**1.1 INTRODUCTION OF THE INDUSTRY**

Automobile is one in every of the biggest industries in worldwide market. Being the chief in product and procedure technology with inside the production sector, it's been diagnosed as one of the drivers of monetary growth. During the last decade, properly directed efforts were made to offer a brand new appearance to the auto coverage for figuring out the sector’s complete ability for the economy. Aggressive advertising and marketing through the automobile finance businesses have additionally performed a giant function in boosting vehicle demand, specifically from the populace with inside the center earnings group.

A Nations financial system is widely known from its transport system. For immediately and fast increase in financial system, a well-evolved and well-networked transportation system is critical. As India’s delivery network is growing at a quick pace, Indian Automobile Industry is developing too. Also, the Automobile enterprise has sturdy to and fro linkages and hence affords employment to a huge phase of the population. Thus the position of Automobile Industry could be very critical in Indian financial system. Various sorts of vehicles are manufactured with the aid of using the Automobile Industry. Indian Automobile Industry consists of the producing of trucks, buses, passenger cars, defense vehicles, two-wheelers.

The automobile producing is dominated by organizations like TVS, Honda Motorcycle and Scooter India (Pvt.) Ltd., Hero Honda, Yamaha, Bajaj, and so forth. The vehicle business in the nation is one of the vital areas of the economy as far as the business openings that it offers. The business straightforwardly utilizes near around 0.2 million individuals and in a indirect way utilizes around 10 million individuals. The possibilities of the business moreover has an orientation on the auto-segment industry which is additionally a significant area in the Indian economy straightforwardly utilizing 0.25 million individuals.

**1.2 INTRODUCTION TO TVS MOTOR COMPANY**

The TVS group was established in 1911 by shri.T.V.Sundaram lyengar.

TVS Motor Company is the third biggest 2-wheeler organization in India with an income of over ₹18,217 cro (over US$2.9 billion). It has a yearly offer of in excess of 3 million units and a yearly limit of over 4.95 million vehicles. TVS Motor is additionally the second biggest exporter in India with fares to more than 60 Countries. An individual from the TVS Group, it is the biggest organization of the gathering regarding size and turnover.

TVS Motor makes the biggest scope of 2-wheelers, beginning from mopeds, to bikes, suburbanite bikes, to dashing motivated bicycles like the Apache arrangement and the RR310. Whatever your prerequisite be , we have one for everybody.

TVS Motor's solidarity lies in its broad innovative work, bringing about items that are industry driving as far as development. We at TVS convey absolute consumer loyalty by expecting client need and introducing quality vehicles at the perfect time and at the perfect cost.

TVS has consistently represented creative, simple to-deal with, and climate amicable items, sponsored by solid client assistance. In excess of 44 million + customers have purchased a TVS item to date. TVS items give you only motivations to smile!

The organization has four assembling plants, three situated in India (hosur in Tamil Nadu, Mysore in Karnataka and Nalagarh in Himachal Pradesh) and one in Indonesia at Karawang.

According to a Medium article, TVS Motor Company is known for producing high quality, affordable, and reliable two wheelers. The company's mission and vision statement is to be a leading manufacturer environmentally friendly, lifetime personal transportation products. TVS's vision is to improve the quality of life of people around the world by providing safe, sustainable, and responsible mobility solutions.

TVS Motor Company is India's third-largest motorcycle company in terms of revenue. It has an annual production capacity of over four million vehicles and annual sales of three million units. TVS is also India's second-largest two-wheeler exporter, with exports to more than 60 countries.

According to a Scribe document, TVS has to improve itself gain the first position in the market.

The TVS group is today a leading player in automobile and automotive industry.

The group has 30 companies and employs more than 40,000 people

**1.3 ABSTRACT**

This study's main focus is to analyze the overall performance of TVS Motors using financial statements that show all incomes and expenses, as well as assets and liabilities, in the format of profit and loss and balance sheet. This statement is analyzed and is known as performance. It assists the firm in making decisions and learning about their financial functions in business. The method used to analyze their performance was ratio analysis (liquidity, profitability, and activity) and schedule changes in working capital. This method assisted in analyzing the company's performance.

**1.4 PRODUCTS:**

**TWO WHEELER**

Scooterette-Scooter pep, scooty teenz ,scooty streak

Scooter-wego

Motorcycles-Sports,city,jive,flame,apache

**THREE WHEELER**

TVS king

**KEYWORDS**: Working capital, TVS motors, financial performance

**1.5 HISTORY OF TVS MOTOR COMPANY**

TVS motor company limited is a prominent two-wheeler and three-wheeler manufacture in India. The company’s history can be traced back to 1911 when T.V. sun dram linger started Madurai’s first bus service .in 1962, sundaram Clayton was founded in collaboration with Clayton demander holdings, untied kingdom.

In 1962, TVS began manufacturing brakes, exhausts, compressors, and other automotive parts . In 1976, TVS set up a manufacturing plant to make mopeds, and in 1989, TVS began making bikes .in 1978 , TVS motors became a division of TVS group , a conglomerate with interests in logistics, electronics ,textiles ,and automotive components.

TVS emblem is a red, leaping horse that moves to the right, representing the brand’s progress and speed. The red color of the TVS emblem represents the brand as passionate, energetic, optimistic, and innovative.

**1.6 SCOPE OF THE STUDY**

This study is limited to the time series analysis on TVS motor company from 2001 to 2020

**2.1OBJECTIVE OF THE STUDY**

1. The objective of the study is to analyze the customer buying behavior of the Respondents in motorbikes of different brands

2. To study the future pros of TVS Motorbikes

3. To provide a fair picture of technology used by TVS Motors

4. To study the sales trend of TVS Motors

5. To analyze the quality of after sales services being provided by TVS Motors

**2.2 INTRODUCTION:** As long as we are accumulating data, "time "remains a crucial factor. Essentially, in time series analysis, time is a significant element of data. A time series is a collection of time order observations of specific process where the time interval between each observation is constant, say, weeks, months and years, in some cases small deviations in time intervals are acceptable. Time series data is helpful to investigate how an asset, security or an economic variable of interest changes over time.

We know that planning about future is very necessary for the every business firm, every government institute, every individual and for every country. Every family is also doing planning for his income expenditure. As like every business is doing planning for possibilities of its financial resources & sales and for maximization its profit. Time series data often arise when monitoring industrial processes or tracing corporate business metrics. The essential difference between modeling data via time series methods. Time series analysis accounts for the fact that data points taken over time may have an internal structure (such as autocorrelation, trend or seasonal variation) that should be accounted. This section will give a brief overview of some of the more widely used techniques in the rich and rapidly growing field of time series modeling and analysis.

**2.3 TIME SERIES ANALYSIS:** Time series analysis is a technique in statistics that deals with time series data and trend analysis. Time series data follows periodic time intervals that have been measured in regular time intervals or have been collected in particular time intervals. In other words, a time series is simply a series of data points ordered in time, and time series analysis is the process of making sense of this data. In a business context, examples of time series data include any trends that need to be captured over a period of time. A Google trends report is a type of time series data that can be analyzed. There are also far more complex applications such as demand and supply forecasting based on past trends. A time series is a set of observation taken at specified times, usually at equal intervals. A time series may be defined as a collection of reading belonging to different time periods time periods of some economic or composite variables.**2.4 TIME SERIES GRAPH:** Time series graphs are simply plots of time series data on axis (typically Y) against time on the other axis (typically X). Graphs of time series data points can often illustrate trends or patterns in a more accessible, intuitive way.**2.5 TIME PLOT STATISTICS**: A time series plot is a graph in which the x-axis represents some measure of time. In fact, the x-axis is labelled as the time -axis. The y-axis represents the variable being measured. Data points are displayed and connected with straight lines in most cases, allowing for interpretation of the resulting graph.**2.6 TIME SERIES ANALYSIS EXAMPLES:** Time series analysis is used for non-stationary data things that are constantly fluctuating over time or are affected by time. Industries like finance, retail, and economics frequently use time series analysis because currency and sales are always changing. Stock market analysis is an excellent example of time series analysis in action, especially with automated trading algorithms. Likewise, time series analysis is ideal for forecasting weather changes, helping meteorologists predict everything from tomorrow's weather report to future years of climate change. Examples of time series analysis in action include:

* Weather data
* Rainfall measurements
* Temperature readings
* Heart rate monitoring (EKG)
* Brain monitoring (EEG)
* Quarterly sales
* Stock prices
* Automated stock trading
* Industry forecasts
* Interest rates

**2.7 TYPES OF TIME SERIES ANALYSIS:**

Because time series analysis includes many categories or variations of data, analysts sometimes must make complex models. However, analysts can't account for all variances, and they can't generalize a specific model to every Sample. Models that are too complex or that try to do too many things can lead to a lack of fit.

Lack of fit or over fitting models lead to those models not distinguishing between random error and true relationships, leaving analysis skewed and forecasts incorrect.

Models of time series analysis include:

* **Classification:** Identifies and assigns categories to the data.
* **Curve fitting:** Plots the data along a curve to study the relationships of variables within the data.
* **Descriptive analysis:** Identifies patterns in time series data, like Trends, cycles, or seasonal variation.
* **Explanative analysis:** Attempts to understand the data and the Relationships within it, as well as cause and effect.
* **Exploratory analysis:** Highlights the main characteristics of the time series data, usually in a visual format.
* **Forecasting:** Predicts future data. This type is based on historical trends.It uses the historical data as a model for future data, predicting scenariosthat could happen along future plot points.
* **Intervention analysis:** Studies how an event can change the data.
* **Segmentation:** Splits the data into segments to show the underlying properties of the source information.

**DATA CLASSIFICATION**Further, time series data can be classified into two main categories:

* Stock time series data means measuring attributes at a certain point in time, like a static snapshot of the information.
* Flow time series data means measuring the activity of the attributes over a certain period, which is generally part of the total whole and makes up a portion of the result.

**IMPORTANT CONSIDERATIONS FOR TIME SERIES ANALYSIS** While time series data is data collated over time, there are different types of data that describe how and when that time data was recorded. For

**Example:**

* Time series data is data that is recorded over consistent intervals of time.
* Cross-sectional data consists of several variables recorded at the same time.
* Pooled data is a combination of both time series data and cross- sectional data.

**2.8 USES OF TIME SERIES DATA:**

* Time series data is gathered, stored, visualized and analyzed for various purposes across various domains:
* In data mining, pattern recognition and machine learning, time series analysis is used for clustering, classification, query by content, anomaly detection and forecasting.
* In signal processing, control engineering and communication engineering, time series data is used for signal detection and estimation.
* In statistics, econometrics, quantitative finance, seismology, meteorology, and geophysics the time series analysis is used for forecasting.

**2.9 MODELS AND TECHNIQUES:** Just as there are many types and models, there are also a variety of methods to study data. Here are the three most common.**Box-Jenkins ARIMA models:** These univariate models are used to better understand a single time-dependent variable, such as temperature over time, and to predict future data points of variables. These models work on the assumption that the data is stationary. Analysts have to account for and remove as many differences and seasonality's in past data points as they can. Thankfully, the ARIMA model includes terms to account for moving averages, seasonal difference operators, and autoregressive terms within the model.**Box-Jenkins Multivariate Models:** Multivariate models are used to analyze more than one time-dependent variable, such as temperature and humidity, over time.

**Holt-Winters Method:** The Holt-Winters method is an exponential smoothing technique. It is designed to predict outcomes, provided that the data points include seasonality.

**2.10 APPLICATIONS:**The usage of time series models is twofold: Obtain an understanding of the underlying forces and structure that produced the observed data Fit a model and proceed to forecasting, monitoring or even feedback and feed forward control.

**Time Series Analysis is used for many applications such as:**

* Economic Forecasting
* Sales Forecasting
* Budgetary Analysis
* Stock Market Analysis
* Yield Projections
* Process and Quality Control
* Inventory Studies
* Workload Projections
* Utility Studies
* Census Analysis

**2.11 ADVANTAGES OF TIME SERIES ANALYSIS:** Data analysts have much to gain from time series analysis. From cleaning raw data, making sense of it, and uncovering patterns to help with projections much can be accomplished through the application of various time series models.Here are a few advantages of time series analysis:

**It Cleans Data and Removes Confounding Factors** Data cleansing filters out noise, removes outliers, or applies various averages to gain a better overall perspective of data. It means zoning in or the signal by filtering out the noise. The process of time series analysi removes all the noise and allows businesses to truly get a clearer picture c what is happening day-to-day.Provides Understanding of Data The models used in time series analysis do help to interpret the true meaning of the data in a data set, making life easier for data analysts. Autocorrelation patterns and seasonality measures can be applied to predict when a certain data point can be expected. Furthermore, stationary measures can gain an estimate of the value of said data point. This means that businesses can look at data and see patterns across time and space, rather than a mass of figures and numbers that aren't meaningful to the core function of the organization.**Forecasting Data** Time series analysis can be the basis to forecast data. Time series analysis is inherently equipped to uncover patterns in data which form the base to predict future data points. It is this forecasting aspect of time series analysis that makes it extremely popular in the business area. Where most data analytics use past data to retroactively gain insights, time series analysis helps predict the future. It is this very edge that helps management make better business decisions.**2.12 DISADVANTAGES OF TIME SERIES ANALYSIS:** Time series analysis is not perfect. It can suffer from generalization from a single study where more data points and models were warranted. Human error could misidentify the correct data model, which can have a snowballing effect on the output.It could also be difficult to obtain the appropriate data points. A major point of difference between time-series analysis and most other statistical problems is that in a time series, observations are not always independent.**For example,** a single chance event may affect all later data points, andit is up to every data scientist to accurately gauge which of these events may have an impact on the analysis in question. Are there similarities in predictions that can make historical data useful.

**2.13 FUTURE OF TIME SERIES ANALYSIS:** Time series analysis represents a highly advanced area of data analysis. It focuses on describing, processing, and forecasting time series. Time series are time-ordered data sets. When interpreting a time series, autocorrelation patterns, seasonality, and stationary must be taken into account before selecting the right model for analysis. There are several time series analysis models, ranging from basic, fine-tuned, and advanced models help data analysis to predict time series heavier with much greater accuracy.With the advent of automation and machine learning techniques. comprehending this information and conducting complex calisations is not as tough as it once was, having the way for a better understanding of our past, and our future.

**METHODOLOGY**

**3.1 TIME SERIES ANALYSIS**

One of the most important tasks before economists and business – men these days is to make estimates for the futures. A businessmen or an industry may be interested in finding out his or its likely sales in the year 2020 as a long term planning so that the production can be adjusted accordingly and avoid the possibility of either unsold stocks or inadequate production to meet the demand. Similarly, an economist may be interested in estimating the likely population in the coming years so that proper planning can be carried out with regard to food supply, jobs for the people, etc. the first step in the making estimates for the future consist of gathering information form the past. In this connection, one usually deals with statistical data, which are collected, observed or recover at successive intervals of time. Such date generally referred to as “time series”. Thus when we observe numerical data at different points of time the set of observations is known as tie series. Mathematically, a time series is de – fined by the values y1,y2… of a variable y at times t1,t2… thus, y is a function of t; this is symbolized y=F(t). Hence, in the analysis of time series , time is the most important factor because the variable is related to time which may be either year, month , week, day, hour or even minute o second.

The sales of a firm and thus its profit can be affected by various forces, which the statistician classifies under four broad heads.

* Changes that have occurred as a result of general tendency of the data to increase or decrease, known as “secular trends”
* Changes that have taken place during a period of twelve months as a result of changing climate, weather condition, festivals etc. Such changes are called “Seasonal variations”.
* Changes that have taken place as results of booms and depression. Such changes are classified under the head “cyclical variation”.
* Changes that have taken place as results of such forces that could not be predicated like floods, earthquakes, famines etc. such changes are classified under the head “irregular variation”.
* These are called components of time series.

**3.2 RESEARCH METHODOLOGY**

Research methods may be understood as all those methods/techniques that are used for the conduction of research. Research methods or techniques thus refer to the methods the researcher use in performing the research operations. In other words, all those methods which are used by the researcher during the course of studying his research problems are turned as research methods since the object of research, particularly the applied research, is to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible. Keeping, this view, research methods can be put into the following three groups

* **Collection of data.**: These methods will used where the data already
* In the first group, we include those methods which are concerned with the Available are not sufficient to arrive at the required solution .
* The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknown.
* The third group consists of those methods, which are used to evaluate
* Accuracy of the results obtained.
* Research methods falling in the above stated last groups are generally taken as Analytical tools of research.

Research methodology is a way to systematically solve the research problem. It may be understood as the science of studying how research is done scientifically .Because of the time constraint only the secondary research is done in studying the market strategies of the company.

**3.3 PRODUCTION CAPACITY**

* TVS Motor Company is a reputed two and three wheeler manufacturer globally, championing progress through Sustainable Mobility with four state-of-the-art manufacturing facilities in hosur, Mysore and Nalagarh in India and Karawang in Indonesia.
* Rooted in our 100-year legacy of Trust, a Value, and Service, we take pride in making internationally aspiration products of the highest -quality through innovative and sustainable processes.
* We are the only two-wheeler company to have received the prestigious Deming Prize.
* Our a products lead in their respective categories in the J.D. Power IQS and APEAL surveys.
* We have been ranked No. 1 Company in the J.D. Power Customer Service Satisfaction Survey for consecutive four years.
* Our group company Norton Motor cycles , based in the United Kingdom, is one of the most motive motorcycle brands in the world.
* Our subsidiaries in the personal e-mobility space, Swiss E-Mobility Group (SEMG) and EGO Movement have a leading position in the e-bike market in Switzerland.
* TVS Motor Company endeavors to deliver the most superior customer experience across 80 countries in which we operate.

**3.4 ROLL OF THE TIME SERIES**

Time series analysis is of great significance not only to the economist and businessmen but also to the scientist, biologist, astrologist, geologist, sociologist, research worker etc., for the reasons given below.

* In helps in the understanding of past behavior

By observing data over a period of time, one can easily understand what changes have taken place in the past. Such analysis will be extremely helpful in predicting the future behavior.

* It helps planning future operations

Statistical techniques have been evolved which enable time series to be analyzed in such way that the influences which have determined the form of that series may be ascertained. If the regularity of occurrence of any established then, with in limits, prediction of probable future variations would become possible.

* It helps in evaluating current accomplishments

The actual performance can be compared with the expected performance and the cause of variation analyzed. Time series analysis will enable us to apply the scientific procedure of holding other things constant as we examine one variable at a time.

* It facilitates comparison

Different time series are often compared and important conclusion drawn there from. However, one should not be led to believe that by time series analysis one could foretell with 100 percent accuracy the course of future events. After all statisticians are not fortune-tellers. But this doses not mean that time series analysis is of no value. When such analysis is coupled with a careful examination of current business indicators, we have improvement in forecasting future business conditions.

* Components of time series

Now, we shall discuss the four components of time series elaborately. It is ordinarily assumed that there is multiplicative relationship between these four components. Symbolically,

**Y=T\*C\*S\*I**

Where,

Y ~ Result of four elements

T ~ Trend

C ~ Cyclical variation

S ~ Seasonal variation

I ~ Irregular variation

Time series analysis amounts to investigating the factors T,C,S and I and is often referred to as a decomposition of a time series into its basic component movements.

**3.5 SECULAR TREND AND ESTIMATION:**

The component of a time series, which reveals the general tendency of the data, is called long period or secular trend can be either upward or downward. It cannot be both ways. Secular trend is the effect of such factors which are more or less constant for a long time or which change very gradually and slowly. Such factors are change population or tastes and habits of people, etc. In the analysis of time series, the trend values are taken as normal values, a idea is obtained about the different types of fluctuations, which may be regular or irregular. The concept of normal values is no doubt an empirical one but it is very useful in studying economic events.

A trend can ne estimated in any of several ways. They are listed be-low,

* The least squares method
* The free hand method
* The semi-Average method
* The moving-Average method

Of these methods, the least-squares method, free hand method and the moving average are method are chosen for this study.

**3.6 THE LEAST-SQUARES METHOD:**

One of the best ways of obtaining trend values is the method of least squares. With this method, a straight line trend is obtained. This line is called the line of the best fit. It is a mathematical method and with its help a trend line is fitted to the data in such manner that the following two conditions are satisfied.

* The sum of deviation of the actual value of y and the computed value of y is zero.
* The sum of square of the deviation of the actual and computed values is least from this line and hence the name method of lest squares.

The straight line trend is represented by equation,

Y= a + b x

Where,

a-The y-intercept

b- The slop of the trend line

x - Time so that∑ x=0

The constants a and b are calculated as,

**a=∑xy/**

**b=∑x y/∑**

# 3.7 THE FREE HAND METHOD

The is a basic method and it represents the data as graphic data. In this method x-axis and y-axis are tow variable lines. The independent variables are noted in the x-axis and dependent variables noted in y-axis.

**3.8 MOVING AVERAGE METHOD:**

A three year moving average is computed. Since the results thus obtained fall between successive quarters instead of in the middle of the year, a 3year moving average is computed, the result is often called four quarterly centers moving averages. The original data for each year is expressed as percentage of the four quarterly of year centered moving average that corresponding to the original data. The percentages for the corresponding year are then average giving the required index. If their mean is not 100%, they should be adjusted, which is done by multiplying them by a suitable factor.

**MERITS:** This method is easy to understand and easy to use because there are no mathematical complexities involved. It is in this respect better than the free hand curve method. It is a flexible method in the sense that if a few more observations are added, the entire calculations are not changed.**DEMERITS**: It is not possible to calculate trend values for all the items of the series. Some information is always lost at its ends. This method can determine accurate values of trend only if the oscillatory and the random fluctuations are uniform in terms of period and amplitude and the trend is, at least, approximately linear. However, these conditions are rarely met in practice. When the trend is not linear, the moving averages will not give correct values of the trend**3.9** **SEMI AVERAGE METHOD**

Under this method, as the name itself suggests semi-averages are calculated to find out the trend values. By semi-averages is meant the verages of the two halves of a series. In this method, thus, the given series is divided into two equal parts (halves) and the arithmetic mean of the values of each part (half) is calculated. The computed means are termed as semi-averages. Each semi-average is paired with the centre of time period of its part. The two pairs are then plotted on a graph paper and the points are joined by a straight line to get the trend. It should be noted that if the data is for even number of years, it can be easily divided into two halves. But if it is for odd number of years, we leave the middle year of the time series and two halves constitute the periods on each side of the middle year.**MERITS:** It is simple method of measuring trend. It is an objective method because anyone applying this to a given data would get identical trend value.

**DEMERITS**: This method can give only linear trend of the data irrespective of whether it exists or not. This is only a crude method of measuring trend, since we do not know whether the effects of other components are completely eliminated or not.

**3.10 SEASONAL VARIATIONS AND ESTIMATION:**

Seasonal variations are those periodic movements, which occur regularly every year and have their origin in the nature of the year itself. Since these variations repeat during the period of 12 months they can predicated fairly accurately. Nearly every type of business activity is susceptible to seasonal influence to a greater or lesser degree and as such these variation are regarded as normal phenomenon recurring every year. The factors that cause seasonal variation are climate, weather conditions, tradition and habits.

To determine the seasonal factor s, we must estimate how the data in the time series vary from month to month

Various methods are available for computing seasonal index. They are,

* The average- percentage method
* The percentage trend or ratio-to-trend method.
* The percentage moving-average or ratio-to-moving average method.
* The link-relative method.

The methods taken for this study the link relative method and ratio-to-trend method.

**3.11 DEPERSONALIZATION OF DATA**

If the original monthly data are divided by the corresponding seasonal index number, the resulting data are said to depersonalized or adjusted for seasonal variation. Such data still include trend, cyclic and irregular movements.

**3.12 CYCLIC VARIATION ESTIMATION:**

These refer to long term oscillations or swing about a trend a trend line or curve. These cycles may not be periodic.tat is they may or may not follow exactly similar patterns after equal intervals of time. In business and economic activities, movements are considered cyclic only if the recur after time intervals of more than one year. A important example of cyclic movements is the so called business cycles representing intervals of prosperity, recession, depression and recovery.

After the data have been depersonalized, they can also be adjusted for trend simply by dividing the data by the corresponding trend values. The process of adjusting for seasonal variation and trend corresponds to dividing Y by ST, which yields CI. An appropriate moving average then serves to eliminate the irregular variation I and to leave only the cyclic variation C. once these cyclic variations have been isolated them can be studied in detail.

**3.13 IRREGULAR VARIATION AND ESTIMATION:**

Irregular variation refers to such variation, which do not repeat in a definite pattern. Irregular variation is really intended to include all types of variations other than those accounting for the trend, seasonal and cyclical movements. Quantitatively, it is almost impossible to separate out the irregular and cyclical movements. Therefore, while analyzing time series, the trend and irregular variation. A suitable moving average can serve to eliminate irregularities and reveal whatever cyclic pattern exists.

**3.14 FORECASTING**

The above methods and principles are used in the important work of foresting time series. Forecasting situation vary widely in their time horizons, factor determining actual outcomes, types of data patterns and many other aspects. Quantitative forecasting can be applied when three conditions quantitative exist.

1. Information about the past is variable.
2. This information can be quantified in the form of numerical data.
3. It can be assumed that some aspect of past pattern will continue into the future.

# 3.15 FITTING THE STRAIGHT LINE BY LEAST SQUARE METHOD:

This is a particular form of linear types of growth line. The equation of the straight line of the form,

**= a + b x;**  (x=1, 2,3,…..)

Where, is the value of the growth characteristics at the point of time t and a And b are the parameters to be estimated. In fitting of this growth line .

1. Defines constant
2. Coefficient of X

**a=∑xy/**

**b=∑x y/∑**

**Table 4.1 SEMI AVERAGE METHOD**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Sales** | **semi total** | **semi average** | **trend value** |
| 2011 | 7949 |  |  | 53961.8 |
| 2012 | 7875 |  |  | 50731.4 |
| 2013 | 8694 | 47501 | 9500.2 | 47501 |
| 2014 | 10788 |  |  | 44270.6 |
| 2015 | 12195 |  |  | 41040.2 |
| 2016 | 13363 |  |  | 37809.8 |
| 2017 | 15618 |  |  | 34579.4 |
| 2018 | 18217 | 63653 | 12730.6 | 31349 |
| 2019 | 16455 |  |  | 28118.6 |
| 2020 | 16423 |  |  | 24888.2 |

**Figure 4.1**

**Table 4.2 LEAST SQUARE METHOD**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **Sales** | **X** | **X2** | **Xy** | **yc** |
| 2001 | 1984 | 19 | 361 | 37696 | -150634 |
| 2002 | 2391 | 17 | 289 | 40647 | -134736 |
| 2003 | 2566 | 15 | 225 | 38490 | -118838 |
| 2004 | 2955 | 13 | 169 | 38415 | -102940 |
| 2005 | 3306 | 11 | 121 | 36366 | -87041.6 |
| 2006 | 3921 | 9 | 81 | 35289 | -71143.6 |
| 2007 | 3310 | 7 | 49 | 23170 | -55245.6 |
| 2008 | 3741 | 5 | 25 | 18705 | -39347.6 |
| 2009 | 4485 | 3 | 9 | 13455 | -23449.6 |
| 2010 | 6857 | 1 | 1 | 6857 | -7551.55 |
| 2011 | 7949 | -1 | 1 | -7949 | 8346.45 |
| 2012 | 7875 | -3 | 9 | -23625 | 24244.45 |
| 2013 | 8694 | -5 | 25 | -43470 | 40142.45 |
| 2014 | 10788 | -7 | 49 | -75516 | 56040.45 |
| 2015 | 12195 | -9 | 81 | -109755 | 71938.45 |
| 2016 | 13363 | -11 | 121 | -146993 | 87836.45 |
| 2017 | 15618 | -13 | 169 | -203034 | 103734.5 |
| 2018 | 18217 | -15 | 225 | -273255 | 119632.5 |
| 2019 | 16455 | -17 | 289 | -279735 | 135530.5 |
| 2020 | 16423 | -19 | 361 | -312037 | 151428.5 |
| ∑10 | ∑163093 |  |  |  |  |

**Figure 4.2**

**Table 4.3 2 YEARS MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Sales** | **2 year total** | **2 year average** |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | 4375 | 2187.5 |
| 2003 | 2566 | 4957 | 2478.5 |
| 2004 | 2955 | 5521 | 2760.5 |
| 2005 | 3306 | 6261 | 3130.5 |
| 2006 | 3921 | 7227 | 3613.5 |
| 2007 | 3310 | 7231 | 3615.5 |
| 2008 | 3741 | 7051 | 3525.5 |
| 2009 | 4485 | 8226 | 4113 |
| 2010 | 6857 | 11342 | 5671 |
| 2011 | 7949 | 14806 | 7403 |
| 2012 | 7875 | 15824 | 7912 |
| 2013 | 8694 | 16569 | 8284.5 |
| 2014 | 10788 | 19482 | 9741 |
| 2015 | 12195 | 22983 | 11491.5 |
| 2016 | 13363 | 25558 | 12779 |
| 2017 | 15618 | 28981 | 14490.5 |
| 2018 | 18217 | 33835 | 16917.5 |
| 2019 | 16455 | 34672 | 17336 |
| 2020 | 16423 | 32878 | 16439 |

**Figure 4.3**

|  |  |  |  |
| --- | --- | --- | --- |
| Year | sales | 4 year total | 4 year average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | 9896 | 2474 |
| 2004 | 2955 | 11218 | 2804.5 |
| 2005 | 3306 | 12748 | 3187 |
| 2006 | 3921 | 13492 | 3373 |
| 2007 | 3310 | 14278 | 3569.5 |
| 2008 | 3741 | 15457 | 3864.25 |
| 2009 | 4485 | 18393 | 4598.25 |
| 2010 | 6857 | 23032 | 5758 |
| 2011 | 7949 | 27166 | 6791.5 |
| 2012 | 7875 | 31375 | 7843.75 |
| 2013 | 8694 | 35306 | 8826.5 |
| 2014 | 10788 | 39552 | 9888 |
| 2015 | 12195 | 45040 | 11260 |
| 2016 | 13363 | 51964 | 12991 |
| 2017 | 15618 | 59393 | 14848.25 |
| 2018 | 18217 | 63653 | 15913.25 |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

**Table 4.4**  4 YEAR MOVING AVERAGE

**Figure 4.4**

**Table 4.5 6 YEAR MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| year | Sales | 6 year total | 6 years average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | \_ | \_ |
| 2004 | 2955 | 17123 | 2853.833 |
| 2005 | 3306 | 18449 | 3074.833 |
| 2006 | 3921 | 19799 | 3299.833 |
| 2007 | 3310 | 21718 | 3619.667 |
| 2008 | 3741 | 25620 | 4270 |
| 2009 | 4485 | 30263 | 5043.833 |
| 2010 | 6857 | 34217 | 5702.833 |
| 2011 | 7949 | 39601 | 6600.167 |
| 2012 | 7875 | 46648 | 7774.667 |
| 2013 | 8694 | 54358 | 9059.667 |
| 2014 | 10788 | 60864 | 10144 |
| 2015 | 12195 | 68533 | 11422.17 |
| 2016 | 13363 | 78875 | 13145.83 |
| 2017 | 15618 | 86636 | 14439.33 |
| 2018 | 18217 | 92271 | 15378.5 |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

**Figure 4.5**

**Table 4.6 8 YEARS MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Sales | 8 years total | 8 year average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | \_ | \_ |
| 2004 | 2955 | \_ | \_ |
| 2005 | 3306 | 26565 | 3320.625 |
| 2006 | 3921 | 29241 | 3655.125 |
| 2007 | 3310 | 34096 | 4262 |
| 2008 | 3741 | 39830 | 4978.75 |
| 2009 | 4485 | 45365 | 5670.625 |
| 2010 | 6857 | 50142 | 6267.75 |
| 2011 | 7949 | 57440 | 7180 |
| 2012 | 7875 | 67069 | 8383.625 |
| 2013 | 8694 | 79063 | 9882.875 |
| 2014 | 10788 | 91288 | 11411 |
| 2015 | 12195 | 102574 | 12821.75 |
| 2016 | 13363 | 111899 | 13987.38 |
| 2017 | 15618 | 122541 | 15317.63 |
| 2018 | 18217 | \_ | \_ |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

**Figure4.6**

**Table 4.7 3 YEARS MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Sales | 3 years total | 3 years moving |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | 6941 | 2313.667 |
| 2003 | 2566 | 7912 | 2637.333 |
| 2004 | 2955 | 8827 | 2942.333 |
| 2005 | 3306 | 10182 | 3394 |
| 2006 | 3921 | 10537 | 3512.333 |
| 2007 | 3310 | 10972 | 3657.333 |
| 2008 | 3741 | 11536 | 3845.333 |
| 2009 | 4485 | 15083 | 5027.667 |
| 2010 | 6857 | 19291 | 6430.333 |
| 2011 | 7949 | 22681 | 7560.333 |
| 2012 | 7875 | 24518 | 8172.667 |
| 2013 | 8694 | 27357 | 9119 |
| 2014 | 10788 | 31677 | 10559 |
| 2015 | 12195 | 36346 | 12115.33 |
| 2016 | 13363 | 41176 | 13725.33 |
| 2017 | 15618 | 47198 | 15732.67 |
| 2018 | 18217 | 50290 | 16763.33 |
| 2019 | 16455 | 51095 | 17031.67 |
| 2020 | 16423 | \_ | \_ |

**Figure 4.7**

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Sales | 5 year total | 5 year average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | 13202 | 2640.4 |
| 2004 | 2955 | 15139 | 3027.8 |
| 2005 | 3306 | 16058 | 3211.6 |
| 2006 | 3921 | 17233 | 3446.6 |
| 2007 | 3310 | 18763 | 3752.6 |
| 2008 | 3741 | 22314 | 4462.8 |
| 2009 | 4485 | 26342 | 5268.4 |
| 2010 | 6857 | 30907 | 6181.4 |
| 2011 | 7949 | 35860 | 7172 |
| 2012 | 7875 | 42163 | 8432.6 |
| 2013 | 8694 | 47501 | 9500.2 |
| 2014 | 10788 | 52915 | 10583 |
| 2015 | 12195 | 60658 | 12131.6 |
| 2016 | 13363 | 70181 | 14036.2 |
| 2017 | 15618 | 75848 | 15169.6 |
| 2018 | 18217 | 80076 | 16015.2 |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

Table 4.8 5 YEARS MOVING AVERAGE

**Figure 4.8**

**Table 4.9 7 YEARS MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Sales | 7 year total | 7 years average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | \_ | \_ |
| 2004 | 2955 | \_ | \_ |
| 2005 | 3306 | 20433 | 2919 |
| 2006 | 3921 | 22190 | 3170 |
| 2007 | 3310 | 24284 | 3469.143 |
| 2008 | 3741 | 28575 | 4082.143 |
| 2009 | 4485 | 33569 | 4795.571 |
| 2010 | 6857 | 38138 | 5448.286 |
| 2011 | 7949 | 42911 | 6130.143 |
| 2012 | 7875 | 50389 | 7198.429 |
| 2013 | 8694 | 58843 | 8406.143 |
| 2014 | 10788 | 67721 | 9674.429 |
| 2015 | 12195 | 76482 | 10926 |
| 2016 | 13363 | 86750 | 12392.86 |
| 2017 | 15618 | 95330 | 13618.57 |
| 2018 | 18217 | \_ | \_ |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

**Figure 4.9**

**Table 4.10 9 YEAR MOVING AVERAGE**

|  |  |  |  |
| --- | --- | --- | --- |
| year | Sales | 9 year total | 9 years moving average |
| 2001 | 1984 | \_ | \_ |
| 2002 | 2391 | \_ | \_ |
| 2003 | 2566 | \_ | \_ |
| 2004 | 2955 | \_ | \_ |
| 2005 | 3306 | \_ |  |
| 2006 | 3921 | 28659 | 3184.333 |
| 2007 | 3310 | 33532 | 3725.778 |
| 2008 | 3741 | 39090 | 4343.333 |
| 2009 | 4485 | 44399 | 4933.222 |
| 2010 | 6857 | 50138 | 5570.889 |
| 2011 | 7949 | 57620 | 6402.222 |
| 2012 | 7875 | 65894 | 7321.556 |
| 2013 | 8694 | 75947 | 8438.556 |
| 2014 | 10788 | 87824 | 9758.222 |
| 2015 | 12195 | 101556 | 11284 |
| 2016 | 13363 | 111154 | 12350.44 |
| 2017 | 15618 | \_ | \_ |
| 2018 | 18217 | \_ | \_ |
| 2019 | 16455 | \_ | \_ |
| 2020 | 16423 | \_ | \_ |

**Figure 4.10**

**FITING THE STRAIGHT LINE BY LEAST SQUARE METHOD**

It has been observed from the table B appendix that the yearly of sales of company thinks are continuously increasing. This wants to fit trend line to the data. By applying the method of least square to trend line fitted

Y= 12757.7+604.8455(x)

|  |  |
| --- | --- |
| Years | preceding value |
| 2021 | 167326.5 |
| 2022 | 183224.5 |
| 2023 | -198328 |
| 2024 | 215020.5 |
| 2025 | 230918.5 |
| 2026 | 246816.5 |
| 2027 | 262714.5 |
| 2028 | 278612.5 |
| 2029 | 294510.5 |
| 2030 | 310408.5 |
| 2031 | 326306.5 |
| 2032 | 342204.5 |
| 2033 | 358102.5 |
| 2034 | 374000.5 |
| 2035 | 389898.5 |

**Table 4.11** **TREND ELIMINATION METHOD**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Sales | X | Xy | X2 | Trend | Y- |
| 2001 | 1984 | -10 | -19840 | 100 | 2393.16 | -409.16 |
| 2002 | 2391 | -9 | -21519 | 81 | 2935.868 | -544.868 |
| 2003 | 2566 | -8 | -20528 | 64 | 3478.576 | -912.576 |
| 2004 | 2955 | -7 | -20685 | 49 | 4021.283 | -1066.28 |
| 2005 | 3306 | -6 | -19836 | 36 | 4563.991 | -1257.99 |
| 2006 | 3921 | -5 | -19605 | 25 | 5106.699 | -1185.7 |
| 2007 | 3310 | -4 | -13240 | 16 | 5649.407 | -2339.41 |
| 2008 | 3741 | -3 | -11223 | 9 | 6192.115 | -2451.11 |
| 2009 | 4485 | -2 | -8970 | 4 | 6734.822 | -2249.82 |
| 2010 | 6857 | -1 | -6857 | 1 | 7277.53 | -420.53 |
| 2011 | 7949 | 0 | 0 | 0 | 7820.238 | 128.762 |
| 2012 | 7875 | 1 | 7875 | 1 | 8362.946 | -487.946 |
| 2013 | 8694 | 2 | 17388 | 4 | 8905.654 | -211.654 |
| 2014 | 10788 | 3 | 32364 | 9 | 9448.361 | 1339.639 |
| 2015 | 12195 | 4 | 48780 | 16 | 9991.069 | 2203.931 |
| 2016 | 13363 | 5 | 66815 | 25 | 10533.78 | 2829.223 |
| 2017 | 15618 | 6 | 93708 | 36 | 11076.48 | 4541.515 |
| 2018 | 18217 | 7 | 127519 | 49 | 11619.19 | 6597.807 |
| 2019 | 16455 | 8 | 131640 | 64 | 12161.9 | 4293.1 |
| 2020 | 16423 | 9 | 147807 | 81 | 12704.61 | 3718.392 |
| 2021 | 16750 | 10 | 167500 | 100 | 7820.238 | 8929.762 |
| ∑21 | ∑164225 |  | ∑417885 | ∑770 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| YEARS | 2019 | 2020 | 2021 | 2022 | 2023 | monthly total for 5 year | five yearly averages | Seasonal variation index |
| JANUARY | 570 | 469 | 486 | 625 | 1036 | 3186 | 637.2 | 87.98269 |
| FEBRUARY | 508 | 466 | 560 | 617 | 1080 | 3231 | 646.2 | 89.22539 |
| MARCH | 456 | 297 | 610 | 654 | 1077 | 3094 | 618.8 | 85.44208 |
| APRIL | 474 | 328 | 592 | 621 | 1138 | 3153 | 630.6 | 87.07139 |
| MAY | 492 | 342 | 618 | 610 | 1302 | 3364 | 672.8 | 92.89824 |
| JUNE | 478 | 378 | 619 | 654 | 1325 | 3454 | 690.8 | 95.38363 |
| JULY | 433 | 392 | 625 | 737 | 1419 | 3606 | 721.2 | 99.58117 |
| AUGUST | 362 | 392 | 585 | 837 | 1521 | 3697 | 739.4 | 102.0942 |
| SEPTEMBER | 352 | 437 | 529 | 908 | 1590 | 3816 | 763.2 | 105.3804 |
| OCTOBER | 418 | 437 | 550 | 983 | 1521 | 3909 | 781.8 | 107.9486 |
| NOVMBER | 484 | 473 | 662 | 1150 | 1592 | 4361 | 872.2 | 120.4308 |
| DECEMBER | 474 | 502 | 689 | 1035 | 1883 | 4583 | 916.6 | 126.5614 |
| TOTAL |  |  |  |  |  | 43454 | 8690.8 | 1200 |
| AVERAGE |  |  |  |  |  | 3621.167 | 724.2333 | 100 |

**Table 4.12 SEASONAL VARIATION AND ESTIMATIONS:**

**CONCLUSION**

Times Series analysis is a must for every company .To understand seasonality, cyclicality, trend and radon’s in the sales and other attributes, the TVs company is the one the leading bike manufacturing The majored conclusion torn they study that Tvs has to improve to itself gain the First Position in the market as it doing well to maintain its Third Position in the Master. The lead and remain the leading manufacture of India . data will be collected from the Tvs gauge during the coming year to evaluate how the statistical properties of TVs motor temporally and spatially Comparison will also be made with the least square Method, radio to trends Medhood, semi average method, Moving average method, Seasonal Indices method for selected The storms through the years. These results can be graphed and analyzed the see trends on a week to week. Month to Month, year to year. The future of TVs company sales in increasing this paper presented review of different methods used for TVs motor prediction and problem one might encounter while applying different approach of tvs motor forecasting.

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