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**RESEARCH ARTICLE**

# ANFIS based Trip Generation model for Meerut

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***Abstract- In the present paper ANFIS based model for trip generation is formed for calculating volume of trip generation in Meerut. This model demonstrates the relationship which is not linear between dependent variables and the independent variables assigned to this model. Forecasting of trips generation is entirely based on demonstrated ANFIS model. Error produced during machine learning phase of this model is very low. The traditional transportation method is based on simple trends extrapolations which are linear in nature.***

***Keyword- Adaptive neuro fuzzy inference system (ANFIS); Trip Generation(TG); Trip Production(TP); Trip Attraction (TA); Trip Production Model(TPM); Trip Generation Model(TGM); Meerut Development Authority(MDA).***

## I. INTRODUCTION

The spatial division between economic and social activities generate intercity and intra-city traffic [1]. Growth in the urban sector has direct impact on the trips produced and trips attracted by a zone. The households living in residential zones, using available transport system, produce trips. Trips are attracted by workplaces; commercial centers educational institutions, health care systems and recreational places. The social-economic system in a city evolves over time, which influences the functioning of the transport system largely in two ways: (i) changes in the demand for transport and (ii) changes in transport technology.

### *A. Factors that Influence Trip Generation*

House hold characteristics, number of persons going to work, number of children going to schools and colleges, income, car ownership, scooter ownership and public transport facility influence the trip production .The factors that influence trip attraction are land –use activities, such as industrial and commercial & health care and recreational & work Centers with educational sectors[2].

In the present paper the urban structure of Meerut City (Uttar Pradesh, India) has been studied and future traffic generation both production and attraction have been estimated based on the master plan of the city for 2021. A neural network model has been trained with the past data collected from Meerut Mahayojana - 2021 (Praroop)

 

of MDA, Meerut over ten years and future traffic estimation has been computed using the projected urban socio-economic variables for 2021.

The goal of the production/attraction model is to predict the total number of trips produced from the city and the total number of trips attracted by the city.

## II. TRIP MODELING

A model describes the behavior of a system as closely as possible to a real situation [6].

Model can be classified according to their way of demonstration. The demonstration preserves to be concrete or physical, as in scale models. Abstract models belong to a totally different group and there are a lot of abstract models [5]. The model that benefits us is the mathematical model. The traffic model is a mathematical model.

We can also classify models according to their end-use. Here, we distinguish between descriptive, predictive and normative models. Descriptive models are confined to the schematic representation of a phenomenon. They do not aim to explain this phenomenon. A predictive model, or a prognosis model, has a greater reach. Starting from the current state of a phenomenon, and having knowledge of probable future influences, it is used to predict the future situation. One can follow a simple trajectory, for example, by extrapolating trends. Or one can try to reach a deeper understanding of the relevant phenomenon by developing a theory. In the last case one speaks of a causal model. The classic traffic demand model is an example of a causal prognosis model. Then there are normative models. Here one decides on a particular norm or objective, namely a goal function, or an objective function that needs to be optimized. Next, one attempts to determine which conditions need to be met in order to achieve the optimal situation. Normative models also come under the name of prescriptive or optimization models.

There are still more possible classifications. We can classify models according to the role that time plays in the description of phenomena. When the flows in a traffic model are time-dependent, we speak of a dynamic model. If we assume that the flows are constant over a specific period of time, we have a static model. Lastly, we mention the classification that looks at the role of chance played in the model. There are many models that use chance or stochastic variables. These are so-called stochastic models. Stochastic variables are not used in deterministic models.

### *A. Regression Model*

Regression modeling is the most frequently used method to calculate productions and attractions.

In a linear regression model we try to predict a variable Y as a linear function of one or more influence variable $X_{i.}$

$$Y=a+b_1X_1+b_2X_2+b_3X_3+\ldots\ldots\ldots +b_nX_n$$

The variable Y to be predicted is called the dependent variable. The influence variables $X_i$ are the independent variables. The coefficient a is the constant factor of the regression equation, the coefficients $b_i$ are the regression coefficients. When there is only one variable X, one speaks of simple regression. When there are several variables $X_1$, $X_2$….., we use the term multiple regression.

When regression analysis is used for the development of production and attraction models, the $X_i$ represent the socio-economic influence factors mentioned above, for example population, car-ownership, etc. The dependent variable Y represents the number of trips produced or attracted, usually subdivided according to purpose. Most production and attraction models predict the number of trips for a peak period.

The constant factor and the regression coefficients are calibrated using socioeconomic data gathered over a base year. The calibration uses the method of least squares for which computer programs are widely available. It is assumed that these coefficients are time-invariant, so that the trips for a forecast year can be determined using the estimated regression equation and expected socio-economic developments.

 

*B. ANFIS Model*

Figure 1 shows all layers of ANFIS model. In the present paper the ANFIS applied to traffic modeling is implemented in two phase's by training of the network based on part data and then estimating the output i.e. the trip produced and the trips attracted by socio-economic activities in Meerut.

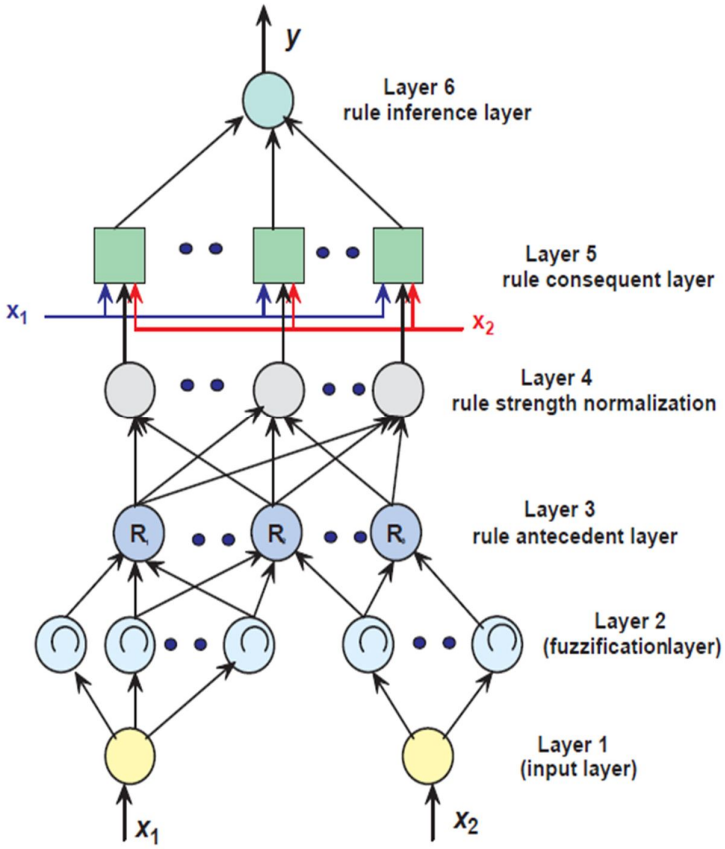


Fig-1 ANFIS Model [7, 8].

## III. IMPLEMENTATION OF TRIP GENERATION MODEL AND RESULTS:

This Generation model splits into two parts:
A. Trip production, and
B. Trip attraction

*A. Trip Production Model using ANFIS*

Hypothesis of the model is that the trip produced (t) in the city is dependent on population (p), number of buses (b), number of two wheelers(s), and number of cars (c) as shown by equation (1).

t=f(p,b,s,c)…….(1).

DATA ON THE INPUT VARIABLES ARE GIVEN IN TABLES 1, TABLE 2 AND TABLE 3 RESPECTIVELY.

 

| Year | p | b | s | c |
|---|---|---|---|---|
| 1992 | 880000 | 1624 | 1311 | 1353 |
| 1993 | 920000 | 1630 | 1400 | 1400 |
| 1994 | 950000 | 1640 | 1500 | 1500 |
| 1995 | 980000 | 1645 | 1600 | 1600 |
| 1996 | 1010000 | 1650 | 1675 | 1650 |
| 1997 | 1040000 | 1660 | 1750 | 1750 |
| 1998 | 1075000 | 1665 | 1850 | 1800 |
| 1999 | 1105000 | 1670 | 1950 | 1900 |
| 2000 | 1140000 | 1680 | 2050 | 1950 |
| 2001 | 1170985 | 1690 | 2150 | 2000 |
| 2002 | 1200000 | 1701 | 2231 | 2112 |

Table-1 For Meerut – Barot Route

| Year | P | b | s | c |
|---|---|---|---|---|
| 1992 | 880000 | 658 | 529 | 271 |
| 1993 | 920000 | 700 | 600 | 350 |
| 1994 | 950000 | 750 | 700 | 450 |
| 1995 | 980000 | 775 | 950 | 500 |
| 1996 | 1010000 | 800 | 1050 | 600 |
| 1997 | 1040000 | 850 | 1150 | 675 |
| 1998 | 1075000 | 900 | 1200 | 750 |
| 1999 | 1105000 | 950 | 1300 | 800 |
| 2000 | 1140000 | 975 | 1350 | 850 |
| 2001 | 1170985 | 1050 | 1450 | 950 |
| 2002 | 1200000 | 1078 | 1561 | 1011 |

Table-2 For Meerut – Prakshit Gharh Route

 

| Year | p | b | s | c |
|---|---|---|---|---|
| 1992 | 880000 | 1452 | 1278 | 1830 |
| 1993 | 920000 | 1500 | 1285 | 1950 |
| 1994 | 950000 | 1600 | 1300 | 2050 |
| 1995 | 980000 | 1650 | 1350 | 2200 |
| 1996 | 1010000 | 1750 | 1400 | 2350 |
| 1997 | 1040000 | 1850 | 1450 | 2500 |
| 1998 | 1075000 | 1900 | 1500 | 2600 |
| 1999 | 1105000 | 1975 | 1550 | 2750 |
| 2000 | 1140000 | 2050 | 1600 | 2900 |
| 2001 | 1170985 | 2150 | 1650 | 3050 |
| 2002 | 1200000 | 2235 | 1692 | 3179 |

Table-3 For Meerut – Garh Route

Note: Data for 1992 and 2002 were directly available. Data for the other years have been interpolated accordingly.

As Per the master plan of Meerut for 2021 the input variables are

*1) Meerut – Barot Route:*

p= 2300000

b=2511 (assuming approx. 2% growth in No. Of buses for 20 year)

s=14464 (assuming approx. 10% growth in No. Of two wheelers for 20 year)

c=13455 (assuming approx. 10% growth in No. Of cars for 20 year)

*2) Meerut – Prakshit Gharh Route:*

p= 2300000

b= 1560 (assuming approx. 2% growth in No. Of buses for 20 year)

s= 2154 (assuming approx. 2% growth in No. Of two wheelers for 20 year)

c= 1411 (assuming approx. 2% growth in No. of cars for 20 year)

*3) Meerut – Garh Route:*

p= 2300000

b= 3194 (assuming approx. 2% growth in No. of buses for 20 year)

s= 11100 (assuming approx. 10% growth in No. of two wheelers for 20 year)

 

c= 20519 (assuming approx. 10% growth in No. of cars for 20 year)

Following are the output on trips produced in 2021 for different routes and figure 2 shows the number of trips produced from Meerut on the following routes in 2021:

Meerut – Barot Route= 47860 Person-Trips.

Meerut – Prakshit Gharh Route= 29703 Person-Trips.

Meerut – Garh Route= 63863 Person-Trips.

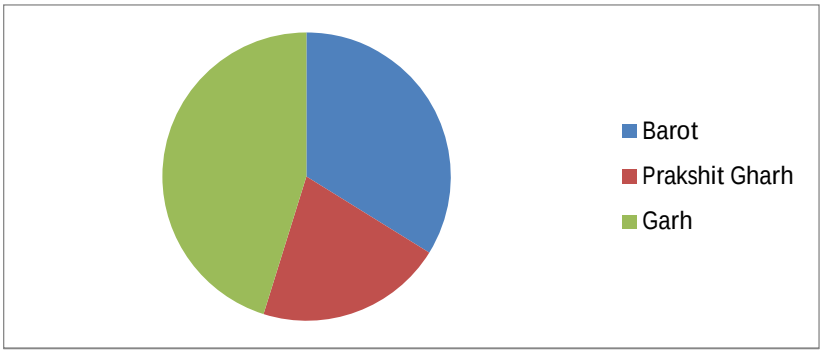


Fig- 2 Person Trips Produced From Meerut.

*B. Trip Attraction Model using ANFIS*

Hypothesis of the model is that the trip attracted (g) in the city is dependent on industrial land (i), Commercial and educational land (ce), recreational land (r), and offices land (o) as shown by equation (2).

g=f (i,ce,r,o)…….(2).

The ANFIS is trained based on the above data given in table 4.

DATA ON THE INPUT VARIABLES ARE GIVEN AS

| **Year** | **I** | **ce** | **r** | **o** |
|---|---|---|---|---|
| 2001 | 1292.8 | 1743.6 | 2358.6 | 303.4 |
| 2003 | 1280 | 1695 | 2395 | 310 |
| 2006 | 1260 | 1640 | 2440 | 320 |

Table-4 For: Land Use in Meerut in Hectares

For 2021 Meerut land (hectare) for various variable data taken from Meerut Mahayojana -2021

i=1185

ce= 1384.42

r= 2680

o= 393.67

Following are the output trips attracted in 2021 different routes and figure 3 shows the number of trips attracted by Meerut on the following routes in 2021

 

Meerut – Barot Route= 46500 Person-Trips.

Meerut – Prakshit Gharh Route= 17509 Person-Trips.

Meerut – Garh Route= 46555 Person-Trips.

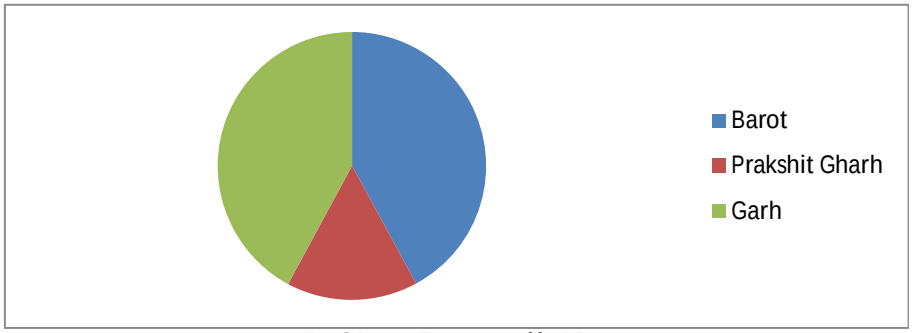


Fig- 3 Person Trips attracted by Meerut.

## IV.CONCLUSION

The present paper has successfully demonstrated the application of ANFIS for modeling trip generation in Meerut city .The data on socio-economic variables have been collected from Meerut Mahayojana -2021 (Praroop) of MDA, Meerut. Error generated in training phase is quite low. The application demonstrates that the relationship between socio-economic variable and transport variable is non-linear which is taken care by ANFIS.

## REFERENCES

[1] Hutchinson B. G. Mc Graw Hill, "*Principles of urban Transport systems planning*".
[2] Guller Peter in SYNERGO, "*Integration of Transport and Land- use planning in Japan: Relevant finding from Europe*", in Workshop on Implementing sustainable Urban Travel Policies in Japan and other Asia-Pacific Countries, 2005, Tokyo
[3] Vijayalakshmi Pai G.A. and Rajasekaran S. PHI. "*Neural Networks, Fuzzy Logic, and Genetic Algorithms Synthesis and Applications*",
[4] Advani Mukti and Tiwari Geetam in (TRIPP) IIT, Delhi, "*Does high capacity means high demand?*" Conference Proceeding-Future Urban Transport, 2006.
[5] Levinson David and Kumar Ajay, "*Specifying, Estimating, and Validating a New Trip Generation Model: A Case Study of Montgomery County, Maryland*", in Record #1413 of Transportation Research.
[6] Ben-Akiva M. , Bowman, "*Behavioral Realism in Urban Transportation Planning Models*", prepared for Transportation Models in the Policy-Making Process: A Symposium in Memory of Greig Harvey Asilomar Conference Center, 1998.
[7] Abraham A., Adaptation of Fuzzy Inference System Using Neural Learning, Fuzzy Systems Engineering Studies in Fuzziness and Soft Computing, Volume No. 181, 2005.
[8] Chang etal., Hydrology and Earth System Sciences, Interactive comment on "Modeling regional evaporation through ANFIS incorporated solely with remote sensing data", 2013.

 