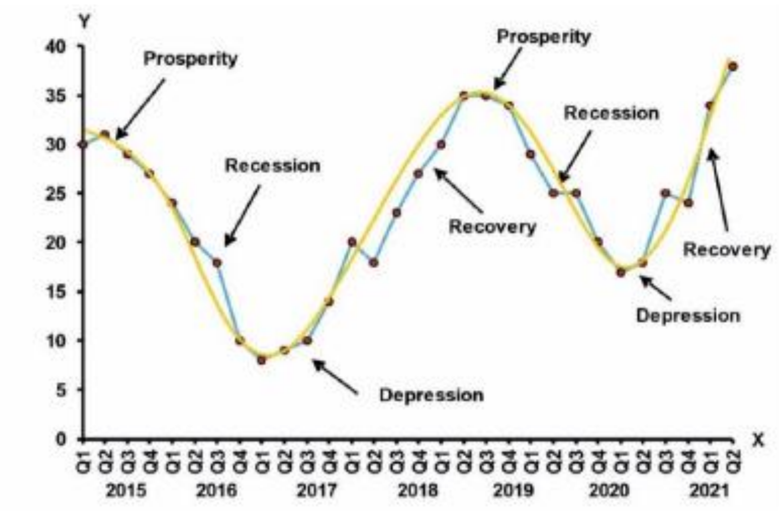
ESTIMATION OF CYCLIC COMPONENTS

A cycle in the time series means a business cycle which normally exceeds a year in length. Business cycles are perhaps the most important type of fluctuations for economists and businessmen. It is to be kept in mind that hardly any time series possesses strict cycles because cycles are never regular in periodicity and amplitude. In most of the business cycle sometimes there is an upward trend then sometimes with the downfall. It touches its lowest level and again a rise starts and it touches its peak. Therefore, a businessman has to reduce the production or stock and increase the production or stocks according to the receding and promoted demands respectively. This is why business cycles are the most difficult type of economic fluctuation to measure

It has four phases prosperity (boom), recession, depression and recovery as discussed in Unit 10 and are shown



To construct meaningful typical cycle indexes of curves similar to those that have developed for trends and seasons is impossible because the successive cycles vary widely in timing, amplitude and patterns and are inextricably mixed with irregular factors. The following methods are used for measuring cyclical variations from a time series:

1. Residual method

2. Reference cycle analysis method

3. Direct method

4. Harmonic Analysis method

We shall be discussing only the first method, which is mostly in use.

RESIDUAL METHODS

Among all methods of estimating cyclical movements of a time series, the residual method is most commonly used. This method consists of the isolation of cyclic variation by eliminating the trend and seasonal effects from the time series data. After removing the trend and seasonal variation, the series is left only with the cyclic and irregular variations. Symbolically, we use the multiplicative model, i.e.

$$Y_t = T_t \times S_t \times C_t \times I_t$$

This method proceeds with:

$$\frac{Y_t}{S_t} = \frac{T_t \times S_t \times C_t \times I_t}{S_t} = T_t \times S_t \times C_t$$

and then

$$\frac{T_t \times S_t \times I_t}{T_t} = C_t \times I_t$$

If irregular variations are also removed from the time series data then we will be able to isolate the cyclic fluctuations. We follow the following steps in the computation of cyclic variations:

Step 1: We first compute the trend values preferably by the moving average method of suitable order as discussed in Unit 10. Generally, the order of moving average is taken as the period of seasonal effect.

Step 2: After finding the trend values, we find the seasonal indices preferably by ratio to moving average.

Step 3: After estimating the seasonal effects, we obtain deseasonalised values by dividing the actual value by its corresponding seasonal index which removes the seasonal effect from the original data.

Step 4: We then fit the trend equation on the deseasonalised data and find the trend values and express the deseasonalised data as a percentage of trend values.

Step 5: If the time series does not contain any random variations, then Step 4 will provide the cyclical variations. Otherwise, we filter/smooth out the random variations by computing moving averages of values obtained in Step 4 with an appropriate period. Weighted moving average with suitable weights may also be used, if necessary, for this purpose.

Let us take up an example to illustrate how to calculate cyclic component.

Example 5: Calculate cyclic effects using the deseasonalised and trend values for the demand of electricity calculated in Example 4. Also, plot the original and deseasonalised values and cyclic effect at the same axis.

Solution: The deseasonalised and trend values for the demand of electricity calculated in Example 4 are given in the following table:

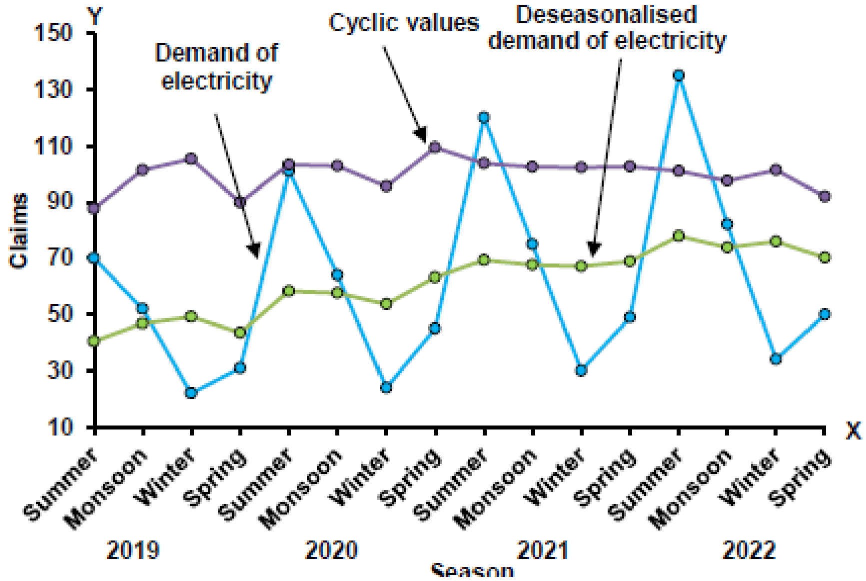
Year	Season	Deseasonalised Demand of Electricity	Trend Value	Cyclic Effect
2019	Summer	38.74	44.19	$\frac{38.74}{44.19} \times 100 = 87.67$
	Monsoon	47.28	46.67	$\frac{47.28}{46.67} \times 100 = 101.31$
	Winter	51.75	49.15	$\frac{51.75}{49.15} \times 100 = 105.29$
	Spring	46.39	51.63	$\frac{46.39}{51.63} \times 100 = 89.85$
2020	Summer	55.89	54.11	$\frac{55.89}{54.11} \times 100 = 103.29$
	Monsoon	58.19	56.59	$\frac{58.19}{56.59} \times 100 = 102.83$
	Winter	56.46	59.07	$\frac{56.46}{59.07} \times 100 = 95.58$
	Spring	67.35	61.55	$\frac{67.35}{61.55} \times 100 = 109.42$
2021	Summer	66.41	64.03	$\frac{66.41}{64.03} \times 100 = 103.72$
	Monsoon	68.19	66.51	$\frac{68.19}{66.51} \times 100 = 102.53$
	Winter	70.57	68.99	$\frac{70.57}{68.99} \times 100 = 102.29$
	Spring	73.33	71.47	$\frac{73.33}{71.47} \times 100 = 102.60$
2022	Summer	74.71	73.95	$\frac{74.71}{73.95} \times 100 = 101.03$
	Monsoon	74.56	76.43	$\frac{74.56}{76.43} \times 100 = 97.55$
	Winter	79.98	78.91	$\frac{79.98}{78.91} \times 100 = 101.36$
	Spring	74.83	81.39	$\frac{74.83}{81.39} \times 100 = 91.94$

We can obtain the cyclic effect by expressing the deseasonalised values as the percentage of trend values as follows:

$$\frac{38.74}{44.19} \times 100 = 87.67$$

You can calculate the rest cyclic effects in the same way. We calculated the same in the last column of the above table.

We now plot the original and deseasonalised values with the cyclic effect



Exercise 5

Compute cyclic component using the deseasonalised and trend values for the number of visitors (in thousands)

ESTIMATION OF RANDOM COMPONENTS

Random variations are also known as irregular variations. An irregular variation cannot be eliminated from any time series because of its nature. It is very difficult to devise a formula for their direct computation. But this component can be removed a little bit by averaging the indices.

Like the cyclical variations, this component can also be obtained as a residue after eliminating the effects of other components. If we use a multiplicative model of time series, then we can estimate it by dividing the original data by all other components. If we use the additive model, then it can be estimated by subtracting all components (trend, seasonal and cyclic) from the original value.

SUMMARY

We have discussed:

- The simple average method is used to estimate the seasonal effect from the given time series data. It is based on the basic assumption that the data do not contain any trend and cyclic components and consists of eliminating irregular components by averaging the monthly (or quarterly or yearly) values over the years.

- The seasonal index also called seasonal effect or seasonal component and it measures the average magnitude of the seasonal influence on the actual values of the time series for a given period within the year and it measures how a particular season compares on average to the mean of the cycle.
- The ratio to trend method is used when cyclical variations are absent from the data, i.e., the time series variable consists of trend, seasonal and random components.
- The ratio to moving average method is better than the simple and ratio to trend methods because of its accuracy, and it can also be applied when all components namely trend, seasonal, cyclic and irregular variations present in time series.
- For calculating deseasonalised values, we divide the actual value by its corresponding seasonal index, that is,

$$\text{Deseasonalised value} = \frac{\text{Actual value}}{\text{Seasonal index}} \times 100$$

- To construct meaningful typical cycle indexes of cyclic component similar to those that have developed for trends and seasons is impossible because the successive cycles vary widely in timing, amplitude and patterns and are inextricably mixed with irregular factors.
- An irregular variation cannot be eliminated from any time series because of its nature. It is very difficult to devise a formula for their direct computation. But this component can be removed a little bit by averaging the indices.
- Time series forecasting is a method for predicting future values over a period or at a precise point in the future using historical and present data.