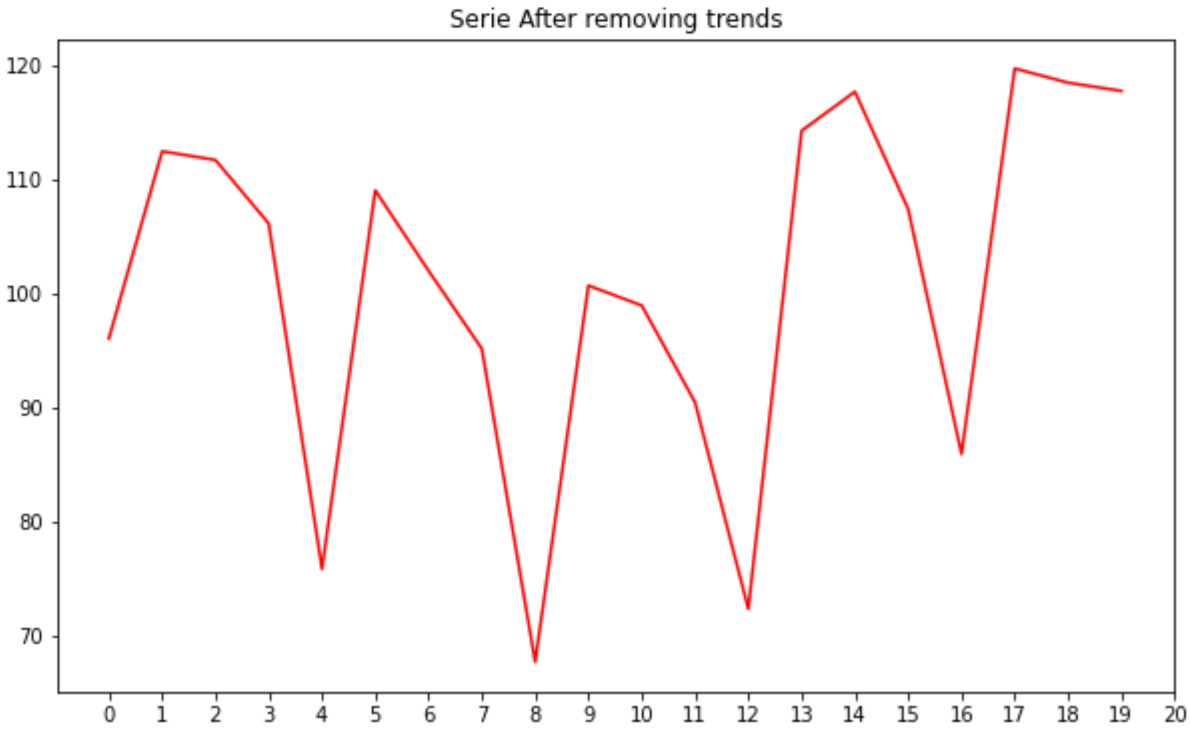
```
# Convert the data frame into numpy one dimentional array
serie = new_data.iloc[:, 1:]
serie = np.reshape(np.array(serie), 20)
serie
```

Out[42]:

```
array([ 96.00960096, 112.45225363, 111.69284468, 106.11452604,
        75.81607582, 109.01918594, 101.96813496,  95.12850019,
        67.65327696, 100.67259709,  98.92374628,  90.43805935,
        72.30196704, 114.25432573, 117.68167108, 107.38255034,
        85.89835361, 119.71567527, 118.46976553, 117.74891775])
```

In [43]:

```
# Plot the serie's data
plt.figure(figsize=(10, 6))
sns.lineplot(data=serie, color='red')
plt.title('Serie After removing trends')
plt.xticks(range(0, 21))
plt.show()
```



In [44]:

```
# Seasonal values
List = [new_data.iloc[:,i].mean() for i in range(1, 5)]
sum =  np.sum(List)
print(f'Sum up the yearly average seaonality {sum}')
```

```
Sum up the yearly average seaonality 403.8684056493646
```

In [45]:

```
# Calculate the value of the correction factor k
k = 400 / sum
print('The correction factor k is', k)
```

```
The correction factor k is 0.9904216185389775
```

In [46]:

```
# Add the seasonal indices for the dataset
seasonal = np.array(List) * k
print(seasonal.tolist())
```

```
[78.77403011925317, 110.15747305618453, 108.69603164721936, 102.372465177343]
```

In [ ]:

In [ ]:

In [ ]:

In [ ]: