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Non-Motorized Transportation Analysis of Traffic Density, Pollution Using Regression Anova Analysis

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ABSTRACT

Planners are now trying to provide greener travel solutions to reduce fiscal, social, and environmental issues. This research, therefore, seeks to find significant reasons for urban transport to enhance the use of alternative transportation modes. This report seeks to establish the connection between influential metrics for urban mobility and regular travel trips from different parts of the world. Deployment of excellent non-motorized transport facilities for Walking and cycling is a good way to encourage the use of bicycles, thereby increasing the physical fitness of end-users. Past studies were thoroughly reviewed and found to be applicable for analysis and application in the real world. Anova's regression analysis is distinguished by a more comprehensive interpretation of the findings. At Rajkamal Intersection, Amravati district, Maharashtra the traffic volume counts were carried out. It is the focus of the transport congestion, which leads to a polluted atmosphere due to prolonged duration at the signals. In this research, it can be seen that with the use of Motorized transport the traffic density & air pollution will increase with time, and with the increase in the use of Non-Motorized transport, the traffic density decreases also the air pollution is at a steady pace. The current study shows the necessity, favourable conditions, and economic benefits of non-motorized sustainable traffic, in the Indian condition.

Keywords : Non-Motorized transportation, traffic density, Pollution, multi-linear regression analysis.

I. INTRODUCTION

Non-motorized modes of transport are also seen as a key component of a sustainability scheme. Walking, cycling, rickshaws, animal carts, etc. We focus on bicycles and feet, well known as an environmentally friendly and safe travel modes. In addition, cycling is a stand-alone mode with low access costs and high traffic efficiency. This bike is then famous in the streets, home, school and entertainment a short distance away. [1].

Reduced vehicle use; urban spatial planning through the promotion of public transport; and social justice and equality [17]. However, even people with small incomes in India have to depend on motor vehicles because of the problem of mobility and hence decrease social equity, which supported the need for high-density urban center, linked these environmental considerations with increasing public health and sustainability. Our current research aims to explain the effect of characteristics on walking and cycling modes, as the primary mode of use: socio-economic, transit and environmental modes.

II. BACKGROUND

Many researches were conducted on the impact assessment of various factors impacting the choice of mode for walking and bikingWardman (2007) found a negative cycling impact for age, whereas Plaut (2005) showed a strong cycling and hydraulic effect for age in the America. Noland and Kunreuther (1995) observed that male walking and cycling had a favorable likeliness. An increase in the travel time using cycle was determined having a reducing impact on the probability of choosing a cycle Buys and Miller (2011) suggested that perceived transport convenience was modulated by journey destination and purpose, with subsequent impacts on travel mode choice [2]. Supporting this notion found a positive impact for school purpose for bicycle mode. Other factors influencing NMT mode choice mentioned in studies were the population density and land-use. Badoe and Miller (2000) pointed out the mixed results elicited by various studies on the effect of land-use and density. Cervero (1996) and Cervero and Kockelman (1997) respectively found out a positive correlation between NMT use and mixed land-use, and NMT use and high density. Rodriguez and Joo (2004) arrived at a inconsistent relationship between non-motorized mode choice and increasing density. They also pointed to the necessity to include certain factors correlated with the environment factors, like vehicle ownership, so that the environmental factors are not over estimated [16].

Non-motorized movement (NMT) involves all modes of transport not based on motor or motor. This includes walking and cycling, tiny transportation such as skateboards, scooters and hand carts as well as roller-coasters. This travel forms will provide both leisure and transport. For example, some people prefer walking or cycling instead of driving because they love the activities. As follows, the significance of non-motorized transport can be summed up: Door-to-door transportation is provided; non-motorized infrastructure typically does have a very high space penetration, non-motorized infrastructure does not lead to waiting in relation to waiting times at public transit stations;; Non-motorized cars are good for the environment; they are cheap forms of transport; Non-motorized components are important in multimodal transmission chains; non- motorized movements are healthy [3-12].

III. PROBLEM FORMULATION

According to Litman (2004), one of the factors that influences travel changes is improving NMT travel. Five areas were identified to improve NMT modes of transport condition as shown in Fig. 1. These are: improved convenience and comfort for NMT users; improved transport options; building up attractive and livable communities; improved basic mobility for non-drivers; and improved land-use efficiency. Improved convenience and comfort to NMT users: Four areas are identified in this study that influences the convenience and comfort of NMT users. The Pedestrian Master Plan, states that the physical infrastructure is one of the indicators that influence convenience and the infrastructure should be accessible to everyone, by accommodating the needs of people, regardless of age and ability. According to Department of Transport (2000), the other indicator is to improve safety and security in that area. There are

many ways to increase safety, such as improving lighting, crossings and signal settings, traffic calming measures, signing and improving accident remedial schemes.

Objectives

- Assessment of different parameters of NMT for Implementation.
- To determine various possibilities for implementation of NMT.
- Analyze the environmental benefits after implementation of NMT.

Targets

To collect

1. Population related data of Amravati City of past years.
2. Accidents related data between cyclists and MT, Pedestrian and MT.
3. Traffic volume count of Amravati city.
4. AQI from Maharashtra Pollution Control Board.

IV. DATA COLLECTED

The traffic volume count was carried out at the Rajkamal intersection of Amravati city, Maharashtra. One of the busiest intersections in the city of Amravati. It is the center point for traffic congestion, longer time at the signal resulting in a polluted environment around. The air quality index data was collected from the Maharashtra pollution control board which has an office here, and a pollution measuring station at the Rajkamal intersection.

V. STEPS FOR IMPLEMENTATION

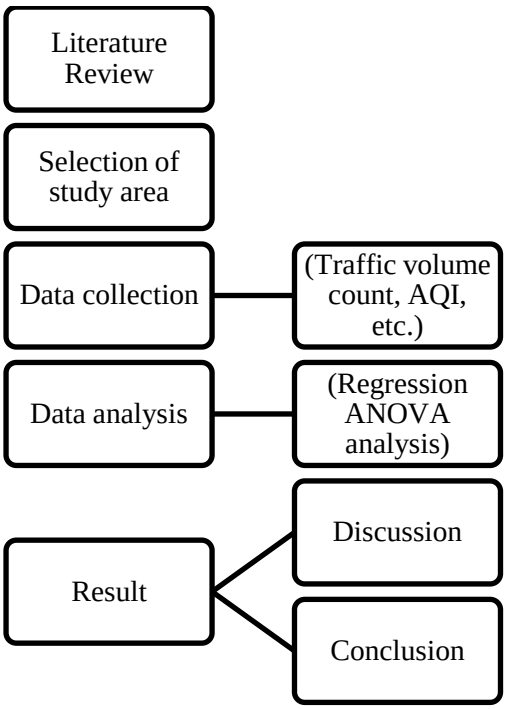

Fig 1. Flow diagram of research

VI. PROPOSED METHODOLOGY

Previous research was extensively reviewed and found to be useful to analyze and apply in the real world. Various methodologies were studied like the regression analysis of Anova is characterized by a better understanding of the results. The Anova analysis for methodology was therefore adopted.

A technique known as ANOVA which is a multi-linear regression analysis compares samples on the basis of its means. Variance analysis (ANOVA) is a method used to analyze statistics, which divides into two sections the measured aggregate variability contained within a data set, systematic factors and random factors. Systematic variables affect the data collection statistically while random factors do not. In a regression analysis analysts are using the ANOVA

test to assess the effect of independent variables on the variable.

Until 1918, when Ronald Fisher analyzed the variance form, t- and z-test methods introduced in the 20th century were used for statistical testing. 12 ANOVA is also known as the Fisher Variance Analysis which is the extension of t and z measures. In 1925 the word "Statistical Methods for Research Workers" was renowned after it is use in Fisher's novel. 3 It was used in laboratory psychology and was subsequently applied to more nuanced topics.

Analysis of variance (ANOVA) in EXCEL : Analysis of variance (ANOVA) can be done in many respects in EXCEL. We are able to carry out this test under EXCEL using the option "Compare means" in the option "one direction ANOVA." If the variance analysis (ANOVA) is carried out in two or three cases, then we can use the alternative 'univariate' in the menu for GLM. EXCEL can also produce more results, such as part eta square, power, regression model, post-hoc check, homogeneity test, etc. The post hoc test is conducted where the group differs dramatically and we want precisely to know which group has means that differ significantly from those of other groups. [14].

4. Data Level and Assumptions

ANOVA plays a vital part in measuring the factors and conclusions of the evaluation. ANOVA needs a constant measuring degree to be the dependent variable. The independent ANOVA variables must be categorical. ANOVA is also a parametric measure, like the t-test, because it has some conclusions. ANOVA assumes the usual distribution of data. ANOVA is equally homogenous, which means that there should be an approximate equivalent difference between different classes. ANOVA also believes that the comments are mutually independent. Researchers should remember to check for foreign or confusing variables when planning every analysis.

Testing of the Assumptions

1. The population from which samples are drawn should be normally distributed.
2. Independence of cases: the sample cases should be independent of each other.
3. Homogeneity of variance: Homogeneity means that the variance among the groups should be approximately equal.

The mathematical software (e.g., intellectual) will verify these hypotheses. Tests such as Levene's test or the Brown-Forsythe test can be used to test the principle of homogeneity of variation. Normal scores can be tested by histograms, by skewing and kurtosis values or by measures such as Shapiro-Wilk or Kolmogorov-Smirnov. The research design will decide the presumption of freedom.

It should be noted that ANOVA is not resilient against breaches of freedom. That means that you can perform the test and essentially trust the results even though you break the principles of homogeneity and normality. However, if the freedom assumption is broken, the ANOVA results are invalid. Usually, the study is regarded as stable if you have equal groups with breaches of homogeneity. For normality breaches, it is usually okay to continue with ANOVA if you have a big sample size.

5. Sample language the working of ANOVA.

- The first column is entitled **"Source of Variation"** and delineates the between treatment and error or residual variation. The total variation is the sum of the between treatment and error variation.
- The second column is entitled **"Sums of Squares (SS)"**. The between treatment sums of squares is

$$SSB = \Sigma n_j \left(\bar{X}_j - \bar{X}\right)^2$$

And is computed by summing the squared differences between each treatment (or group) mean and the overall mean. The squared differences are weighted by the sample sizes per group (n_j). The error sums of squares is:

$$SSE = \Sigma\Sigma\left(X - \bar{X}_j\right)^2$$

and is computed by summing the squared differences between each observation and its group mean (i.e., the squared differences between each observation in group 1 and the group 1 mean, the squared differences between each observation in group 2 and the group 2 mean, and so on). The double summation (SS) indicates summation of the squared differences within each treatment and then summation of these totals across treatments to produce a single value. (This will be illustrated in the following examples). The total sums of squares is:

$$SST = \Sigma\Sigma\left(X - \bar{X}\right)^2$$

Computed by summing the squared differences between each observation and the overall sample mean. In an ANOVA, data are organized by comparison or treatment groups. If all of the data were pooled into a single sample, SST would reflect the numerator of the sample variance computed on the pooled or total sample. SST does not figure into the F statistic directly. However, SST = SSB + SSE, thus if two sums of squares are known, the third can be computed from the other two.

- The third column contains **degrees of freedom**. The between treatment degrees of freedom is df_1 = k-1. The error degrees of freedom is df_2 = N - k. The total degrees of freedom is N-1 (and it is also true that (k-1) + (N-k) = N-1).
- The fourth column contains **"Mean Squares (MS)"** which are computed by dividing sums of squares (SS) by degrees of freedom (df), row by row. Specifically, MSB=SSB/ (k-1) and MSE=SSE/ (N-k). Dividing SST/ (N-1) produces the variance of the total sample. The F statistic is in the rightmost column of the ANOVA table and is computed by taking the ratio of MSB/MSE.

The mathematical model that describes the relationship between the response and treatment for the one-way ANOVA is given by

Yij=μ+τi+ϵij,

where Yij represents the j-th observation (j=1,2,…,ni) on the i-th treatment (i=1,2,…,k levels). So, Y23 represents the third observation using level 2 of the factor. μ is the common effect for the whole experiment, τi represents the i-th treatment effect, and ϵij represents the random error present in the j-th observation on the i-th treatment.

VII. SIMULATION

Table 1 - With and Without NMT pollution Prediction table

Station	Year	Avg SOx	Avg Nox	Avg of RSPM
Annual Permissible Limits (CPCB)		50	40	60
Rajkamal chowk	2006-07	13	19	79
	2007-08	11	16	78
	2008-09	12	15	100
	2009-10	14	16	125
	2010-11	13	15	146
	2011-12	15	18	108
	2012-13	12	13	109
	2013-14	12	13	128
	2014-15	12	14	133
	2015-16	12	14	135
	2016-17	12	14	141
	2017-18	13	23	120
	2018-19	18	19	119

Table 2 - With and Without NMT Prediction density table

Date	Motorized Total	Non-Motorized Total	PCU Motorized	PCU Non-Motorized
04-Jan-21	2593	110	1373	124
05-Jan-21	2822	106	1480	140
06-Jan-21	2552	156	1330	197
07-Jan-21	2632	129	1390	169
08-Jan-21	2721	141	1415	175

Table 3 - Without NMT density prediction table

PROBABILITY OUTPUT	
Percentile	*MOTORIZED TOTAL*
10	2552
30	2593
50	2632
70	2721
90	2822

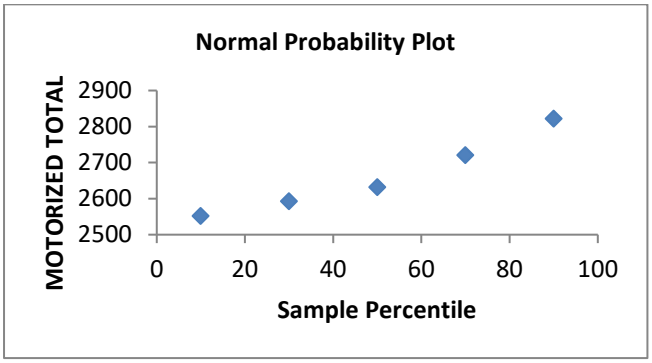

Fig. 2 Without NMT density prediction : -it shows that with time the traffic density will grow exponentially.

Table 4 - With NMT density prediction table

PROBABILITY OUTPUT	
Percentile	*NON MOTORIZED TOTAL*
10	106
30	110
50	129
70	141
90	156

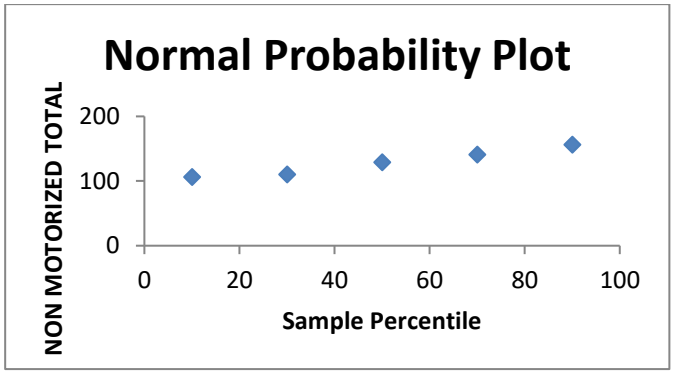

Fig. 3 With NMT density prediction: - It shows that with time the traffic density will steadily grow.

Table 5 - Without NMT Probability output sox

PROBABILITY OUTPUT	
Percentile	*Avg SOx*
3.571429	11
10.71429	12
17.85714	12
25	12
32.14286	12
39.28571	12
46.42857	12
53.57143	13
60.71429	13
67.85714	13
75	14
82.14286	15
89.28571	18
96.42857	50

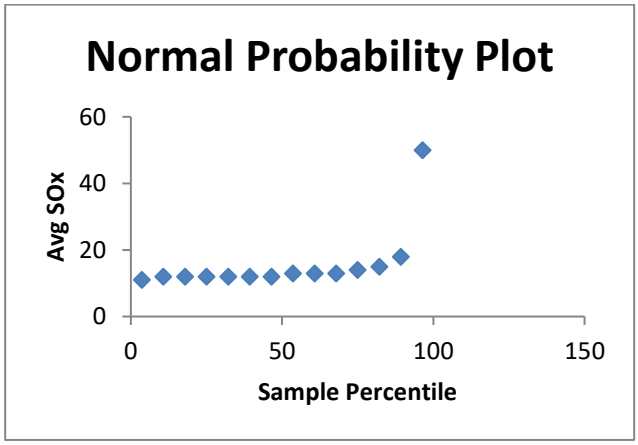

Fig. 4 Without NMT Probability output SOx: - It shows that with the implementation of NMT the SOx will be at steady pace as compared to MT.

Table 6 - Without NMT Probability output NOx

PROBABILITY OUTPUT	
Percentile	*Avg Nox*
3.571429	13
10.71429	13
17.85714	14
25	14
32.14286	14
39.28571	15
46.42857	15
53.57143	16
60.71429	16
67.85714	18
75	19
82.14286	19
89.28571	23
96.42857	40

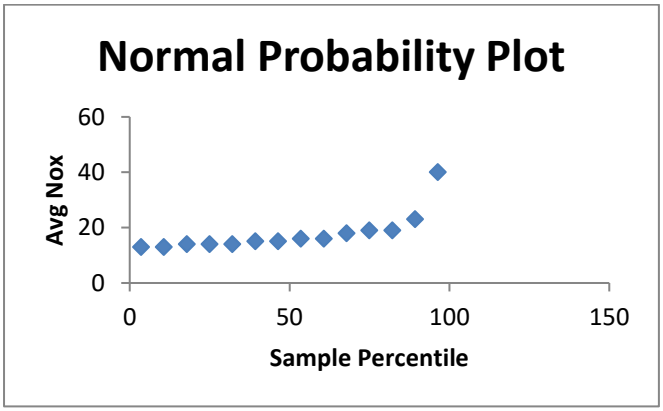

Fig. 5 Without NMT Probability output NOx: - It shows that with the implementation of NMT the NOx will be at steady pace as compared to MT.

VIII. RESULTS

The following interpretation can be drawn –

1. If the same motorized transport system continues, the density of traffic will grow exponentially.
2. Also, SOx, NOx will increase with time.
3. On the other hand, with the integration of NMT the traffic density will steadily increase with time.

NMT will directly affect the growth of SOx & NOx which will lower the pollution in the surrounding environment

IX. CONCLUSION

This research examines the philosophy of biking and walking in the urban world and how NMT can be integrated into public transport. In previous studies, several factors were established to establish this system that is essential for preparing and implementing cycling and walking. The authors have therefore collected all considerations which could affect the effectiveness of the NMT in a metropolitan environment. In the next step of this analysis, the variables that affect cycling and walking must be described carefully and weighed.

Implementation of Non-motorized transport will pave the road for sustainable transport. The current study shows the necessity, favorable conditions, and economic benefits of non-motorized sustainable traffic, in the Indian condition.

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