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Modal Split Study on Students Trips from Dhule to Shirpur: A Transportation Survey

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ABSTRACT: The population in the growing city like Dhule is continuously increasing the number of two wheelers and four wheelers are continuously increasing. And the public transport vehicles are also increasing. But at the same time the width of roads is not increasing and which causes heavy congestion at some places mainly in peak hours and this congestion is due to the more use of private vehicles and less use of public transport. The choice of mode which the user prefers is mainly dependent on the various factors such as number of vehicles available, household structure, trip purpose, travel time, comfort, reliability etc. So modal split analysis helps to decide the mode of travel as bus, car, auto, railway, etc. The choice of transport service is a key issue in understanding the transport market and designing a competitive transport system. The customer's choice of transport service is based on a number of factors that are considered and weighted against each other.

Objective of the research is to focus on trip behavior of students by data acquisition. SPSS generate model, study suggests the major students are willing to utilize the public transport mode (like government Bus service). Such estimates shall serve as important ingredients for developing travel demand scenario and assess changes in mode preference in horizon years

I. INTRODUCTION

Modal split can be defined as the proportionate division of the total number of person trips between different methods or modes of travel. It can be expressed numerically as a fraction, ratio, or percentage of the total number of trips. The need of this analysis of modeling is to understand the social and economic characteristics and problems of students and how they affect travelling of these students.

Objective of Study

The overall objective is to develop models to analyze the effect of modal transfer to educational institute. The study is specifically interested in the relationship between different modes it concentrated on usage for different modes in the college period. Therefore mode choice models reflecting choices between uses of different modes.

The main purpose of modal split analysis is to determine the proportion of total person trips that can be expected to used, in future horizon year the:

1. Private cars and
2. Public transportation facilities (transit)

Type of Transportation Modes

1. College bus.
2. Van.
3. S.T Bus.
4. 3-wheeler: Auto-rickshaw.
5. 2-wheelers.
6. Cars.

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Factors influencing the choice of mode

1. Characteristics of the trip maker:
 - a. Car availability or ownership.
 - b. Possession of a driving license.
 - c. Household structure (young couple, couple with children, retired people etc.)
 - d. Income.
 - e. Decisions made elsewhere, for example the need to use a car at work, take children to school, etc.
 - f. Residential density.
2. Characteristics of the journey: Mode choice is strongly influenced by
 - a. The trip purpose for example, the journey to work is normally easier to undertake by public transport than other journeys because of its regularity and the adjustment possible in the long run.
 - b. Time of the day when the journey is undertaken.
 - c. Late trips are more difficult to accommodate by public transport.
3. Characteristics of the transport facility
 - a. Relative travel time in-vehicle, waiting and walking times by each mode.
 - b. Relative monetary costs (fares, fuel and direct costs)
 - c. Availability and cost of parking.

II. METHODOLOGY

Types of modal split models

1. Trip-end modal split models

Traditionally, the objective of transportation planning was to forecast the growth in demand for car trips so that investment could be planned to meet the demand. When personal characteristics were thought to be the most important determinants of mode choice, attempts were made to apply modal-split models immediately after trip generation. Such a model is called trip-end modal split model. In this way different characteristics of the person could be preserved and used to estimate modal split. The modal split models of this time related the choice of mode only to features like income, residential density and car ownership.

The advantage is that these models could be very accurate in the short run, if public transport is available and there is little congestion. Limitation is that they are insensitive to policy decisions example: Improving Public transport, restricting parking etc. would have no effect on modal split according to these trip-end models.

2. Trip-interchange modal split models

This is the post-distribution model that is modal split is applied after the distribution stage. This has the advantage that it is possible to include the characteristics of the journey and that of the alternative modes available to undertake them. It is also possible to include policy decisions. This is beneficial for long term modeling.

3. Aggregate and Disaggregate Models

Aggregate demand (first-generation) transport models, are either based on observed relations for groups of travellers, or on average relations at zonal levels. Aggregate travel demand models are directly estimated, with the data on travel behavior at some level of aggregation within a geographical zone that serves as an observational unit for the statistical analysis.

On the other hand, disaggregate demand (second-generation) models are based on observed-choice made by individual traveler. Since most transportation studies collect micro-level data (typically surveys of individual households), analysts estimate models directly on this information without first aggregating it to a zonal level. Such models have come to be called disaggregate. A major innovation in the analysis of transportation demand was the development of

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disaggregate travel demand models based on discrete choice methods.

4. Binary logit model

Binary logit model is the simplest form of mode choice, where the travel choice between two modes is made. The traveler will associate some value for the utility of each mode. If the utility of one mode is higher than the other, then that mode is chosen. But in transportation, we have disutility also.

The estimated logit model is expressed in terms of following equations.

Utility Equation Derivation

The utility functions, derived out of the choice sets help to observe the relative attractiveness of each alternative, for a given trip. The contribution of each attribute to a utility of an alternative is indicated by the sign of its coefficients. A positive value indicates a positive impact on the utility and opposite applies to a negative value. The correlation of various attributes was analyzed in SPSS. Depending upon the value of regression coefficient selection of the attribute was done for derivation of utility equation. The inclusion and exclusion of the variables is dependent on their significance test. If the parameter of a variable is giving very low significance test results, they are excluded. Based on this theory, models were developed which are described below. This utility expression was used to determine the total utility of the Public transport and Private Vehicle. In this case a high utility value indicates that the commuters preferred the Public transport more and thus the Public transport will be more attractive to its potential users.

$$U_{pt} = \text{Constant} + B_0X_0 + B_1X_1 + B_2X_2 + \dots + B_nX_n$$

Where,

U_{pt} = Utility function of public transport

$B_0, B_1, B_2 \dots B_n$ = Utility parameter of the corresponding variable $X_0, X_1, X_2 \dots$

X_n = Different attributes affecting utility function

The variables entered in the model are the existing public transport attributes that have been considered important to study in this research. In this binary choice model it was assumed that Total travel time, Travel cost, Travel distance, 2-wheeler and 4-wheeler ownership, HH Income and other socio economic attributes are the factors influencing the mode choice. Table below shows model input variables.

III. DATA COLLECTION

Various Data Required For the Analysis at Various Stages of This Research Are

1. Personal Information Location of the household, age, income, vehicle availability, household size, occupation/status
2. Travel Characteristics: Total travel time, transport mode, travel cost, walking time, and waiting time, travel distance.
3. Mode Characteristics: Comfort, safety, Regularity, economy, door to door services.
4. Mode shift data: Willingness to shift to existing mode of transport from their private mode of transportation on the basis of various attributes.
5. Model Estimation based on the Socio-Economic differences of the Samples.
- 6.

Methods Which Can be employed in Collection of The Requisite Data Can Be

1. Field survey providing information about the socio-economic character and their travel behaviour of a students.
2. Individual surveys which can attempt to relate the socio-economic background of students with his/her travel behaviour are being made.
3. The Reveal preference survey which can help to know the choice-making behavior of an individual.
4. Identification of the attributes which influence the utility value of a particular mode and utility functions on the basis of the shift using regression analysis in SPSS.

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IV. MODE CHOICE ANALYSIS

Socio-economic & Household Characteristics:

Socioeconomic and household characteristics such as sex, age, occupation, household size, household income, vehicle ownerships, play an important role in the travel characteristics.

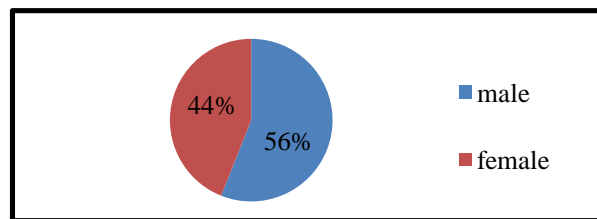


Fig.1: Gender Compositions in the Sample.

Out of total responses, 56 % are male they have higher percentage in the target group and on the other hand 44 % are female

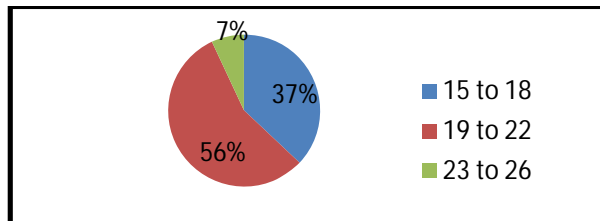


Fig.2: Age Composition in the Sample.

In Age group most of the Respondents are belonging from 15 to 18 and 19 to 22 years of Age group (37 % and 56 % respectively).

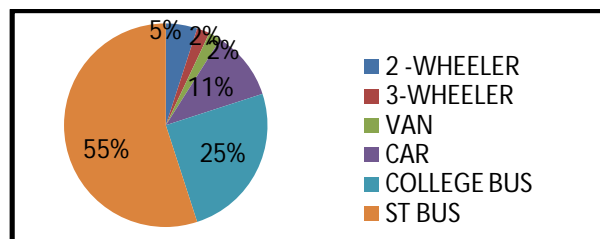


Fig.3: Mode Share (Percentage) In Sample.

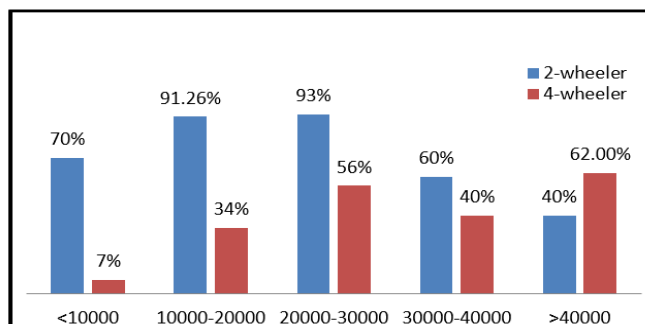


Fig.4: Vehicle Ownership Vs Income Group

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According to above chart 20000 to 30000 income group people are using more 2-wheelers and for >40000 income group people are using more 4-wheelers.

ModeShifting

In this Part some of the choices in the question form were asked to respondent like

1. If Government bus service can provide you transport facility to your area to college in less charges then what will you do?
2. If your college prohibited 2-wheeler then what will you do?
3. If bus service is only provided for students then what will you do?

The objective of this study is to find out whether a person is willing to choose the Public transport. This part of survey format takes an aim on accessing the student's attitude towards public transport system. It needs to determine the attributes that determine the influence of mode choice also best and worst attributes of existing public transport in Dhule to Shirpur.

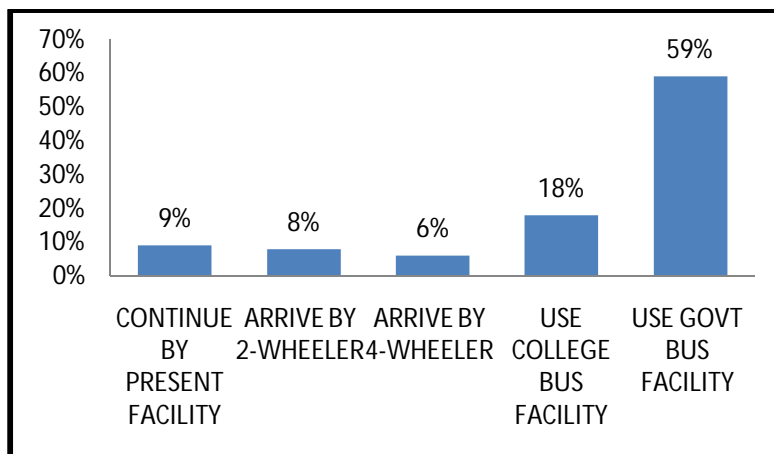


Fig.5: If government bus service can provide you transport facility to your area to college in less charge then which mode of transportation will you prefer?

If government bus service can provide for transport facility to college then 59% students are used to government bus facility its means that they are accept government bus service.

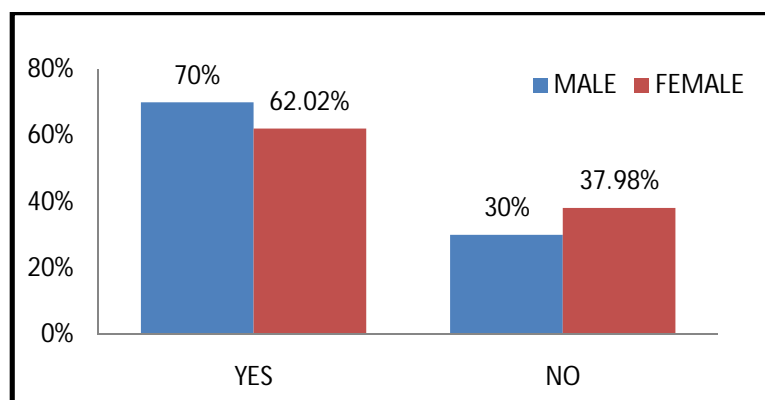


Fig.6: Gender wise Cases willing to use Public Transport

According to chart it is clear that both male and female are willing to join or use the public transport.

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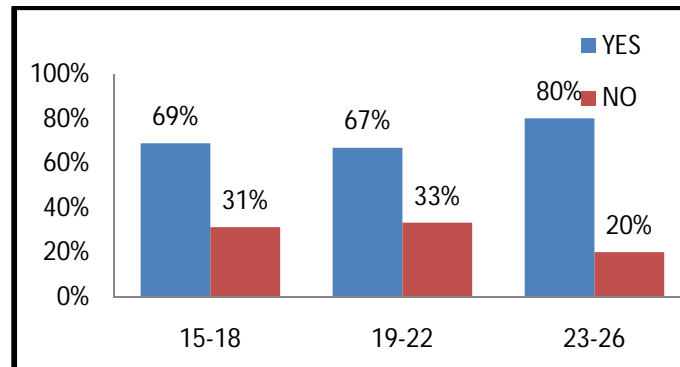


Fig. 7: Age group wise cases willing to use Public transport

According to 23-26 age group students are more willing to use public transport.

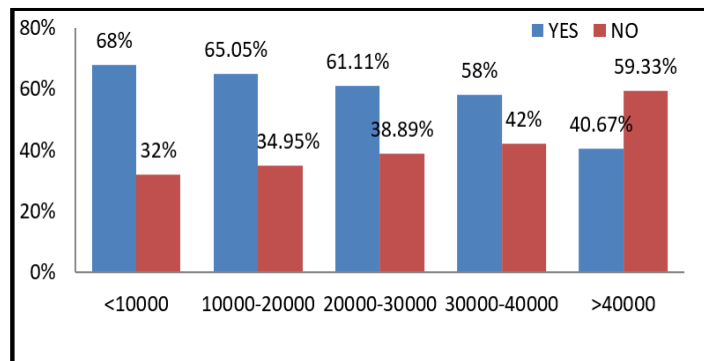
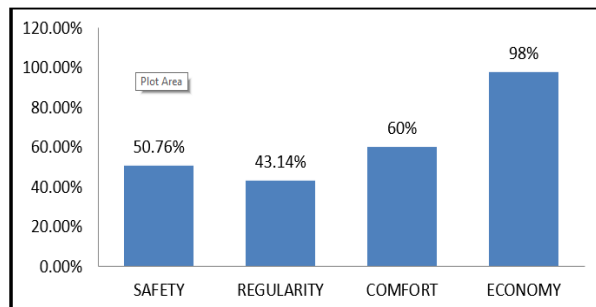
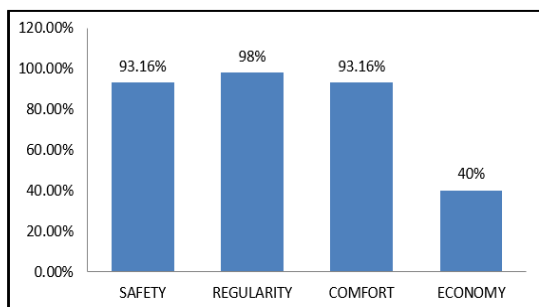


Fig. 8: Income group wise cases willing to use Public transport

Weightages Given to Attribute of Private and Public Vehicles

In the following chart there are four reasons asked by means of survey and they have given different weightages to the reason. So from that weightage in percentage is given in the chart.



Weightages Given to Attribute of Private Vehicles by Respondents

Weightages Given to Attribute of Public Vehicles by Respondents

Fig. 9: Weightages Given to Attribute of Private and Public Vehicles

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Calculation of no of trip generated for public and private vehicles Binary Logit model

The estimated logit model is expressed in terms of following equations.
The utility function of the **Public transport** is,
Example

TC: - Travel Cost, (Rs) = 58
TD: - Travel Distance, (Km) = 58
TRPS: - Time to Reach Pick up Stand, (Minute) = 10

The utility function of the **Public transport** is,
 $U_{pt} = 0.263 + 0.0607(TC) + 0.0272(TD) - 0.511(TRPS)$
 $U_{pt} = 0.263 + 0.0607(58) + 0.0272(58) - 0.511(10)$
 $U_{pt} = 0.251$

Probability of selecting the public transportation

$$P_{pt} = \frac{e^{-U_{pt}}}{e^{-U_{pt}} + e^{-U_{pv}}}$$

$P_{pt} = 0.925$

And, Utility function of **Private Vehicle** is,

TC: - Travel Cost, (Rs) = 65
TD: - Travel Distance, (Km) = 58
TRPS: - Time to Reach Pick up Stand, (Minute) = 10
 $U_{pv} = 0.095 - 0.032(TC) - 0.027(TD) + 0.632(TRPS)$
 $U_{pv} = 0.095 - 0.032(65) - 0.027(58) + 0.632(10)$
 $U_{pv} = 2.769$

Probability of selecting the Private Vehicle

$$P_{pv} = \frac{e^{-U_{pv}}}{e^{-U_{pv}} + e^{-U_{pt}}}$$

$P_{pv} = 0.074$

Total 50 numbers of Educational trips are generated from this origin of these kinds of students,

No. of Public transport trips = $P_{pt} \times$ Total no of trip generated
No. of Public transport trips = $0.925 \times 50 = 46$ trips.

No. of Private vehicle trips = $P_{pv} \times$ Total no of trip generated
No. of Private vehicle trips = $0.074 \times 50 = 04$ trips.

V. CONCLUSION

Most feasible mode share is public mode of transportation because of 46 trips are generated in public transportation and only 4 trips are generated in private transportation. Therefore, the Present Research claims the use of public mode of transport i.e. S.T. bus is more feasible mode of transport.

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With the analysis and data survey of our project the students are more feasible with ST. Bus and overall feasibilities towards ST. Bus than other mods (i.e. car, college bus and motor cycle). This is due to economy compare to the other mode.

Second feasible mode is towards college bus. It has more safety and comfort than public mode of transportation.

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