

## **A Study on Multivariate Analysis in Statistics**

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### **Abstract**

Advertising is just a single component of the advancement blend; however, it regularly thought to be noticeable in the general promoting blend plan. Its high deceivability and inescapability made it as a critical social and enconia point in Indian culture.

Advancement might be characterized as the co-appointment of all bender started endeavors to set up channels of data and influence to encourage the size of a decent or administration. Promotion is regularly expected to be a supporting part in an advertising blend. Advancement choice must be incorporated and co-ordinate with whatever is left of the showcasing blend, especially item/mark choices, so it might adequately bolster a whole advertising blend procedure. The advancement blend comprises of four essential components.

1. Advertising is the scattering of data by non-individual means through paid media where the source is the supporting association.

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2. Personal offering is the dispersal of data by non-individual techniques, similar to up close and personal, contacts among gathering of people and workers of the supporting association. The wellspring of data is the supporting association.
3. Sales advancement is the dispersal of data through a wide assortment of exercises other than individual offering, promoting and exposure which invigorate customer buying and merchant adequacy.
4. Publicity is the dispersing of data by individual or non-individual means and isn't straightforwardly paid by the association and the association isn't the source.

## **BEGINNING AND GROWTH OF ADVERTISING**

It has been wrongly expected that the publicizing capacity is of late birthplace. Confirmations recommend that the Romans working on promoting; yet the most punctual sign of its utilization in this nation goes back to the middle Ages, when the utilization of the surname demonstrated a man's occupation. The following stage in the development of promoting was the utilization of signs as a visual articulation of the tradesman's function and methods for finding the wellspring of products. This technique is still in like manner utilized.

The dealer in crude circumstances depended upon his uproarious voice to draw in consideration and advice purchasers of the accessibility of his administrations. On the off chance that there were numerous contenders, he depended upon his very own attraction to pull in regard for his stock. Regularly it wound up plainly important for him to fall back on influence to pinpoint the upsides of his items. In this manner, the vender was doing the total advancement work himself.

Advancement of retail locations, made the merchants to be more worried about pulling in business. Advising clients of the accessibility of provisions was very imperative. A few sorts of outside advancement were vital. Signs on stores and in conspicuous places around the city and notification in printed matters were at times utilized.

At the point when clients were at long last pulled in to the store and happy with the

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administration at any rate once, they were still subjected to aggressive impacts; in this way, the dealer's signs and notices helped clients to remember the proceeding with accessibility of his administrations. Now and then dealers would converse with present and previous clients in the boulevards, or join social associations keeping in mind the end goal to have proceeding with contacts with present and potential clients.

As the business sectors became bigger and the quantity of clients expanded, the significance of drawing in them likewise developed. Expanding dependence was put on publicizing techniques for advising about the accessibility of the items. These publicizing techniques were more sparing in achieving vast quantities of purchasers. While these publicizing techniques were valuable for illuminating and reminding and reminding, they couldn't do the entire limited time work. They were utilized just to achieve every purchaser by and by. The vendor still utilized individual influence once the clients were pulled in to his store.

The development of hand press expanded the possibilities of publicizing. By Shakespeare's circumstances, blurbs had shown up, and expected the capacity of cultivating interest for existing items. Another critical occasion was the rise of the handout as a publicizing medium. The early cases of these flyers uncover their sponsorship by organizations need to produce generosity for their exercises. The ease of blurbs and handbills energized various distributors to explore different avenues regarding different techniques.

**OUTSIDE FACTORS**

The outside elements in the arranging structure are natural, social and legitimate contemplations. To a significant degree, these exist as requirements on the improvement of a promoting plan and basic leadership. In creating particular promotion, there are sure legitimate requirements that must be considered. Tricky promoting is illegal by law. What is beguiling is regularly troublesome, in light of the fact that diverse individuals can have distinctive impression of similar promotions. Along these lines, a publicist who endeavors to give particular, significant data must be very much aware of what constitutes misdirection in a legitimate and moral sense and of different parts of promoting direction.

Significantly more troublesome thought for individuals engaged with the promoting exertion is wide social and monetary issues as expressed beneath.

1. Does promoting raise costs or hinder rivalry?

2. Is the utilization of sex or dread interests is fitting? Ladies and minority bunches are misused in promoting by throwing them in very stereotyped parts.
3. Is it more aggravating than engaging?
4. Is an interruption into an as of now too much contaminated condition?
5. Advertising coordinated at kids.

## **MULTIVARIATE MODELS FOR IMPACT OF ADVERTISING OF TWO WHEELERS**

### **INTRODUCTION**

India is the second biggest maker of the bikes. The bike sections contribute the biggest volume among every one of the portions in car industry. The nation remains alongside China and Japan regarding creation and deals individually. The business is developing at 30 % every year. It comprises of three sections: Scooters, cruisers and moped. Lion's share of Indians, particularly the adolescents lean toward motorbikes instead of autos. Catching a vast offer in the bike business, bicycles and bikes cover a noteworthy section. Bicycles are thought to be the top choices among the young age, as they help in simple replacement

### **PRESENT AND FUTURE TREND OF TWO WHEELER INDUSTRY IN INDIA**

Car is one of the biggest ventures in worldwide market. Being the pioneer in item and process advances in the assembling area, it has been perceived as one of the drivers of financial development. Amid the most recent decade, well- - coordinated endeavors have been made to give another seek the car arrangement for understanding the part's maximum capacity for the economy. Steps like nullification of authorizing, evacuation of quantitative confinements and activities to carry the strategy system inconsonance with World Trade Organization necessities have set the business in a dynamic track. Removal of the prohibitive condition has helped rebuilding, and empowered industry to assimilate new advancements and adjusting itself to the world-wide improvement and furthermore to understand its potential in the nation.

The progression approaches have prompted constant increment in rivalry which has

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at last brought about modernization in accordance with the worldwide gauges and in generous cut in costs. Forceful advertising by the car fund organizations have additionally assumed a noteworthy part in boosting car request, especially from the populace in the center wage gathering.

### **MARKET SHARE COVERED BY FIRM**

Market share is defined as - a level of aggregate sales volume in a market caught by a brand, item, or organization. In this research it is computed by taking ratio of units sold out by the firm and total number of households in state during that particular year.

### **MARKET SHARE FOR OUTSIDE PRODUCTS**

Market share for outside products is defined as - a level of aggregate sales volume in a market caught by other brand, item, or organization. In this research it is calculated by taking difference from one to the ratio of units sold out by the firm and total number of households in state during that particular year.

### **GOODWILL STOCK OF ADVERTISING**

Accepted estimation of the appealing power that produces deals income in a business, and enhances its benefits. Altruism is an impalpable however salable resource, relatively indestructible with the exception of by tactlessness. It is fabricated carefully finished the years for the most part with (1) substantial and nonstop use in advancement, (2) creation and upkeep of strong client and provider connections, (3) high caliber of merchandise and enterprises, and (4) high caliber and lead of administration and representatives. Altruism incorporates the value of corporate character, and is upgraded by corporate picture and an appropriate area. Its esteem isn't perceived in account books yet is acknowledged when the business is sold, and is reflected in the company's offering cost by the sum in overabundance over the company's total assets.

### **REGRESSION ANALYSIS**

To understand the functional relationship between the variables or may say to measured unit changes impact of variables, an application of multiple regressions is used. Before that it is also necessary to examine the co-linearity between the variables.

Co-linearity generated by internal impacts of the independent variables that may result on estimated values of constants or coefficients and results of regression model may vary than

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the actual prediction. Thus, the details of estimated regression model can be studied by using variance inflation factor (VIF). The standard error of the b weight with all independent variables can be determine by using

The terms are the squared correlation where independent first variable is considered as a dependent variable, same way all other independent variables have been studied and the results are presented in table 2.2.

The value for standard VIF can be computed by taking diagonal elements of  $R^{-1}$ . The inverse of independent variable matrix, called  $\beta = R^{-1} \cdot r$ , so the value of weights for computed the results can be obtained. The theory of VIF shows that higher the value of  $r^2$  caused to higher value of VIF. Thus, the tolerance value of each independent variable can be measured by

$$1 - R^2 = 1 \quad \text{for each of the independent variable.}$$

*VIF*

Smaller value of tolerance i.e. closed to zero caused trouble to the estimation. The results of collinearity can also judge by taking condition indices. The computation of condition indices is decomposing a correlation matrix into linear combination of variables. The linear combination are selected for the highest value as first largest variance, the second is with the next highest variance subject to being uncorrelated with first variable and same way each of the values can be determine. The variance explained by each of the linear combination is defined as eigenvalue. Based on the theoretical framework table 2.3 can be concluded for results. The variance proportion for each of the variable has been studied. It can be seen that dimension 13 is highly associated with goodwill stock of advertising (37%), average length of area in kilometer (52%), maximum speed of vehicle (59%), maximum speed of vehicle (97%) and average age of vehicle (60%).

The condition index computed 59.51% higher for the said variables. Similarly the higher impact is computed for market share for outside products and cubic capacity of engine. The said two independent variables are highly associated and that may affect the result of regression estimation. Amid the said independent variables, which shows the major impact on model can be studied by using an application of tolerance level of variables in table 2.2. It can be seen from table 2.2 that the values of market share of other products population (tolerance = 0.004) and maximum speed of vehicle (tolerance = 0.047) causes higher trouble

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to the regression model.

The VIF values are also computed higher i.e. 244.6 for market share of other products and 21.32 for maximum speed of vehicle. Thus, the said two variables may result forced to derived unnecessary model of regression for two wheeler industry.

The model summary is presented in table 2.3. It can be seen that the computed R is 0.6. It shows 36% direct effects of the variables and 64% are the impact dumped due to other factors of two wheeler industry. The standard error of model is estimated as 0.259 shows 26% results are not concluded or defined properly. Thus, the researcher has laying down hypothesis about the effect of the said result on model. It is assumed that there is no direct effect of the concluded results on model, and caused higher variability in selected parameters. The hypothesis can be tested with help of F- study. The  $F_{cal}$  resulted 26.115 at 5% level of significance for (13, 636) degree of freedom. The result of  $F_{cal}$  was computed higher than the significant value. It rejects the null hypothesis. Thus, it is cleared that the derived results have direct effects on regression model. It is also important to study the effect of standard deviation as it was computed 26% of fluctuation in variables. So it is necessary here to examine the results of residual on regression model. Thus a hypothesis is derived for impact of residual on regression model and the results are presented in table 2.4.

**TABLE 2.3 MODELS SUMMERY**

| R   | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics |          |     |     |               | Durbin-Watson |
|-----|----------|-------------------|----------------------------|-------------------|----------|-----|-----|---------------|---------------|
|     |          |                   |                            | R Square Change   | F Change | df1 | df2 | Sig. F Change |               |
| 0.6 | 0.348    | 0.335             | 0.259767                   | 0.348             | 26.115   | 13  | 636 | 0             | 0.436         |

**TABLE 2.4 ANOVA**

| Particulars | Sum of Squares | df  | Mean Square | F      | Sig.              |
|-------------|----------------|-----|-------------|--------|-------------------|
| Regression  | 22.909         | 13  | 1.762       | 26.115 | .000 <sup>b</sup> |
| Residual    | 42.917         | 636 | 0.067       |        |                   |

The hypothesis for residual impact is derived as: there is higher impact of residual

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on regression model. The result in table 2.4 rejects the null hypothesis. Finally the regression model can be studied and presented in table 2.5 underneath of theoretical frame work discussed earlier.

| TABLE 2.5 MULTIPLE REGRESSION MODEL FOR TWO WHEELER INDUSTRY |                             |       |                           |        |       |                         |        |
|--|-----------------------------|-------|---------------------------|--------|-------|-------------------------|--------|
| Model - 1  | Unstandardized Coefficients |       | Standardized Coefficients | t      | Sig.  | Collinearity Statistics |        |
|  | B                           | SE    | Beta                      |        |       | Tolerance               | VIF    |
| (Constant)   | 1.21                        | 0.178 | 1.27                      | 6.818  | 0     |                         |        |
| SALE   | 0.075                       | 0.02  | 0.176                     | 3.738  | 0     | 0.463                   | 2.159  |
| MS_F   | -0.122                      | 0.027 | -0.215                    | -4.449 | 0     | 0.44                    | 2.275  |
| MS_OP  | 0.262                       | 0.112 | 1.172                     | 2.34   | 0.02  | 0.004                   | 244.58 |
| GSA  | 0.006                       | 0.063 | 0.007                     | 0.095  | 0.924 | 0.209                   | 4.791  |
| AVG_V  | -0.789                      | 0.207 | -0.564                    | -3.814 | 0     | 0.047                   | 21.317 |
| AGE_V  | 0.52                        | 0.123 | 0.346                     | 4.226  | 0     | 0.153                   | 6.551  |
| AVG_FH   | 0.191                       | 0.029 | 0.304                     | 6.503  | 0     | 0.468                   | 2.138  |
| AVG_OP   | 0.308                       | 0.047 | 0.248                     | 6.56   | 0     | 0.718                   | 1.393  |
| PKMP   | 0.119                       | 0.083 | 0.08                      | 1.438  | 0.151 | 0.328                   | 3.046  |
| TRF  | -0.147                      | 0.035 | -0.199                    | -4.224 | 0     | 0.463                   | 2.158  |

The simple multiple regression models can be determined as:

$$Y_x = \alpha + \beta_1x_1 + \beta_2x_2 + \dots + \beta_3x_3 + \epsilon$$

Thus we may finally write the multiple regression models as

$$Y_{SP\_AD} = 1.21 + 0.075 SALE - 0.122 MS\_F + 0.262MS\_OP + 0.006 GSA - 0.789 AVG\_V + 0.52 AGE\_V + 0.191 AVG\_FH + 0.308 AVG\_OP + 0.119 PKMP - 0.147 TRF$$

It is noticeable that the variables cubic capacity of engine, average length of area and maximum speed of vehicle have similar value for each year and area thus, it cause higher collianarity and are omitted from the best fit of ordinary least square model. It is also



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necessary to study individual impact of each of the parameter on spending on advertising cost for firm.

Thus, an application of step regression is used for farther classification formodel study.

## **POOLED PANEL REGRESSION**

Panel information examination is a technique for concentrate a specific subject inside different locales, intermittently saw over a characterized time span. Inside the sociological, panel examination has empowered specialists to embrace longitudinal investigations in a wide assortment of fields. In financial matters, panel information examination is utilized to ponder the conduct of firms and wages of individuals after some time. In political science, it is utilized to examine political conduct of gatherings and associations after some time. It is utilized as a part of brain research, human science, and well-being exploration to consider qualities of gatherings of individuals took after over the long haul. In instructive research, specialists examine classes of understudies or graduates after some time

With rehashed perceptions of enough cross-segments, panel examination allows the scientist to think about the elements of progress with brief time arrangement.

The blend of time arrangement with cross-areas can upgrade the quality and amount of information in ways that would be outlandish utilizing just a single of these two measurements (D. C. Gujarati). Panel investigation can give a rich and intense investigation of an arrangement of individuals, on the off chance that one will consider both the space and time measurement of the information.

The benefits of utilizing panel information: In brief the vital favorable circumstances of panel information are as following.

1. More perceptions are for the most part accessible, particularly with respect to time arrangement information.
2. The ability to distinguish and separate between substantial quantities of contending speculations. This takes after from the way that we watch the same monetary units over the long run.
3. The ability to control for imperceptibly heterogeneity at the level of the person.

We underline that panel information bear the cost of the way to investigate all the more

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completely the idea of the idle, or imperceptibly, unsettling influence terms in econometric connections. In what tails we will utilize the word individual in a nonexclusive sense, where the utilization of the term singular impact will allude to the quantifiable impact of the cross-sectional unit of perception, regardless of whether this be a firm, a nation, an area, or a man.

Panel information examination blesses relapse investigation with both a spatial and fleeting measurement. The spatial measurement relates to an arrangement of cross-sectional units of perception. These could be nations, states, provinces, firms, products, gatherings of individuals, or even people. The transient measurement relates to intermittent perceptions of an arrangement of factors portraying this traverse a specific time traverse.

A best example of a panel information arrangement is a collection of states for which there are the same parameters affects the advertising — such as sale during the year, market share covered by firm, market share for outside products, goodwill stock of advertising, average fleet held, average fleet operated and total revenue of firm. This pooled data set, sometimes called time series cross-sectional data, contains a total of  $168 \times 28 = 4704$  observations.

## **ESTIMATION FOR MULTIVARIATE MODELS FOR IMPACT OF ADVERTISING OF TWO WHEELERS**

### **INTRODUCTION TO ESTIMATION**

Strong relapse is a vital instrument for breaking down information that is debased with exceptions. It can be utilized to distinguish exceptions and to give safe outcomes within the sight of anomalies. So as to accomplish this steadiness, strong relapse confines the impact of exceptions. The issues with anomalies in both the y-bearing and the x-space can likewise be tended to with hearty relapse strategies. Displaying information by the methods for direct slightest squares technique is critical and pivotal. Regularly, in any case, the notable slightest squares relapse strategy is just ideal under certain distributional suspicion of blunders. Practically speaking, this supposition may not hold in light of plausibility of the skewness or nearness of anomalies in information. In principle, when the presumption of ordinarily does not meet, the standard slightest squares estimation for the relapse coefficients will be one-sided and additionally non-proficient.

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At the point when the presumption of ordinarily is not met in a direct relapse issue, a few elective techniques for the standard Least Squares relapse have been proposed by Sweran and Kobbler, 1999; Kenmen et al., 2005; Robert et., 2007. Among these, the estimation strategies we have connected are strong Hubars M-estimation created by Hubar, in 1968, slightest Absolute Deviations strategy, Dealman and Paffenbeger, 1988 and Blumb Feeldar and Steager, 1987 and non-parametric - arrange based techniques, Abecha, 1964; Jareconva, 1965; Jeackel, 1977. ‘Least Trimmed Square’ estimation of Rosue, 1982, ‘Square’ estimation Rosue, and Yehe, 1987, ‘least median of square’ estimation Rosue in 1985.

The point of this exploration is a formal examination of these strategies through a numerical report. We have connected distinctive powerful estimation strategies on information of bike firms of India for the money related year 2001 to 2012. We have connected this system on the pooled organized information as examined in part two for bike firms' informational collections on 10 chose autonomous factors named – SALE, MS\_F, MS\_OP, GSA, AL\_AKM, AVG\_FH, AVG\_OP, PKMP, TRF and TIME.

The analyst has report some rundown consequences of a numerical report embraced to contrast the properties of a few options with standard slightest squares strategies for basic and numerous straight relapse examination.

## **CONCLUDING REMARKS AND FUTURE PROSPECTS**

### **REMARKS OF THE RESEARCH**

In this thesis rigorous study of some statistical techniques in advertising research is carried out. This research work is carried with the particulars of advertising of two-wheeler and its main impacts scrutinizing the following aspects:

Advertising of two-wheeler is the main medium which can control – in the event that need message to hit on the day an item dispatches or occasion is going to occur, this is the main means control totally by producer.

Advertising of two-wheeler enables to target perfect clients just – when the producer coordinate an extremely close to home message to a select group of onlookers they get far more prominent association.

Advertising of two-wheeler makes mindfulness for producers' substance

– The power that drives a lot of change and trust fabricating nowadays is instructive substance – digital books, workshops and blog entries – promoting is an extraordinary method to help get that content found and expended once the producers have gone to the push to create it.

Promoting ads validity to producer's message – do not ask them for what reason this is actually, however every time they run advertising of two- wheeler individuals remark that business should get going admirably. The observation that they can manage the cost of advertising of two-wheeler is regularly enough to sell and exchange prospects and clients alike and makes it simpler to stand out enough to be noticed for their whole messages.

Advertising of two-wheeler enhances everything else they are doing – when they are utilizing promoting to make mindfulness for their substance consequently make more mindfulness for all that they are doing. It is also observed organizations that promote, referral sources recall organizations that publicize, individuals fan and pursue and companion from advertisements, and agents can point to all around put promotions as a wellspring of pride set up they work.

The research work deals with particulars about the collected information of two-wheeler data for the year 2001 to 2012 for selected 28 states of India dealing with advertising of two-wheelers. The impact of marketing study and advertising are studied in terms of management and economics– sometimes it also studied for social sciences. On other hand the statistical approaches are done to measure the influences of statistical model constructions. This research is carried out first time in terms of econometrics. Thus, the listed 13 variables are studied for dependent variable spending for advertisings. In construction of second chapter an applications of multivariate analysis for pooled panel data have been discussed. Before that the relations between the variables have been tested with correlation. It was computed with higher collinearity. Thus, after diagnosed the collinearity the variables are accepted finally for model construction. It is also important to test the individual impact of each of the variable. Thus, step regression analysis is applied.

The nature of data is found violated thus, it is necessary to test the normality of

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data before further application. Thus, estimation and error models are also tested with support of various estimations and error techniques to takeout the outliers from the process. This chapter is presented with two short of models. The first model is constructed with

outlier data and after test of estimation it is observed with outlier free datamodels.

This research is carried out for selected 28 states of India for their spending after advertising. Thus, it is also necessary to test the geographical impact of the total cost on advertising. The fourth chapter is constructed with support of three dimensional analyses for testing the simple application of ordinary least square model, three dimensional autoregressive models and three dimensional error models. Finally, the comparisons between these three models have been made for testing the best results.

As research is tends to the many affective parameters it is necessary to conclude the major impressive parameters which have higher impact on total spending of advertising. Thus, the loaded factors are studied with support of principle component analysis.

The principle component analysis or factor analysis represents the common effects of listed observations of variables. Thus, to short the dataon actuarial ground the standby variable spending on advertising is taken as a group variable and the impact of other relative parameters are tested with support of discrimination analysis.

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