Sales Forecasting for Automobile Manufacturer

Sales can be seen as a time series. The factors that are responsible to bring about changes in a time series, also called the components of time series, are as follows:

1. General Trend

2. Seasonal Movements

3. Cyclical Movements

4. Irregular Fluctuations

Trend:
The secular trend is the main component of a time series which results from long term effect of socio-economic and political factors. This trend may show the growth or decline in a time series over a long period. This is the type of tendency which continues to persist for a very long period. Prices, export and imports data, for example, reflect obviously increasing tendencies over time.

Seasonality:
These are short term movements occurring in a data due to seasonal factors. The short term is generally considered as a period in which changes occur in a time series with variations in weather or festivities. For example, it is commonly observed that the consumption of ice-cream during summer us generally high and hence sales of an ice-cream dealer would be higher in some months of the year while relatively lower during winter months. Employment, output, export etc. are subjected to change due to variation in weather. Similarly sales of garments, umbrella, greeting cards and fire-work are subjected to large variation during festivals like Valentine's Day, Eid, Christmas, New Year etc. These types of variation in a time series are isolated only when the series is provided biannually, quarterly or monthly.

Cyclic Movement:
These are long term oscillation occurring in a time series. These oscillations are mostly observed in economics data and the periods of such oscillations are generally extended from five to twelve years or more. These oscillations are associated to the well-known business cycles. These cyclic movements can be studied provided a long series of measurements, free from irregular fluctuations is available.

Irregularity:
These are sudden changes occurring in a time series which are unlikely to be repeated, it is that component of a time series which cannot be explained by trend, seasonal or cyclic movements. It is because of this fact these variations some-times called residual or random component. These variations though accidental in nature, can cause a continual change in the trend, seasonal and cyclical oscillations during the forthcoming period. Floods, fires, earthquakes, revolutions, epidemics and strikes etc, are the root cause of such irregularities.

Therefore, sales Y(t) can be expressed in terms of Trend T(t), Seasonality S(t), Cyclic movement C(t) and Irregularity I(t).

$$Y(t) = T(t)*S(t)*C(t)*I(t)$$

Problem Statement

Tera Motocorp is a leading bike manufacturer with dealers across all major states/cities in India. The company faces the following issues due to inconsistent sales across the year:

a. High inventory costs due to dip in sale of bikes during a part of the year

b. Risk of stock-out during peak sales periods (festive season)

The company can reduce its costs by resolving the above issues and thereby, increase its profitability. The unit sales data is available for the past 3 years. Using this data, company wants to predict the sales in the upcoming year to plan their production and procurement activities accordingly.

Given sales Y(t) for 2014-2018

Time (t)	Year	Month	Unit Sales Y(t)
1	2014	April	5,71,054
2		May	6,02,481
3		June	5,41,594
4		July	5,29,862
5		August	5,58,609
6		Septembe	6,04,052
7		October	5,75,056
8		Novembe	5,47,413
9		December	5,26,097
10	2015	January	5,58,982
11		February	4,84,769
12		March	5,31,750
13		April	5,33,305
14		May	5,69,876
15		June	5,42,362
16		July	4,87,580
17		August	4,80,537
18		Septembe	6,06,744
19		October	6,39,802
20		Novembe	5,50,731
21		December	4,99,665

Example | Example_Dataset | Sales_Forecasting_Prob_Statmt | Problem Dataset | Sheet2

Predicted Sales

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Time (t)	Year	Month	Unit Sales Y(t)	CMA1	CMA2	Y(t)/CMA2 = S(t)*I(t)	S(t) Normalised	y(t)/s(t) Normalised	T(t) --> Y = mX+c	Y(T) --> T(t)*S(T) Normalised(Predicted Y(t))		
2	1	2014	April	5,71,054				1.019874206	559925.9169	545365.6901	556204.4003		
3	2		May	6,02,481				1.025484106	587508.862	546265.9801	560187.0801		
4	3		June	5,41,594				0.972888808	556686.4325	547166.2701	532331.9405		
5	4		July	5,29,862				0.90809494	583487.4491	548066.56	497696.4699		
6	5		August	5,58,609				0.972616968	574336.0626	548966.85	533934.4734		
7	6		September	6,04,052				1.134071815	532639.9899	549867.14	623588.8254		
8	7		October	5,75,056	5,52,643	5,51,070	1.043525521	1.097193181	524115.543	550767.43	604298.2687		
9	8		November	5,47,413	5,49,498	5,48,139	0.998675594	0.991242086	552249.554	551667.7199	546836.2616		
10	9		December	5,26,097	5,46,780	5,46,812	0.962116046	0.926673935	567726.1228	552568.0099	512050.3719		
11	10	2015	January	5,58,982	5,46,844	5,45,083	1.025499496	1.013236859	551679.4964	553468.2999	560794.4817		
12	11		February	4,84,769	5,43,321	5,40,068	0.897607477	0.93186123	520215.8695	554368.5899	516594.596		
13	12		March	5,31,750	5,36,815	5,36,927	0.99035794	1.01912457	521771.3474	555268.8798	565888.1584		
14	13		April	5,33,305	5,37,039	5,39,737	0.988083085	1.019874206	522912.5286	556169.1698	567222.5906		
15	14		May	5,69,876	5,42,435	5,42,573	1.050321339	1.025484106	555714.1225	557069.4598	571265.8768		
16	15		June	5,42,362	5,42,711	5,41,610	1.001388607	0.972888808	557475.8341	557969.7498	542842.525		
17	16		July	4,87,580	5,40,509	5,40,691	0.901772826	0.90809494	536926.2382	558870.0397	507507.0551		
18	17		August	4,80,537	5,40,872	5,43,632	0.883938506	0.972616968	494066.0256	559770.3297	544442.121		
19	18		September	6,06,744	5,46,391	5,49,507	1.104159969	1.134071815	535013.7373	560670.6197	635840.7472		SUMMARY OUTPUT
20	19		October	6,39,802	5,52,624	5,55,933	1.150860842	1.097193181	583126.1175	561570.9097	616151.7729		
21	20		November	5,50,731	5,59,243	5,59,795	0.983808578	0.991242086	555596.8695	562471.1996	557545.1254		*Regression Statistics*
22	21		December	4,99,665	5,60,347	5,60,645	0.891231824	0.926673935	539202.6055	563371.4896	522061.6749		Multiple R	0.3

Graph for actual sales vs predicted sales with predicted sales for the next year