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Factors Affecting the Service Costs of Maruti Suzuki, Hyundai and Honda Cars in South Delhi

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Abstract:

The rationale of the study is to evaluate the impact that different factors may have on the cost of service of a car. The study primarily focuses on the cost of service of cars from three major brands in the Indian automative sector, namely, Maruti Suzuki, Honda and Hyundai. The study is limited to the geographic region of Greater Kailash, Jamia Nagar, Lajpat Nagar, Kalkaji, Defense Colony, New Friends Colony, Chanakyapuri, Amar Colony and Kailash Colony areas of South Delhi. A questionnaire was prepared to collect data, a total of 358 observations were collected out of which 217 observations were used for the aid of this study as they were deemed acceptable. The study's main findings were that mileage had a significant impact on the service cost of a car, whereas, age, which is considered to be a huge contributing factor in the service cost of a car was found to have an inconsequential influence on the service cost of a car. Other factors that have an effect on the service cost of a car were transmission type, service provider and size of the car. Fuel was found to have an inconsequential impact on the cost of service of a car, which is contrary to popular belief. It was also found that Hyundai cars were significantly more expensive to get serviced, whereas service cost of a Honda car was not different, both when compared to cars from Maruti Suzuki.

Keywords: Honda, Hyundai, Maruti Suzuki, mileage, service cost, transmission, fuel, maintenance, service provider.

Chapter I:

Introduction:

The Indian automobile industry is the third most substantial in the world and is also the seventh largest commercial vehicle manufacturer in the world (Gupta & Ruchika, 2019). The industry provides employment to more than five lakh people and contributes to 4.7% of the Indian GDP and accounts for 19% of indirect tax revenues (Rana & Lokhande, 2015). Car ownership is made up of two cost components, which are fixed cost and variable cost. Purchase decision of a product is regulated by factors like risk (Yee, San & Khoon, 2011). Risk in this example is the cost corresponding with the failure of parts in a car. A customer consider the cost

that he might have to bear if anything goes wrong with the vehicle they have purchased and how much it will then cost him to get the vehicle fixed. Fixed costs can also be considered to be owning costs, in other words these are the costs which come with owning a vehicle, these costs are incurred whether the vehicle is driven a lot or not driven at all. These costs include the cost of insurance, depreciation, road tax and the vehicle registration fees. On the other hand, variable costs are costs that can be considered to be running or operational costs for a car. A car's usage will have a consequential influence on the variable cost of the car. Variable costs include cost of fuel, tires and periodic service or maintenance costs. Service or maintenance cost is said to be an integral part of ownership for any kind of vehicle. This cost is part of the internal costs that a consumer has to pay to own and run the car. Focusing on the Indian consumer and the Indian mindset, the cost of car ownership is as important as the upfront purchase price of the car. Consumers have to bear the service cost after the purchase of a car at regular time or mileage intervals. The car needs to be serviced periodically for its functioning. Maruti Suzuki is a very successful brand in the Indian market because of its focus on affordability and the strategy to ensure ease of purchase (Kumar, 2018).

Arriving at a price that is fair for the work done can be a difficult task for any service providing dealer. The service cost has to be reasonable and should be set while keeping in account the consumer and their assurances from the automaker. The service provided by the automaker depends hugely upon the service facility, scope of repair and service and the complexity in the design of the vehicle and it's internals. These components can be a cause that the service cost for cars can be affected by many different value-added services as well. A lot of advancements have been made in the previous two decades and consequential contributions have been made for major changes in the design, configuration and vehicle's capability to reduce the cost of ownership and to reduce the service costs borne by consumers. Most of the sales in the Indian automotive market are made up of small passenger cars in the small and compact segment (Chopra, 2018). Due to this reason the paper does not focus on luxury brands and focuses more on brands which have their products in these categories.

Another important consideration for the triumph of a brand as per Broadbent and Cooper (1987) are the images and symbols, which should relate to the needs, values and differentiate the brand from other competitors. In this regard Honda and Hyundai have similar looking brand logos and a novice might have trouble in differentiating between the two. A brand can be seen in one of two ways; the first is the product plus view in which the brand is an addition to the product, the other view is the holistic view in which the brand itself is the focus and is more than just a product (Ambler and Styles, 1996). Maruti Suzuki is seen as an overall affordable brand when compared to its competitors. Almost every Maruti Suzuki car is the cheapest in the segment that it competes in. This is also evident by the availability and the price of spare parts of Maruti Suzuki cars which are very affordable (Kumar, 2018) and are cheaper than parts of other brands.

Statement of Problem:

Every new cars comes with a limited time manufacturers warranty. Manufacturers also offer a certain number of free services wherein they don't charge cost of labour but only charge the cost if parts and consumables. Many consumers get their cars serviced by the authorised service providers until they get free labour under their free services, after which they start getting their cars serviced from local mechanics. Consumers do this because they find it cheaper to get the car services by a local mechanic as compared to getting the car serviced at the authorised service provider. This is the reason because of which the main concern associated with getting a car serviced is whether to get the car serviced by the authorised service provider or through a local

mechanic. A consumer may find it compelling to get the car serviced locally because of the lower service cost, but while doing so they should also keep in mind the warranty of the car which may get voided once the car is serviced by a local mechanic. Mileage of the car has a straight association with the cost of ownership of the car, it also has an impact on the service intervals of a car. Every manufacturer has a recommended service interval and a recommended mileage after which the car needs to be serviced. Most manufacturers have a six month or ten thousand kilometre service interval, whichever comes earlier. If the car is used more often then the service will be required more frequently, as well as the car's service costs will increase. The consumers need to factor in their daily or monthly usage while looking at their options while purchasing a car, as for someone who uses their car more than average, a car which can be driven for more kilometres before requiring a service will be a better choice.

Chapter II:

Review of Literature:

How Much Do Car Maintenance Costs Increase With Mileage? by Maddy Martin, July 21, 2016.

It is crucial to understand which car cantata us far and which may have us stranded at the side of the road. This article tries to explain how cars hold up as they are used. In other words, which cars are the most expensive to maintain and which cars are the least expensive to maintain. The article also keeps a check on how the maintenance cost for a car increases as the mileage of the car increase in intervals of 25,000 miles or 40,000 kilometres. It was discovered that the cost of maintaining a car was roughly $1,400 for the first 25,000 miles or 40,000 kilometres and from there the cost of maintenance increased dramatically until the 1,00,000 mile or the 1,60,000 kilometre mark. From there on, the increase in the cost of maintenance was less intense. Another factor that was analysed in the article was the brands which were least and most expensive to maintain. For the first 75,000 miles or 1,20,000 kilometres, Hyundai and Kia cars were the least expensive to maintain and on the other side BMW cars were the most expensive to maintain. Things changes with increase in mileage as Toyota and Honda cars were the least expensive to maintain and BMW cars were still the most expensive to maintain for the first 1,50,000 miles or 2,40,000 kilometres.

Maintenance Costs Increase with Longer Service Lives, Recalls, by Mike Antich, March 10, 2015.

This articles centres upon the influence of service lives safety recalls of cars on their maintenance costs. Passenger car maintenance cost per unit per month increased 9 percent and the cost per mile increased 13 percent in 2013. Cars which could be serviced at longer service intervals helped offset the costs. Another important feature studied was the labour cost which is a part of the maintenance cost of a car, the labour cost was found to be increasing and has incremented in the year 2014 from the prior year 2013 and an even further increase was anticipated in the year 2015. Some of the trends that affected the maintenance cost in the year 2014 were found out to be the extended manufacturer required service intervals, the impact of the automakers safety recalls and the increased usage of vehicle telematics.

Are Diesel Maintenance Costs Similar to Gasoline Cars? by Martin, February 21, 2012. The rationale of this article was to discuss if the maintenance cost of a diesel car is similar to that of a petrol powered car. A diesel car needs less maintenance than a petrol powered car. One reason for this low maintenance cost is the commission of spark plugs in diesel engines, these engines don't use spark plugs which are an integral part of a petrol powered car. Another reason for the low maintenance cost is that a diesel engine is more efficient than a petrol engine and therefore reduces wear and tear of the engine components. It should be noted that these low maintenance costs are low overall, diesels are expensive to maintain when they need repairs but due to the lesser demand for maintenance and service, the overall cost to maintain a diesel car is offset and is often lower than the petrol counterpart.

Are Manual Transmissions Cheaper to Repair and Maintain Than Automatics? by Rick Popely, June 8, 2016. The article explains how automatic transmission cars are generally expensive to maintain when compared to manual transmission cars. The cost of maintaining an automatic is usually higher because the transmission consists of a large number of mechanical, hydraulic and electrical elements which are need for the functioning of the gearbox. There are more things that can go wrong with an automatic transmission. Other than this, an oil replacement for an automatic transmission varies from anywhere between $100 to $200 depending on a number of factors relating to the car and the service provider. On the other hand, a manual transmission vehicle will also require an oil change but this is generally half the cost of an automatic transmission car due to the simple nature of a manual transmission which only consists of a few mechanical gears and relies on the driver to change the gears. It was also found that traditional automatics are often cheaper to replace than newer continuously variable transmissions (CVT) and transmissions with multiple clutches. An example of this is that to replace a CVT in a Nissan Sentra, the cost would be $4,000, whereas, to replace an orthodox six-speed automatic in a Chevrolet Cruze, which is a car from the same segment as the Nissan would cost $2,500.

"Consumer Preference Towards Maruti Suzuki and Hyundai Motors: A Comparative Study of The Automobile Sector", by Dr. Gayatri Chopra, July, 2018.

This paper aims to compare the consumer's preference towards passenger cars offered by Maruti Suzuki and Hyundai Motor Company India in the region of New Delhi. The brands were compared based on five different criteria, namely, interior, colour, price, after sales- service and re-sale value of the car. The findings of the paper were that there is no difference in consumer preference when it comes to factors like colour, interior and after-sales service, but there is a variation in the consumer taste when it comes to re-sale value of the car and its price.

Chapter III : Methodology Aims:

The rationale of the study is to determine if age and mileage of a car make a difference to the service or maintenance cost of the car. Realistically, if a car gets older, its service cost should increase and same is the case with mileage, if the car is driven more than it should be serviced more often thereby increasing the service cost over a one year period. This study is therefore conducted to find if these assumptions are true.

This paper also aims to discover additional variables that may have an impact on the service cost of a car and to find out which category of car is the most and least expensive to get serviced and maintain.

Objectives:

- To study the impact of age and mileage on the service cost of a car.
- To assess what other factors influence the service cost of a car.
- To find out the most and least expensive type of car to maintain.

Hypothesis:

H0: There isn't any sort of consequential relationship between the service cost of a car and its age.

Ha: There is a consequential relationship between the service cost of a car and its age.

H0: There isn't any sort of consequential relationship between the service cost of a car and its mileage.

Ha: There is a consequential relationship between the service cost of a car and its mileage.

Sample Selection:

The area of study was limited to South Delhi. This region of Delhi includes areas like Greater Kailash, Kalkaji, Defense Colony, Lajpat Nagar, Jamia Nagar, New Friends Colony, Chanakyapuri, etc. A questionnaire was circulated in these areas to collect the data. People over the age of 20 were included in this study with all of them working full-time. Both women and men were included in the study.

Tool used for Data Collection:

A questionnaire was put together to collect the data. The model of the car owned was the first question asked which was followed by asking for more particulars about the car. These questions comprised of the type of fuel used by the car, the choices were petrol, diesel and CNG; the transmission in the car, the choices were automatic and manual transmissions; the number of kilometres driven in a month, the service interval for the car, options were six months and one year; where the car is serviced, this was either through the authorised service provider or a local mechanic; the cost of getting the car serviced and car's age in number of years.

Procedure for Data Collection:

A questionnaire was developed which was then circulated among people in various areas of South Delhi which helped with the collection of primary data required for this study. The questionnaire was developed with the aid of Google Forms and the link to fill the form was sent to the sample selected. The total number of samples collected was 358 samples out of which only 217 samples were deemed acceptable for the study and the rest were discarded. The reasons for discarding 141 samples were, invalid responses and cars owned from different automakers than the ones being studied in this paper. Most of the unnecessary samples were because of invalid and inappropriate responses.

Variables:

The study consists of both dependent and independent variables. Independent variables consist both of quantitative variables and dummy variables. The dependent variable in the study is cost of service (Y) for cars. The variable of service cost depends on many other factors which are taken as independent variables. There are two quantitative variables studied, which are mileage (X1) and age (X2) of the vehicle. Mileage refers to the number of kilometres that a car is driven between service intervals. Car's age is how old the car is in terms of the no. of years. Other variables which may have an influence on the service cost of a car are taken as dummy variables. These variables include fuel (D3), transmission (D4), service provider (D5), the type of car, i.e., sedan (D6) or crossover (D7) and the automaker, i.e., Honda (D8) and Hyundai (D9). There is one more type of car, i.e., hatchback and there is one more automaker, i.e., Maruti Suzuki, these have been taken under the benchmark category. Fuel refers to the type of fuel that the car uses eg. petrol, diesel or CNG. Transmission for the car can be either a manual or an automatic. Service provider is where the car gets serviced and can either be an authorised service provider or a local mechanic. The three types of cars taken under the study are hatchback, sedan and crossover. The three automakers carried out in the research are Maruti Suzuki, Honda and Hyundai. The benchmark category for the study is a Manual Maruti Suzuki hatchback, which runs on petrol and gets serviced by an authorised service provider.

Statistical Analysis:

An excel file containing the responses was downloaded form Google Forms. The data was then cleaned, formatted and put up in a presentable form which could then be used for the study of the data in Microsoft Excel. For analysing the data available at hand, Excel was used and a regression analysis was done on the data with the service cost of a car being the dependent variable and mileage & age were taken as independent variables. Various other factors which may have an impact on the service cost of a car were also considered and these variables were taken as dummy variables, these included, fuel type, transmission type, service provider, size of the car and the automaker. Regression interpretation was done and results were found. Further tests were done to see the model fitness and the relevance of the model and the data collected. Four further tests were done, these included, VIF Test for Multi-Collinearity, Durbin Watson Test for Autocorrelation, Breusch-Pagan test for Heteroscedasticity and Shapiro-Wilk Test for Normality.

The check for multicollinearity is done to see if two or more independent variables are greatly correlated, because of this, there is an issue. if two or more variables are highly correlated, they will move together and will undermine the statistical significant of the independent variable. To test for multi-collinearity, the variance important factors (VIF) is used, which are the most commonly used rules (Yoo, Mayberry, Bae, Singh, He & Lillard, 2014).

Autocorrelation represents the similarity between a given time series and a lagged version of itself over successive time intervals (Huitema & Laraway, 2006). In other words, autocorrelation measures the connection between a variable's present value and past values. The inspection for autocorrelation was conducted to see if the error term observations followed a path, if such a path is present then there is autocorrelation and there is something wrong with the data. The Durbin-Watson test is the most straightforward method for analysing residual autocorrelation (Chen, 2016).

Heteroscedasticity is the change in spread of residuals over the range of measured values. In simple words, heteroscedastic data is the data which doesn't follow any particular path. Breusch-Pagan Test is done for heteroscedasticity, ideally, the data should be homoscedastic, i.e., the data should be constant and should follow a clear path. This test assesses whether the model error terms are related with any of the model predictors (Oscar, Astivia & Zumbo, 2019).

It is important for the data to be normal in simple linear regression. Normality is when the data set is well-modelled by a normal distribution. The Shapiro-Wilk Test is conducted to check for normality. Hair, Black, Babin, Anderson and Tatham (2006) identified this test as the most widely used test done for normality along with the Kolmogorov-Smirnov test. For the purpose of this study we will be using the Shapiro-Wilk test for normality.

Regression Model:

$$Yi = \beta1 + \beta2X1 + \beta3X2 + \beta4D3 + \beta5D4 + \beta6D5 + \beta7D6 + \beta8D7 + \beta9D8 + \beta10D9 + ui$$

The model is a data analysis technique which checks for a relationship between a dependent or target variable and one or more independent or predictor variables (Uyanik & Guler, 2013).

Chapter IV : Analysis of Results

The analysis of data was conducted on Microsoft Excel and R Studio. The assumptions of multi-collinearity, autocorrelation, heteroscedasticity and normality must be met with. If one or more of these assumptions is broken, the model will fail and is not acceptable in estimating the population parameters (Daoud, 2017).

Regression Analysis:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.62738147
R Square	0.39360751
Adjusted R S	0.36724262
Standard Err	3461.34488
Observations	217

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	1609791599	178865733.3	14.9292297	1.3793E-18
Residual	207	2480048032	11980908.37		
Total	216	4089839631			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	6758.02112	706.2013071	9.569539241	3.3902E-18	5365.75203	8150.29021
Mileage (X1)	0.04616021	0.014474252	3.189125594	0.00164857	0.01762436	0.07469606
Age (X2)	87.5329911	115.0719087	0.760680796	0.44771335	-139.33017	314.396153
Fuel (D3)	151.940425	565.3276739	0.268765234	0.78837802	-962.59765	1266.4785
Transmissior	1210.62662	559.4673292	2.163891538	0.03161777	107.642156	2313.61108
Service Provi	-3674.7825	568.2479179	-6.466864883	7.0742E-10	-4795.0778	-2554.4872
Sedan (D6)	3080.53493	651.4417737	4.728795498	4.1737E-06	1796.22373	4364.84612
Crossover (D	3318.39297	783.9497653	4.232915323	3.4669E-05	1772.84354	4863.9424
Honda (D8)	90.1380974	728.6047398	0.123713301	0.90166232	-1346.2991	1526.57534
Hyundai (D9)	1447.34313	560.5084009	2.582197039	0.01050721	342.306206	2552.38006

The image above displays the regression outcome for the suggested regression model as stated earlier. The image shows the regression statistics along with the ANOVA table which helps with the interpretation of the results. From the image above, the R-square can be seen to be 0.3936, this explains a 39.36% variance in the responding variable, i.e., service cost of a car, is explicated by the exposure variables. A better statistic to look for to understand the variance in the responding variable caused by the exposure variables is the adjusted R- squared. The adjusted R-squared is a revised style of R-squared and has been remodelled in the regression model for number of predictors. The adjusted R-square of 0.3672 more accurately explicated the variance. It explains that a 36.72% variance in the variable, i.e., service cost of a car, is explicated by the exposure variables. The significance f value under the ANOVA table explains the overall significance of the model. The significance f value of 1.3793E-18 explains that the overall regression model is significant, i.e., changes in the independent variables correlate with shifts in the responding variables. A value below 0.05 is considered to be significant and the value that the output presented is much less than the threshold value.

Looking at the predictor variables and their p-values we can discover which variables are significant in describing a variance in the dependent variable, i.e., which independent variable has an actual impact on the dependent variable. A p-value below 0.05 is considered to be acceptable and a variable having a p-value below the cut-off value is deemed significant, i.e., a change in that variable has an impact on the dependent variable. Considering the p-values of all the independent variables, mileage (X1) is significant with a p-value below 0.05 at 0.0016, age (X2) is insignificant with a p-value above 0.05 at 0.4477, fuel (D3) is insignificant with a p-value of 0.7883, transmission (D4) is significant with a p- value of 0.0316, service provider (D5) is significant with a p-value of 7.0742E-10 which is way less than the cut-off value of 0.05, sedan (D6) is significant with a p-value of 4.1737E-06, crossover (D7) is significant with a p-value of 3.4669E-05, Honda (D8) is insignificant with a p-value of 0.9016 and Hyundai is significant with a p-value of 0.0105. It should be taken into account that the independent variables service provider (D5), sedan (D6) and crossover (D7) have very small p-values and therefore have more impact on the change in the dependent variable than other significant independent variables. Focusing on the only significant quantitative variable in the model, i.e., mileage (X1), as the mileage of the car increases by 1 unit, the service cost of the car increases by 0.046 unit. In other words, as the mileage of the car increases by 1 kilometre, the service cost of the car increases by 0.04671 rupees.

Further tests were run to see the model fit of the regression and the relevance os the model and the data collected to interpret the results. The fours tests conducted were VIF Test for Multi- Collinearity, Durbin Watson Test for Autocorrelation, Breusch-Pagan test for Heteroscedasticity and Shapiro-Wilk Test for Normality. The results and interpretation of these tests are further discussed below.

VIF Test for Multi-Collinearity:

VIF stands for variance inflation factor, this is a test for multicollinearity. Multicollinearity is the presence of high intercorrelation between two or more independent variables undertaken too conduct a study in a multiple regression model. The regression model in this study has nine independent variables which makes the test for multicollinearity a must as few of these variables may show high levels of intercorrelation among themselves which could lead to bigger confidence intervals that will further lead to less authentic probabilities when it comes to the effect model's independent variables. To put it another way, the presence of multicollinearity is a problem as it understates the significance of the independent variable.

```
> vif(model_servicecost)
     Mileage          Age         Fuel Transmission Service_Provider        Sedan    Crossover        Honda      Hyundai
    1.074564     1.249958     1.225101     1.145656     1.079558     1.769747     1.363018     1.797281     1.286958
```

The graph above represents the results of the multicollinearity test conducted in R Studio. The way to correctly interpret the outcomes of the multicollinearity test are as follows-

A value less than 1 means no multicollinearity.

A value between 1 and 5 means moderate multicollinearity that does not require any attention.

A value between 5 and 10 means the presence of a severe level of multicollinearity.

A value above 10 requires immediate attention and is not acceptable and changes should be made in the model.

In the VIF test conducted for this study, the results of which are shown in the image above, all the independent variables have a VIF value which lies between 1 and 1.8, this explains that the model is very moderately correlated and does not need any attention and no changes are required to be made in the model and study can be further proceed with the regression model.

Durbin Watson Test for Autocorrelation:

The Durbin - Watson test is used to examine the autocorrelation in the regression model. Autocorrelation, also known as serial correlation or lagged correlation is the level of similarity between a particular time series data and a lagged version of itself over differing time intervals. In other words, autocorrelation measures the alliance between a variables present value and its past value.

```
> durbinWatsonTest(model_servicecost)
 lag Autocorrelation D-W Statistic p-value
   1       0.00323532      1.978036   0.824
 Alternative hypothesis: rho != 0
```

The image above displays the results of the Durbin - Watson test for the suggested regression model. Upon conducting the test, the outcomes can range from anything between and including zero and four. The corresponding meaning of these values are interpreted as follows-

A value of 2 means no autocorrelation.

A value between 0 and less than 2 is a positive autocorrelation, this is a common result in a time series data set.

A value between greater than 2 and 4 is a negative autocorrelation and is less common in a time series data set.

Generally accepted rule for the Durbin Watson test is that a value between 1.5 and 2.5 is thought to be common. Any value outride this range is a matter of concern and should be dealt with accordingly. A value which is less than 1 or more than 3 is a definite cause for concern and can have major effects on the regression model. Such values can occur when the regression model is incorrectly specified.

For the regression model undertaken for this study, the Durbin Watson statistic is 1.978 which is nearer to a value of 2 which signifies the presence of very little to no autocorrelation. Such an outcome is somewhat predicted as the dataset does not include historical values for any given variable. Autocorrelation is more useful in analysing a set of historical data such as trends in stock prices or changing fuel prices.

Breusch-Pagan Test for Heteroscedasticity:

The Breusch-Pagan test is a test developed to inspect the heteroscedasticity in a linear regression model. The test assumes that the error terms are normally distributed. The test checks for the dependence of the variance of the errors from a regression on the values of the independent variables. The null hypothesis for the test is that the error term discrepencies are all equal or in other words, the model is homoscedastic. The other alternative hypothesis is that the error term variances are unequal or in other words, the model is heteroscedastic.

```
> bptest(model_servicecost)

        studentized Breusch-Pagan test

data:  model_servicecost
BP = 10.528, df = 9, p-value = 0.3095
```

The dataset used in the regression analysis should be homoscedastic which means “having the same scatter” as opposed to being heteroscedastic which means “different scatter.” A homoscedastic dataset means that the random disturbance in the error terms or the association between the regressor variables and the dependent variable is the same across all the different values of the independent variable. In contrast, a heteroscedastic dataset is when the standard deviations in a predicted variable, when observed over differing values of an explanatory variable are not constant. Therefore, for the purpose to progress further, we need to accept the null hypothesis and in order to satisfy the conjecture and accept the null hypothesis, the p-value obtained by conducting the test should be more than the cut-off value of 0.05. upon running the test, the p-value calculated was 0.3095, as seen in the image above, this means that the null hypothesis is accepted and homoscedasticity is assumed.

Shapiro - Wilk Test for Normality:

The Shapiro - Wilk test is done to inspect if a random sample comes from a normal distribution or not. The premise of normal distribution applies only to the error terms and not to the independent variables. The null hypothesis of the test is that the sample is normally distributed and the alternative hypothesis is that the sample is not normally distributed. And in order to progress further, the null hypothesis needs to be accepted and in order to accept the null hypothesis the p-value of the S-W test should be less than the threshold value of 0.05.

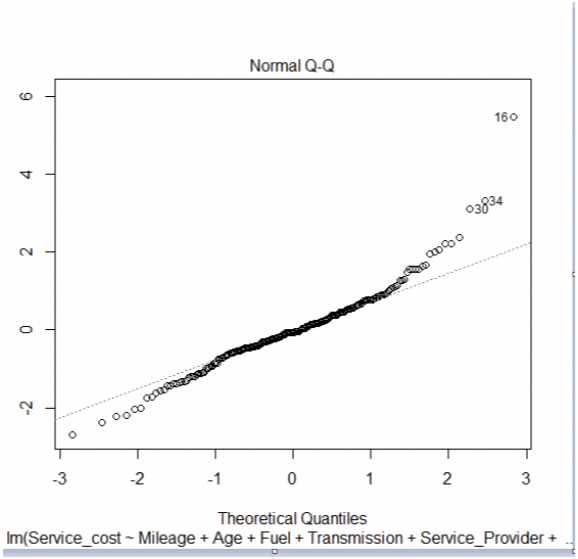
```
> residuals <- residuals(model_servicecost)
>
>
>
> shapiro.test(residuals(model_servicecost))

        Shapiro-Wilk normality test

data:  residuals(model_servicecost)
W = 0.94485, p-value = 2.408e-07
```

From the image above, displaying the result of the Shapiro - Wilk test, the p-value can be seen to be 2.408e-07 which is very small and falls well below the cut-off point of 0.05, as a result, the null hypothesis is rejected. of assumption of normal distribution. The data set is not distributed normally and the assumption of normality is not met.

It's worth noting that for a large sample size, the test will detect even minute departures from the null hypothesis, therefore in order to get a better understanding, additional investigation on the size of the impact is advised , this can be done by way of a Quantile - Quantile (QQ) plot.

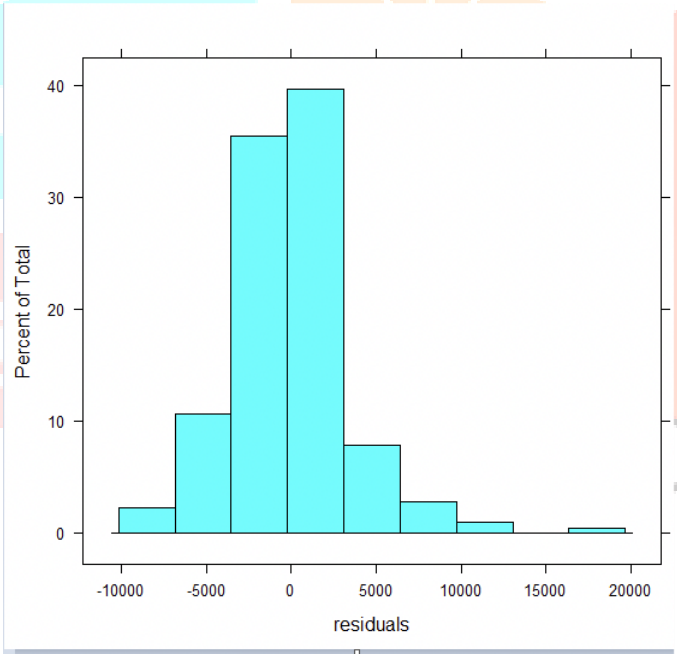
Quantile - Quantile (QQ) Plot:

A Quantile-Quantile plot is another way to investigate normal distribution or to check for the assumption of normality. The plot is created by plotting two different sets of quantiles against each other. In case of a normal distribution both the sets of quantiles will come from the same distribution and should perfectly fit in such a way forming a roughly straight line. If the data set is normally distributed then the points should form a straight diagonal line, any deviance from the straight line provides evidence that the datasets come from populations with varying distributions. The greater the deviation, the more sizeable the evidence of a distribution that is not normal.



The graph above shows the QQ plot for normality and inference can be drawn that the data does not fall in its entirety on the straight reference line and many points deviate from the line of reference, the deviation from the character line shows that the data set is not normally distributed.

Histogram:



Another way of checking for the normal distribution of the data set is through the graphical depiction of the data set on a histogram. If the constructed histogram is roughly bell-shaped and symmetric about the mean, then the data set is assumed to be normally distributed (Das & Imon, 2016) and the assumption of normality is met. Looking at the histogram above, we can say that the histogram is not bell shaped and hence it can be concluded that the data set is not normally distributed.

Chapter V : Discussion

Following the regression analysis and various different tests for eg. the VIF test for multicollinearity, Durbin - Watson test for autocorrelation, Breusch - Pagan test to check for heteroscedasticity and the Shapiro - Wilk test to check normality along with plotting a Quantile - Quantile plot and constructing a histogram it was discovered that the are various factors that do affect the service cost of cars. Some of these factors are quantitative in nature, meaning they can be measured in numeric form and some of these factors are non- numeric factors and can not be measures in numeric form.

A significant influencing factor the service cost of a car is the mileage, or how much a car is driven in total, this is one of the two quantitative independent variables undertaken in this study. As the car is driven more and more kilometres are added to it, the service cost of the car increase. To put this in numeric form, as the car is driven for 1 additional kilometre, its service cost will increase by 0.046 rupees. This figure might not seem much on a per kilometre basis, but can become a substantial amount as the kilometres increases. Also, it was found that age, that is the other quantitative independent variable included in the study does not have any consequential impact on the cost of service of a car.

Other than these two quantitative factors, the other factors that do have a bearing on the service cost of a car are transmission type and the service provider. It was found that fuel type does not have any consequential impact on the service cost of a car. Finally, it was found that it was more costly to get a sedan and a service crossover when compared to a hatchback and Hyundai cars were more expensive to get serviced when compared to Maruti Suzuki cars. On the other hand, Honda cars were not significantly more expensive to get serviced when compared to Maruti Suzuki cars.

Finally, it was discovered that manual, petrol, Maruti Suzuki hatchbacks which were serviced by a local mechanic were the cheapest to get serviced at Rs. 3083, whereas, automatic, diesel, Hyundai crossovers which were serviced by an authorised service provider were the most expensive to get serviced at Rs. 12,886.

Chapter VI : Summary and Conclusion

Further an additional study can be done on the subject with more factors being studied, there are always more factors that may have an influence on the service cost of a car apart from the important one's undertaken in this study. A greater sample size can be taken in order to get a more robust result. An increase in the size of sample may turn the current insignificant variable into significant variables. The current adjusted R-squared, of 0.3672 may also improve with an increase in the number of samples and also this will help in predicting the variance in the dependable variable more reliably and a more consequential relationship between the dependent and independent variable could be established. The study is also limited to a narrow geographic region and can be expanded to cover a larger demographic. Some of the major renowned companies in the Indian automotive market are studied in this paper, more emphasis can be given to other brands which do not sell as many units as the three brands studied. Also, there is a popular belief that diesel cars are much more expensive to get serviced when compared to petrol powered cars, this was found to be untrue, as there was not a significant difference between the service cost of a petrol and a diesel powered car.

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