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## EMPERICAL ANALYSIS OF URBAN TRAFFIC SYSTEM OF LUCKNOW USING DATA MODELING AND CAPTURING TECHNIQUE

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### Abstract

This paper highlights the empirical analysis of Urban Traffic System of Lucknow and its adjacent areas. It uses various types of questionnaire design methodologies which are helpful in collecting the most relevant data for analysis. The analysis part deals with various extrapolation and interpolation techniques of statistic to derive some concrete solution which is helpful to traffic department.

*Keywords:* urban traffic, data modeling, mathematical analysis

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### 1. INTRODUCTION

Urban transport is one of the most important components of urban Infrastructure. A good network of roads and an efficient Mass Urban Transport System make a substantial contribution to the working efficiency of a large city. A poor urban transport system may slow down economic growth of the city and also lead to its decay. It has been estimated that the poor traffic and transportation in Urban areas of

results in loss of the order of thousand of crores in vehicle operating and travel time costs. In a view of the rapidly growth urban population, pressure on urban transport system is bound to increase much more in the coming years, so there is an urgent need of accurate and effective urban traffic planning in order to table with this problem.

For planning it is important to have precise information about the number of vehicle their type and speed. Traffic count may provide the information but it does not

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provides other data that are essential in urban traffic planning such as routing, durations, travel purpose. Collection of such data requires good survey instruments such as mailed questionnaire, telephonic surveys, face to face home surveys etc.

Here our focus is to develop a methodology of framing effective questionnaire useful for collecting data in Urban Traffic planning using continuous petrinet as shown in Fig. 1. The aim of this methodology is to provide government authorities with the methods, questionnaire and guidelines to investigate Urban Traffic problems and public policies to deal with India's Urban Traffic crises. Analysis of such questionnaire helps in the development of new planning model in Urban transport requirements.

## 2.CATEGORIZING QUESTIONNAIRES

Broadly two types of questionnaires may be designed for respondent :

1. Questionnaire on the problem faced

by respondent

2. Questionnaire on the suggestions to improve urban traffic planning.

The first group of questionnaire can be classified under three major categories :

- a. Questionnaire on traffic congestion.
- b. Questionnaire on Vehicular Emmission and Environmental pollution.
- c. Questionnaire on traffic injuries and fatalities.

The second group of questionnaires are designed suggestions for improving urban transportation. The questionnaire focus on the following issues :

- a. Improved public transportation system specially buses.
- b. Provision of footpaths and cycle lane for pedestrians and non motorized vehicle respectively.
- c. Restriction on old age commercial vehicles and Private vehicles.
- d. Strict enforcement of Traffic Management by Traffic Management by Traffic Police.
- e. Discouraging Private vehicles users by imposing heavy parking and toll charges.

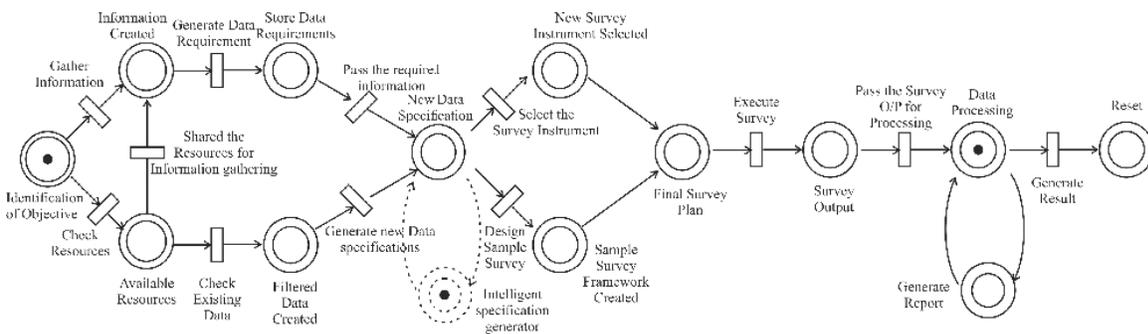


Figure 1. Workflow of Survey Design and Conduct using Countinuous Petrinets

- f. Construction of new roads, flyovers, bridges, and subways.
- g. Better coordination among various government agencies like Municipal corporations, telephone department, waterworks etc.
- h. Proper Audit of accident prone areas.

**2.1. Survey Choice**

The questionnaire can be designed to conduct the survey on either telephonic interviews or through face to face interviews. The interviews can be further subdivided into two parts :

- 1. Road Side Survey of Road Uses : Drivers/Riders
- 2. Pedestrian Survey

Table 1. shows the comparative study of two survey Methodologies covering various factors like Response Rate, Data Attributes, Geographic Coverage etc.

**3. ANALYSIS OF THE SURVEY**

The total sample of 100 was take out of which 80 were private vehicle owners and 20 were drivers of Government vehicles and public transport. For calculating of the sample size we have used Yamane's Formula (Yamane, 1967).

To facilitate the analysis we have done the collection of data across various locations of Lucknow like Badshahnagar Crossing, SGPGI, Chowk and Lalbagh

The data set presented in Table- II, are taken four distinct locations which represents distant boundary of Lucknow city, with sample size of 50 respondent from each locality. From Table II we can draw the bar graph representation of the respondent age and vehicle ownership and safety awareness.

XY - Plane : Age Vs Vehicle ownership

XZ - Plane : Age Vs Type of Vehicle

To further analyze our survey we have used two more analysis tools pie- chart and likert's scale Analysis. These two tools are used for the first and second questionnaire.

*Table 1. Comparative Analysis of two survey Methodologies*

S.No.	Methodology	Disrupt the traffic	Response Rate	Cost Effectiveness	Statistical Reliability	Data Attributes	Geographical Coverage
1	Face to face Road side Interview	Disruption of Traffic or Respondent	High Response Rate	Higher Responses requires higher Investment	Best Statistical Control	Best for O.D. Surveys	Covers Vehicles passing through geographical areas
2.	Phone Surveys	No disruption of Traffic	Low Response Rate	Less Investment	Low Response, may	Detailed data can be obtained with good explanation of survey	No Geographical Limitation

Table 2. Respondent Age, Vehicle Ownership and Safety Awareness

S.No.	Respondent Age	Percentage of Respondent Under Particular Age Group	Vehicle Ownership	Type of Vehicle			Safety Awareness
				Car	Two Wheeler	Public	
1.	18-22	40%	38%	10	27	63	38
2.	22-35	27%	45%	19	41	50	44
3.	36-49	12%	63%	37	29	34	51
4.	50-61	13%	67%	61	13	26	63
5.	62-78	08%	70%	73	08	29	69

Pie- chart gives us the responses regarding safety suggestion given by various types of commuters.

The thrust is basically on the improvement in street lighting and Implementation of Road dividers, Second survey relates to the congestion problem. The analysis is divided into two phases the first phase deals with bar graph analysis,

while the second stage covers the statistical interpretation.

The second survey covers the information relating to the type of vehicle which the commuter has to encounter during his travel with different time zones.

There is significant variation in the type of vehicles commuting at four different locations. To check whether the difference

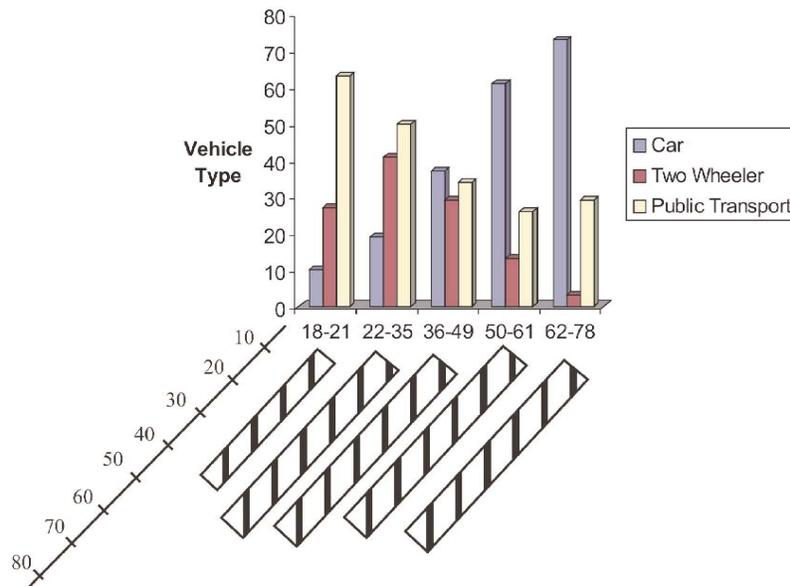


Figure 2. Plot of Respondents Age versus vehicle ownership and type of vehicle

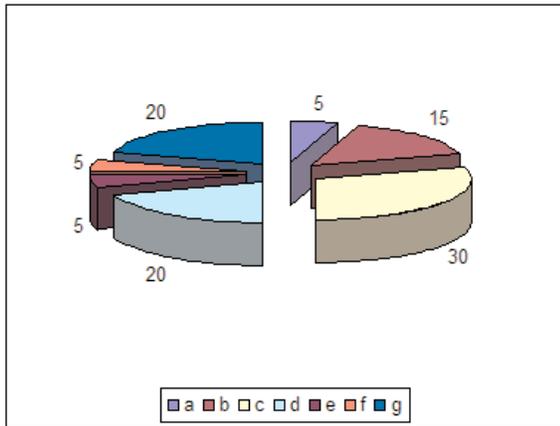


Figure 3. Safety suggestions generated from the questionnaire

where:

- a = Designated have
- b = Flyover Recommendation
- c = Improvement in street lighting
- d = Road Dividers Recommendations
- e = Speed Breakers
- f = Large Crossing Area
- g = Suggestions of One - Way at some congestion points.

between sample proportion are significant or only due to chance we use chi-square test of independence consider the following hypothesis :

$$H_0: PT1 = PT2 = PT3$$

$$H_1: PT1 \neq PT2 \neq PT3.$$

PT1 = Proportion of Public and Private Vehicle (Total) at time sample 8 am - 11 am.

PT2 = Proportion of Public and Private Vehicle (total) at Time sample 12 Noon - 4 pm.

Starting with the contingency Table :

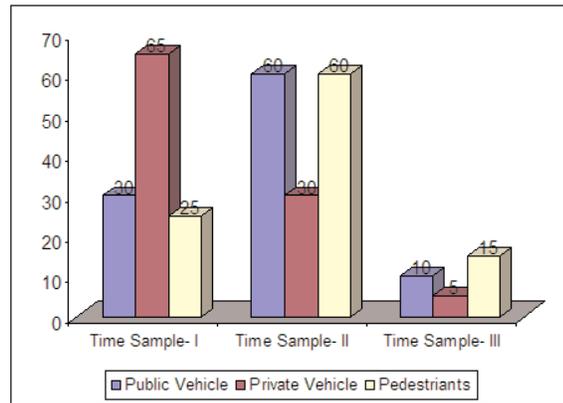


Figure 4. Interpretation from Congestion Analysis

Combined proportion of Public + Private Vehicles  
 $= (90 + 95 + 85) / 300 = 270/300 = 0.9$

$$\chi^2 = \frac{(f_0 - f_e)^2}{f_e}$$

Substituting the values in the equation we get  $\chi^2 = 5.54$

We compare observed values of  $\chi^2$  with critical value of  $\chi^2$  and follow the rules of hypothesis :

$\chi^2_{\text{observed}} < \chi^2_{\text{Critical}} \Rightarrow$  Accept the Null Hypothesis

and if,

$\chi^2_{\text{observed}} > \chi^2_{\text{Critical}} \Rightarrow$  Reject the Null Hypothesis

Now calculating the degree of freedom we get :

$$dF = (r-1) (c-1)$$

$$dF = (2-1) (3-1)$$

$$dF = 2$$

$$\text{at } \alpha = 10\% = 0.10$$

$$\chi^2_{\text{Critical}} / \alpha = 0.10$$

Plotting the graph for acceptance Region (shown in Fig. 5).

Since sample chi-square lies outside the acceptance region we reject the null

Table 3. Contingency Table from Questionnaire - II

	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Total
Number of Public + Private Vehicles	90	95	85	270
Number of Pedestrians	10	5	15	30
Total Sample in each time	100	100	100	300

Table 4. Tabular representation of observed and expected frequencies

f <sub>o</sub>	f <sub>e</sub>	(f <sub>o</sub> -f <sub>e</sub> )	(f <sub>o</sub> -f <sub>e</sub> ) <sup>2</sup>	(f <sub>o</sub> -f <sub>e</sub> ) <sup>2</sup> / f <sub>e</sub>
90	90	0	0	0
95	90	5	25	0.27
85	90	(-5)	25	0.27
10	10	0	0	0
5	10	-5	25	2.5
15	10	5	25	2.5

hypothesis i.e. proportions of public and private vehicle at different time samples are not same.

The third questionnaire on vehicular emission highlights the relationship between the duration of exposure on road and increase in health hazards in individuals. If it is there than what is the type of relationship that exists between these two variables. In order to analyze our result we have used regression analysis to determine the relationship between dependent and independent variable. The dependent variables are defined as "number of health

problems of.

The total sample size is 100 (by using Yamanes Formula) the survey is concluded at I.T. Crossing Daliganj Railway crossing and Kapoorthala, Mahaganar as road.

We use scatter diagram to plot the two variables.

The relationship between X and Y takes

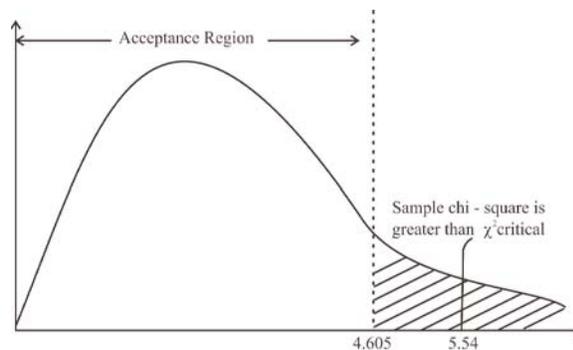


Figure 5. Sample Acceptance Region

the term of curvilinear giving a direct, relationship in health related problem increases the duration of exposure increases.

### 3.1. Inferences from the Analysis

We have divided the interpretation into three parts, the first part deals with traffic safety awareness and the suggestions made by the commuters. From the survey we are able to derive the conclusion that young generation of commuters is least aware of the rules and regulations. The reason may lack of safety related guidelines in magazines and T.V. programmes popular amongst young generation. One step in this direction would be to increase these campaign through electronic media with some lucrative schemes and offers.

The next inference from the pie- chart we are able to specify three major problems :

Table 5. Tabular representation of Vehicular Pollution and Emission.

Respondent Age Group	% of Respondent	Respondent Sex Category		Duration of Exposure in Hours (Hrs)			
		Male	Female	1-2 Hrs	3-5 Hrs	6-8 Hrs	9 Hrs & More
15-36	26%	59%	41%	43%	28%	21%	8%
31-45	39%	62%	38%	32%	39%	20%	9%
46-60	24%	65%	35%	36%	31%	23%	10%
61 & above	11%	86%	14%	58%	25%	11%	6%

1. Lack of street lighting
2. Suggestion of one-way at some specific location
3. Road Dividers

These problems are very common to Lucknow. Due to lack of street lighting drivers (specially older people) find it very difficult to drive in might be because of the glare from the opposite vehicle. Secondly, the absence of dividers in Alambagh and Chowk areas lures the two wheeler drivers to overtake even crossing the opposite lane mark, henceforth they are in constant danger of getting hit from vehicle coming from opposite side.

The point "Two way to one way" has

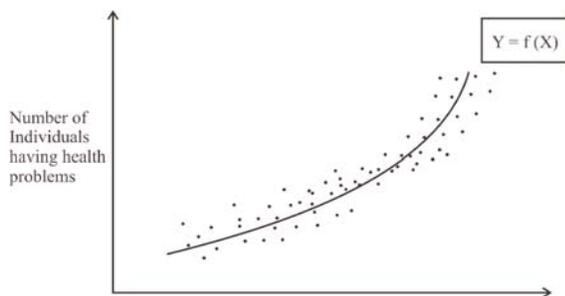


Figure 6. Duration of exposure of an individual

certain disagreement value as it causes some problem with the frequent of that route, they feel that making it one way is not a permanent solution rather than the road in that area should be widened or flyovers should be made. The outburst mainly consists of private vehicles because of the lack of public transport system which could cater to every class of commuters.

In the afternoon the situation cases out with population of public transport dominating the private vehicles.

The evening slot becomes worst when the ratio of private and public vehicles is almost equal, because of office goers which form a large portion of commuters strength. Since there is no planning of footpaths for pedestrians, these generate tendency is to walk on road, worsening the condition of traffic flow from the above interpretation we can sum up the conclusion into three basic sections the awareness regarding the safety standards, the congestion and the vehicular emission/ environmental pollution.

#### 4. CONCLUSION

The awareness regarding safety standards

is very poorly penetrated amongst young generation. They are hardly aware of the traffic rules and regulation. One of the remedial solution in order to propagation about safety norms could be to organize camps and road shows in maximum number of colleges and schools, by clubbing it with some incentive scheme such maximum number of students attend the drive about safety standard.

Secondly, has to be implemented at the infrastructure level. Priority should be assigned to the areas which are lacking in the basic road safety standards.

The congestion survey has provided a new dimension of study. The reduction of the private vehicle or enforcement of car pooling in certain areas could be one of the possible solutions. Secondly ploughing of public vehicle like mass Transit system in fixed section of the Road could provide considerable respite to the congestion levels spread across certain hot spots. Lastly,

accommodating, pedestrian space could provide a faster movement of traffic thereby reducing the pollution levels.

The last section focuses on vehicular emission, from the regression analysis we can conclude that in Lucknow, the person who is exposed to 40 to 50 Kms of daily commuting is likely to have health problem like asthma, blood pressure and severe depression.

The study provides an empirical analysis of various problems and possible solutions to it. If necessary steps then we hope that our finding can help the government in building Lucknow a better place to live -in.

## ЕМПРИЈСКА АНАЛИЗА УРБАНОГ САОБРАЋАЈНОГ СИСТЕМА ГАРДА ЛУКНОВ УЗ КОРИШЋЕЊЕ МОДЕЛОВАЊА ПОДАТАКА И ТЕХНИКЕ АКВИЗИЦИЈЕ

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### Абстракт

Овај рад говори о емпријској анализи урбаног саобраћајног система града Лукнов у Индији, као и негових суседа. Коришћени су различити типови методологија и упитника који су помогли у сакупљању података за анализу. Анализа у раду се заснива на различитим техникама екстраполације и интерполације статистичких података како би се дошло до конкретних решења разматраног проблема.

*Кључне речи:* урбани саобраћај, моделовање података, математичка анализа

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**QUESTIONNAIRE - II**  
**Sample Questionnaire for Congestion**

1. Do you feel traffic congestion is a major problem in your route

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

2. Please specify the type of Traffic under various time zones.

Time sample-I : 8 am - 11 am.

- (a) Public Vehicles : \_\_\_\_\_ % (Approx.)
- (b) Private Vehicles : \_\_\_\_\_ %
- (c) Pedestrians : \_\_\_\_\_ %

Time Sample - II : 12 Noon - 4 P.M.

- (a) Public Vehicles : \_\_\_\_\_ % (Approx.)
- (b) Private Vehicles : \_\_\_\_\_ %
- (c) Pedestrians : \_\_\_\_\_ %

Time Sample - III : 4 P.M. - 8 P.M.

- (a) Public Vehicles: \_\_\_\_\_ % (Approx.)
- (b) Private Vehicles: \_\_\_\_\_ %
- (c) Pedestrians: \_\_\_\_\_ %

3. Suggests measures to control traffic congestions?

a. Strict traffic enforcement by the police.

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

b. Convert two way to one way

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

c. Restrict Parking on Roads

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

d. Specific Stoppage and constant check of Public transport system.

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

e. Designing of Large Sized crossings

1	2	3	4	5
Strongly	Agree	Neutral	Disagree	Strongly Disagree

f. Others (Pl. Specify)

**QUESTIONNAIRE – III****Sample Questionnaire on Vehicular Emmission & Environmental Hazards**

1. Date \_\_\_\_\_ ; Place of Study \_\_\_\_\_ Time \_\_\_\_\_
2. Sex : Male                      Female
3. Age : 15-30  
          31-45  
          46-60  
          61 and Above
4. Respondent Type  
      Owner  
      Driver  
      Commuter  
      Conductors/ Helpers
5. Type of Vehicle Used :  
      Bus  
      Auto  
      Two Wheeler  
      Four Wheeler
6. Type of Fuel used :  
      Petrol  
      Diesel  
      CNG  
      LPG
7. Duration of Exposure on Road  
      (a) Due to two hours  
      (b) Three to give hours  
      (c) Six to Eight Hours  
      (d) Nine Hours or More
8. Effect on Individuals  
      (a) Sleeplessness/ Insomnia  
      (b) Asthmatic  
      (c) Headache  
      (d) Depression  
      (e) Blood Pressure  
      (f) Getting Imitated too often
9. Remedial Actions  
      (a) Reduce Road Congestion by  
enforcement of Traffic Rules  
      (b) Ban Old Vehicles  
      (c) Use CNG/ LPG  
      (d) Others (Pl Specify) \_\_\_\_\_  
      (e)