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# ANALYSIS OF HEADWAY DISTRIBUTION PATTERN IN HETEROGENEOUS TRAFFIC

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***Abstract:*** Time headway is a key microscopic traffic flow characteristic that may be used to develop microscopic traffic simulation models, analyze driver behavior, assess safety, estimate capacity, and assess the level of service on a roadway. Many studies have concentrated on time headway analysis in lane-disciplined and homogeneous traffic, but only a few studies have been undertaken in heterogeneous and mixed traffic. In this project, the headway distribution pattern for a selected study area is going to be determined for different combinations of vehicles. Headway is going to be determined by the video graphic survey. Analyzing the headway distribution pattern can be done by statistical software which gives the output and finds the distribution. Further, vehicle-specific headway for different vehicular pairs is also determined. Under heterogeneous traffic flow conditions, three statistical tests are typically used to observe headway distribution patterns. The Chi-Square, Anderson–Darling, and Kolmogorov-Smirnov statistical tests are recommended (K-S test). For this study, the Kolmogorov-Smirnov test (K-S test) is used.

***Index Terms* -** Heterogeneous Traffic, Headway, Distribution, Kolmogorov-Smirnov Test, EasyFit Software

## I. INTRODUCTION

Traffic circumstances in developing countries like India are exceedingly varied, with vehicles of varying physical dimensions, axle configurations, weight, power-to-weight ratio, and other dynamic characteristics like braking power, acceleration, and so on. Due to these qualities, the vehicles do not adhere to lane discipline and can be found in any lateral position throughout the whole width of the road, regardless of lane markings. Ahmedabad is a metropolis with well-developed air and rail transportation systems. At the same time, the city is concerned about traffic concerns such as congestion, delays, and so on. Traffic congestion is a problem in the city during rush hour, and one of the reasons is the narrowing of carriageways due to ongoing Metro rail construction. The city has focused on development rather than overall development in the road networks as a result of rapid industrialization and irregular land use patterns. Because industrial zones and software businesses are concentrated in one area of the city, travel time and vehicle running costs are increased. The statistics provide a deeper insight into the aggregate behavior of vehicles and drivers, hence studies on time headway distributions of road traffic are crucial.

In traffic engineering, understanding speed and time-headway is critical, as the construction of a good transportation system is entirely based on it. It is significant in a variety of domains, including road geometric design, accident research, traffic regulation and control, ascertaining travel time, determining capacity, delay and queue analysis, level of service analysis, and so on. In order to promote safe and efficient movement of drivers, it is required to understand speed and time headway distribution. Time headway is a fundamental microscopic parameter in traffic flow theories that is quantified by the difference in the time interval between two succeeding vehicles as they pass a reference point on the roadway using the same common attributes of both vehicles. However, in mixed traffic, headway is defined as the time gap between two consecutive vehicles passing a reference line across the entire width of the roadway. Again, because three-wheeler rickshaws and motorcycles have high maneuverability, they can sneak through gaps between larger vehicles, slowing their unfettered movement. Even if there are proper lane markers, they do not adhere to lane discipline. Because of all of these factors, the traffic situation is quite complicated.

Statistical software that offers the output and finds the distribution can be used to analyse the headway data for heterogeneous distribution. For the observation of headway distribution patterns under heterogeneous traffic flow conditions, three statistical tests are typically used. The Chi-Square, Anderson–Darling, and Kolmogorov–Smirnov tests are recommended (K-S test).

## II. LITERATURE SURVEY

Multivariate Analysis of Freeways Speed and Time Headway under Mixed Traffic Streams by Sandeep Singh, Akshay Kumar, Muhamed Niyas, Moses Santhakumar,12th International Conference on Communication Systems & Networks, 2020[1].

Headway distribution models of two-lane roads under mixed traffic conditions: a case study from India by Rupali Roy & Pritam Saha, European Transport Research Review, 2018[2]. Time Headway Analysis on Urban Roads of the city of Marrakesh by Saad Touhbi, Mohamed Ait Babram, Tri Nguyen-Huu, Nicolas Marion, Moulay L. Hbid, Christophe Cambier, and Serge Stinckwich, Procedia Computer Science, 2018[3]. Time Headway Analysis for Four-Lane and Two-Lane Roads by Sanhita Das, Akhilesh Kumar Maurya Transp. in Dev. Econ. 2017[4]. Preferred time headway of drivers on two-lane highways with heterogeneous traffic by Pritam Saha, Rupali Roy, Ashoke Kumar Sarkar & Manish Pal, The International Journal of Transportation Research, 2017[5]. Study on Speed and Time-headway Distributions on Two-lane Bidirectional Road in Heterogeneous Traffic Condition by Akhilesh Kumar Mauryaa, Sanhita Das, Shreya Dey, Suresh Namab, ScienceDirect Transportation Research Procedia2016[6]. Headway Analysis using Automated Sensor Data under Indian Traffic Conditions by Mohamed Badhrudeena, Ramesh Vb, Lelitha Vanajakshi, Transportation Research Procedia, 2016[7]. Time Headway Analysis to Determine the Road Capacity by I Wayan Suweda, Journal Spectra, July 2016[8]. Discharge headway model for heterogeneous traffic conditions by Sanjay Radhakrishnan, Gitakrishnan Ramadurai, Transportation Research Procedia, 2015[9]. Estimation of Headway Patterns on Urban Roads in Hyderabad City – A Case Study by Nimbagal Abhinav, A. Ramesh, Kumar Molugaram, i-manager's Journal on Civil Engineering, August 2014[10].

## III. Methodology and Study Area

The proposed methodology involves various steps to achieve the aim of the study. For that, the first problem identification is done. After that, a literature review is conducted to select the aim and objectives of the study. For the selection of study areas, a total of five locations are considered in Ahmedabad City, Gujarat State, India, namely University Road, near Sahjanand College (Location 1), C.G. Road (Location 2), Ambawadi Road, near Parimal Garden (Location 3), RTO Road (Location 4), and Kasturba-Gandhi Road, Delhi Darwaja, near Kalupur Station (Location 5). After that, for the purpose of obtaining data, a videography survey and a traffic composition survey are carried out at the selected locations. To analyse the obtained data, data extraction is done from the captured video by playing a video file at a speed of 0.25x and noting the leading and following vehicle entry times in milliseconds to get the desired accuracy for headway calculation in heterogeneous traffic. After that, with the help of EasyFit 5.6 software (statistical software) to obtain the headway distribution pattern for different combinations of vehicles, a statistical test is conducted. The Kolmogorov-Smirnov test is adopted. Once the result is obtained, a comparison will be carried out for the selected locations and an appropriate conclusion will be given.

Ahmedabad is one of the country's fastest developing cities, and rising urbanization has resulted in more people migrating from all across the state and country. At the same time, the city is concerned about traffic concerns such as congestion, delays, and so on. For performing a video graphic survey, five different locations namely University Road, near Sahjanand College (Location 1) (road width- 9.7 m.), C.G. Road (Location 2) (road width- 7.4 m), Ambawadi Road, near Parimal Garden (Location 3) (road width-9.8 m), RTO Road (Location 4) (road width- 9.7 m) and, Kasturba-Gandhi Road, Delhi Darwaja, near Kalupur Station (Location 5) (road width- 9.65 m), are considered in the Ahmedabad city, Gujarat, India.

## IV. Data Collection

Data was collected at the selected midblock locations in Ahmedabad city, Gujarat State, India. All of the selected midblock were free of intersections, traffic lights, and curvature, and the pavement is in good condition. A video graphic technique is used to collect traffic data. On regular working days with no adverse weather, data is collected throughout the morning hours from 09:00 a.m. to 11:00 a.m. The video camera is mounted on a tripod stand to cover the survey starch and the reference line is marked with the help of tape on the entire width of the carriageway. To obtain the percentage distribution of vehicular composition, a traffic volume count survey has been conducted from the captured video at the selected location during the morning peak hour.

## V. Data Analysis and Result

After performing a video graphic survey at the selected locations, a time-headway analysis is going to be carried out. Time headway analysis was carried out by playing a captured video file on the computer a repeated number of times. To obtain a higher degree of precision, the video was playing at the slowest speed of 0.25x in the VLC media player. The data extracted from the video was tabulated in the excel file as type of leading vehicle, type of following vehicle, entry time of the leading vehicle, and entry time of the following vehicle. For better accuracy, the entry times of the leading and following vehicles were noted in milliseconds. Time headway at all the locations was determined as the time gap between the front bumper of the leading vehicle and the front bumper of the following vehicle passing a reference line on the entire width of the roadway. For analysis, vehicles that are moving one behind the other are chosen.

### 5.1. Statistical Test for Headway Distribution Pattern

#### 5.1.1. Statistical Test for Headway Distribution Pattern for All Vehicles at Selected Locations

A set of probability density functions (pdf) is evaluated for time headway data. EasyFit 5.6 Software, which fits and ranks frequency distributions based on K-S test findings, fits and ranks probability density functions to frequency distributions. The null hypothesis is considered in the K-S test because the data follows a certain distribution. The sample size and K-S value at the required significant level are used to compute critical K-S values. The K-S values are then determined based on the observed frequency and expected frequency acquired from a given probability density function. We accept the null hypothesis if the estimated K-S value is greater than the critical K-S value. At a 5% significance level, parameter estimation and goodness of fit tests for the models are performed in this work. Despite the fact that the distributions are sorted according to the K-S value, -values are calculated as well. The null hypothesis must be rejected if the P-value is less than 0.05.

**Table 5.1: Statistical properties of a time headway for selected locations**

| Location | Min (sec) | Max (sec) | Mean (sec) | Median (sec) | Standard Deviation (sec) | Co-efficient of variation | Skewness | Kurtosis | Sample Size |
|---|---|---|---|---|---|---|---|---|---|
| **Location 1** | 0.254 | 8.605 | 1.563 | 1.38 | 1.043 | 0.667 | 2.874 | 12.34 | 397 |
| **Location 2** | 0.325 | 11.938 | 1.625 | 1.288 | 1.279 | 0.787 | 3.674 | 20.28 | 424 |
| **Location 3** | 0.302 | 5.876 | 1.443 | 1.24 | 0.877 | 0.607 | 2.217 | 7.251 | 405 |
| **Location 4** | 0.4 | 5.476 | 1.800 | 1.554 | 0.996 | 0.553 | 1.231 | 1.464 | 436 |
| **Location 5** | 0.289 | 2.992 | 1.085 | 0.99 | 0.458 | 0.422 | 1.270 | 2.309 | 565 |

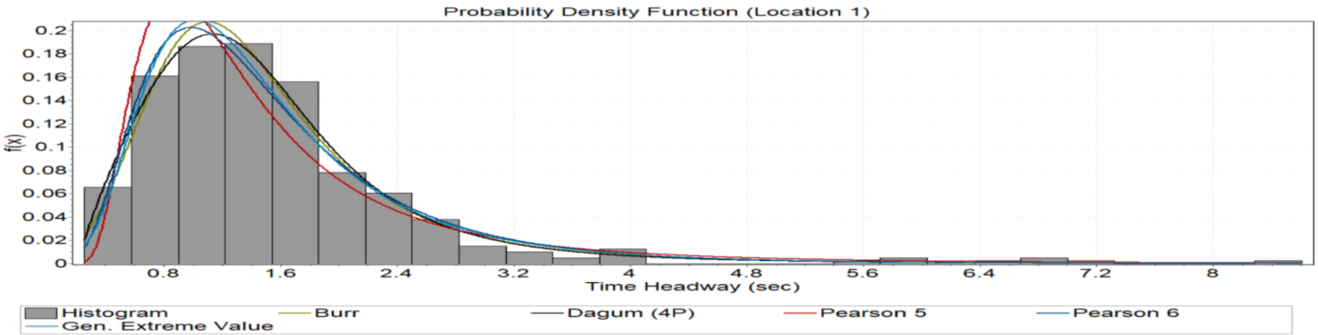
Table shows some basic statistical results for mixed vehicle-type headway. Table includes the minimum and maximum headway, mean headway, median value of headway (or 50$^{th}$ percentile value), standard deviation, co-efficient of variation, skewness, kurtosis and sample size of vehicles.

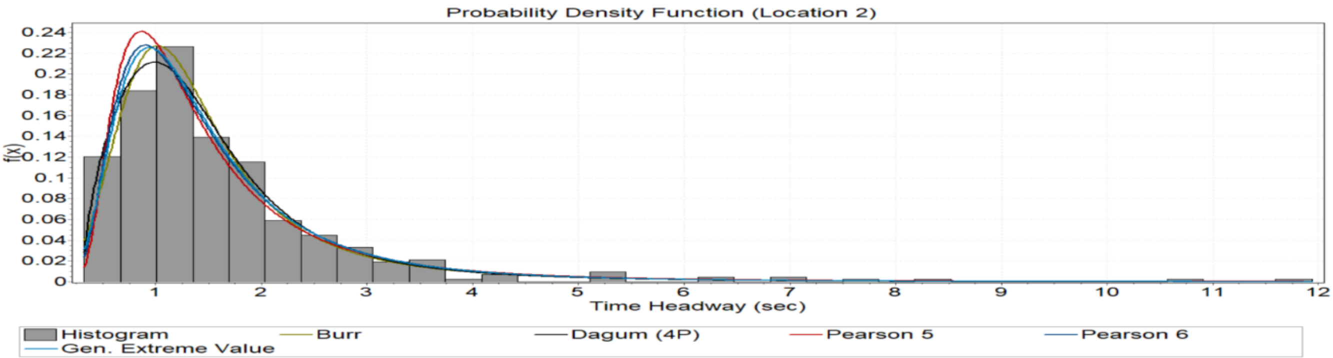
**Table 5.2: Details of Kolmogorov-Smirnov test and estimated parameters of the fitted distribution**

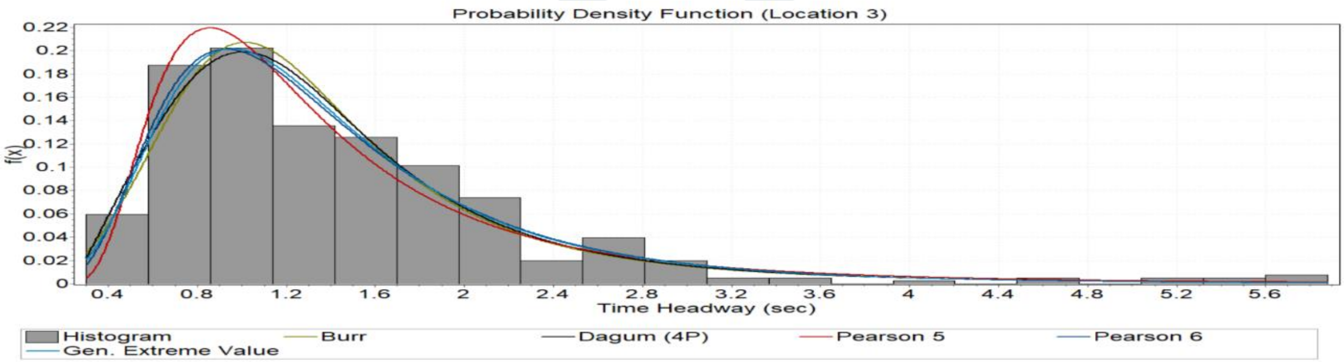
| Location | Type of Distribution | Parameters | P-Value | Best Fit | K-S value | Critical K-S value | Significance Level ($\alpha_0$) | Hypothesis Test (Reject / Do not Reject) |
|---|---|---|---|---|---|---|---|---|
| **Location 1** | Dagum (4P) [1] | k = 0.53901, α=3.3649 β= 1.5134, γ= 0.21225 | 0.8582 | Dagum (4P) | 0.0299 | 0.0681 | 5% | Do not Reject |
| | Gen. Extreme Value [4] | k=0.18302, σ=0.57438, μ=1.1061 | 0.6019 | | 0.0379 | 0.0681 | 5% | Do not Reject |
| | Burr [7] | k= 1.1383, α= 3.0478, β= 1.4193 | 0.5769 | | 0.0387 | 0.0681 | 5% | Do not Reject |
| | Pearson 6 [11] | α1=6.833, α2 =6.6889, β = 1.296 | 0.5213 | | 0.0404 | 0.0681 | 5% | Do not Reject |
| | Pearson 5 [27] | α = 3.2504, β = 3.6672 | 0.0101 | | 0.0811 | 0.0681 | 5% | Reject |
| **Location 2** | Burr [1] | k=0.78176, α= 3.2745, β =1.1691 | 0.6341 | Burr | 0.0358 | 0.0659 | 5% | Do not Reject |
| | Dagum (4P) [2] | k = 0.60096, α=2.6506 β= 1.3472, γ= 0.30945 | 0.6098 | | 0.0365 | 0.0659 | 5% | Do not Reject |
| | Gen. Extreme Value [8] | k=0.27897, σ=0.57781, μ=1.0748 | 0.3713 | | 0.0440 | 0.0659 | 5% | Do not Reject |
| | Pearson 6 [11] | α1=16.545, α2 =3.901, β = 0.28455 | 0.2329 | | 0.0499 | 0.0659 | 5% | Do not Reject |
| | Pearson 5 [20] | α = 3.1833, β = 3.6104 | 0.0573 | | 0.0643 | 0.0659 | 5% | Do not Reject |
| **Location 3** | Pearson 5 [1] | α = 3.7522, β = 4.0705 | 0.3915 | Pearson 5 | 0.0443 | 0.0674 | 5% | Do not Reject |
| | Pearson 6 [7] | α1 = 10.3, α2 =5.9651, β = 0.69593 | 0.2775 | | 0.0489 | 0.0674 | 5% | Do not Reject |
| | Gen. Extreme Value [14] | k=0.17636, σ=0.51558, μ=1.0385 | 0.1924 | | 0.0533 | 0.0674 | 5% | Do not Reject |
| | Dagum (4P) [20] | k = 0.69259, α=2.9562 β= 1.2037, γ= 0.23656 | 0.1280 | | 0.0578 | 0.0674 | 5% | Do not Reject |
| | Burr [21] | k=0.78176, α= 3.2745, β = 1.1691 | 0.0954 | | 0.0608 | 0.0674 | 5% | Do not Reject |
| **Location 4** | Gen. Extreme Value [1] | k=0.10405, σ=0.69184, μ=1.3226 | 0.7812 | Gen. Extreme Value | 0.0310 | 0.0650 | 5% | Do not Reject |
| | Burr [3] | k=1.2892, α= 2.9526, | 0.7614 | | 0.0316 | 0.0650 | 5% | Do not |

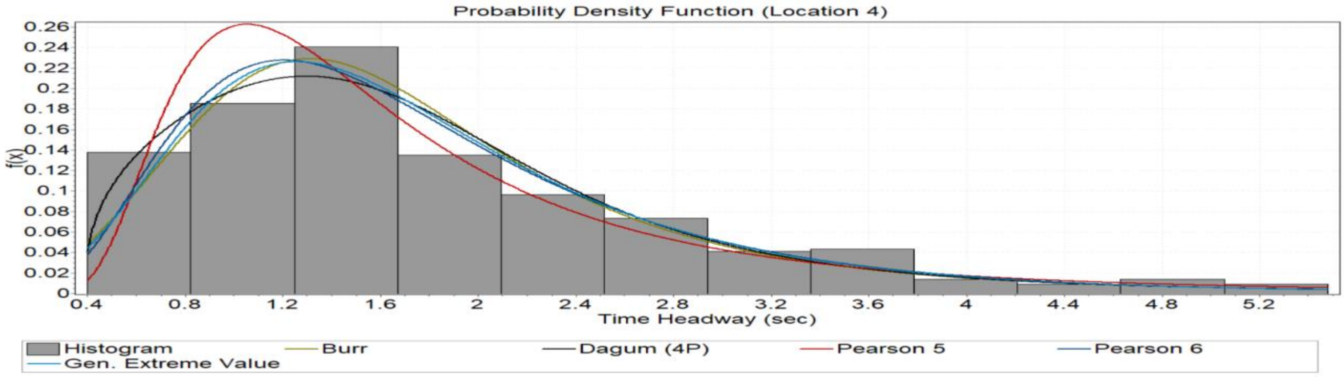
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | β = 1.7748 | | | | | | Reject |
| | Pearson 6 [6] | α1=6.2262, α2=8.7463 β = 2.2444 | 0.7214 | | 0.0328 | 0.0650 | 5% | Do not Reject |
| | Dagum (4P) [9] | k = 0.41674, α=3.3439 β= 1.8535, γ= 0.38974 | 0.6265 | | 0.0355 | 0.0650 | 5% | Do not Reject |
| | Pearson 5 [31] | α = 3.557, β = 4.7885 | 0.0229 | | 0.0711 | 0.0650 | 5% | Reject |
| | | | | | | | | |
| **Location 5** | Gen. Extreme Value [1] | k=0.05527, σ=0.33479, μ=0.87294 | 0.8353 | Gen. Extreme Value | 0.0258 | 0.0571 | 5% | Do not Reject |
| | Pearson 6 [4] | α1=12.629, α2=12.748 β = 1.0098 | 0.7126 | | 0.0291 | 0.0571 | 5% | Do not Reject |
| | Dagum (4P) [14] | k = 0.69108, α=3.8237 β= 0.90429, γ=0.21607 | 0.5128 | | 0.0341 | 0.0571 | 5% | Do not Reject |
| | Burr [17] | k=1.0255, α= 4.2995, β = 1.0071 | 0.4063 | | 0.0371 | 0.0571 | 5% | Do not Reject |
| | Pearson 5 [22] | α = 6.2416, β = 5.7489 | 0.2928 | | 0.0409 | 0.0571 | 5% | Do not Reject |

Note: The rank of distributions based on the K–S test is indicated by superscripts.
Shape parameters (α, σ, k) > 0; Scale parameters (β, μ) > 0; Location parameter (γ) > 0





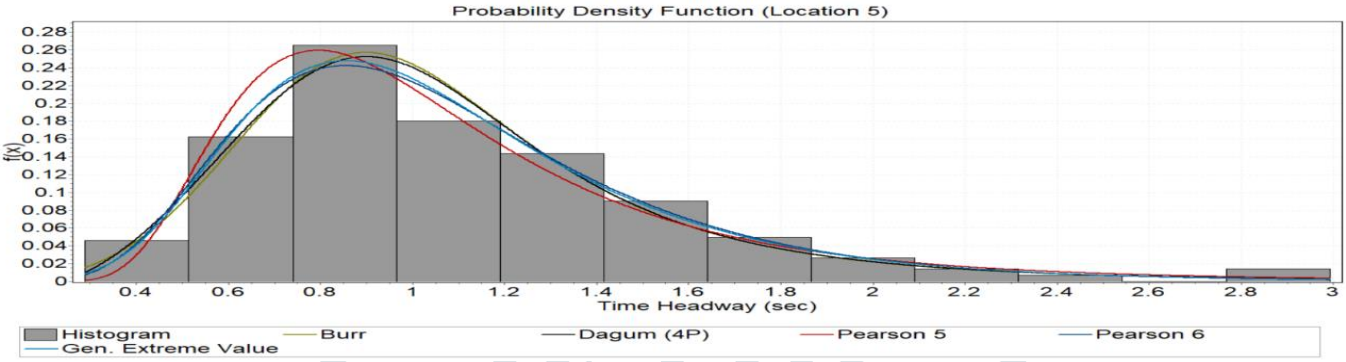




**Figure 5.1: Probability density curves for headway distribution for selected locations**

### 5.1.2. Statistical Test for Vehicle Specific Headway Distribution for Different Vehicle Pairs

Vehicle-type specific headway analysis gives a better understanding of how different combinations of leader–follower vehicle pairings interact. Car-following behavior varies depending on vehicle type and static and dynamic features, resulting in various headway scenarios. A thorough examination of vehicle-type-specific headway can reveal potential implications for enhancing road capacity, level of service (LOS), and safety, resulting in a more effective traffic management system. Headway distribution for different vehicle pairs is analyzed in this section. Working with fewer data leads to erroneous results, hence only samples with headway data higher than 30 are used in this study.

**Table 5.3: Statistical properties and best fitted distribution for different vehicle pairs**

| Location | Leading Vehicle | Following Vehicle | Best Fit | P- Value | Mean (sec) | Median (sec) | Standard Deviation (sec) | Sample Size |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Location 1 | 2W | 2W | Dagum (4P) | 0.98585 | 1.090 | 0.968 | 0.63266 | 83 |
| | 2W | CAR | Burr | 0.93241 | 1.290 | 1.262 | 0.61749 | 41 |
| | 3W | 2W | Gumble Max. | 0.93839 | 1.134 | 1.056 | 0.51284 | 33 |
| | 3W | CAR | Weibull | 0.87888 | 1.578 | 1.4675 | 0.98052 | 30 |
| | CAR | 2W | Gen. Pareto | 0.9804 | 1.670 | 1.385 | 1.0233 | 38 |
| | CAR | 3W | Weibull | 0.9626 | 2.140 | 2.019 | 0.89095 | 32 |
| | CAR | CAR | Burr | 0.96501 | 1.712 | 1.531 | 0.69467 | 77 |
| | | | | | | | | |
| Location 2 | 2W | 2W | Dagum (4P) | 0.57549 | 1.258 | 0.865 | 1.0288 | 102 |
| | 2W | 3W | Lognormal | 0.90937 | 1.558 | 1.298 | 1.3728 | 37 |
| | 2W | CAR | Burr | 0.5473 | 1.611 | 0.969 | 1.4517 | 37 |
| | 3W | 2W | Dagum | 0.95873 | 1.542 | 1.363 | 0.75289 | 47 |
| | 3W | CAR | Weibull | 0.91429 | 1.546 | 1.269 | 0.60859 | 31 |
| | CAR | 2W | Gumble Max. | 0.9757 | 1.255 | 1.102 | 0.56918 | 35 |
| | CAR | CAR | Gen. extreme value | 0.96228 | 1.726 | 1.52 | 0.89609 | 61 |
| | | | | | | | | |
| Location 3 | 2W | 2W | Log-Logistic (3P) | 0.46503 | 0.949 | 0.887 | 0.39482 | 91 |
| | 2W | CAR | burr | 0.93335 | 1.223 | 1.1465 | 0.50956 | 36 |
| | 3W | 2W | Gen. extreme value | 0.47707 | 1.221 | 0.952 | 0.7365 | 33 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3W | CAR | Weibull | 0.87583 | 1.379 | 1.3 | 0.57985 | 36 |
| | CAR | 2W | Gen. Pareto | 0.80658 | 1.266 | 1.248 | 0.50928 | 47 |
| | CAR | CAR | Weibull | 0.86898 | 1.761 | 1.65 | 0.9337 | 54 |
| | | | | | | | | |
| Location 4 | 2W | 2W | Gen. Gamma | 0.56838 | 1.285 | 1.303 | 0.70806 | 83 |
| | 2W | 3W | Log-Logestic (3P) | 0.96858 | 1.531 | 1.15 | 0.90567 | 36 |
| | 2W | CAR | Burr | 0.54605 | 1.601 | 1.427 | 0.87997 | 51 |
| | 3W | 2W | Dagum | 0.90695 | 1.586 | 1.653 | 0.60426 | 43 |
| | CAR | 3W | Log-Logestic (3P) | 0.40751 | 2.516 | 2.632 | 0.84602 | 32 |
| | CAR | CAR | Weibull | 0.90121 | 1.882 | 1.8 | 0.68433 | 67 |
| | | | | | | | | |
| Location 5 | 2W | 2W | Dagum (4P) | 0.84324 | 0.814 | 0.816 | 0.27028 | 95 |
| | 2W | 3W | Lognormal | 0.97355 | 0.886 | 0.807 | 0.34819 | 79 |
| | 2W | CAR | Burr | 0.57644 | 0.981 | 1.005 | 0.3162 | 43 |
| | 3W | 2W | Gen. Pareto | 0.65127 | 1.075 | 1.0435 | 0.32308 | 70 |
| | 3W | 3W | Gen. extreme value | 0.45156 | 1.126 | 0.929 | 0.49987 | 78 |
| | 3W | CAR | Burr (4P) | 0.89104 | 1.213 | 1.075 | 0.42597 | 47 |
| | CAR | 2W | Gen. Pareto | 0.97012 | 1.067 | 1.056 | 0.30171 | 39 |
| | CAR | CAR | Gen. extreme value | 0.9924 | 1.121 | 1.087 | 0.27062 | 30 |

From the above tables, it is concluded that the mean time headway for locations 1 and 4 is higher than at locations 3 and 5 for the different vehicle pairs. It means that as traffic flow increases, the mean and median values of all vehicle type-specific headways fall, because headways become relatively stable at high flow levels. For higher traffic flow levels at locations 3 and 5, the standard deviation of time headway is lower than the moderate traffic flow levels at locations 1 and 4 for different vehicular pairs. This shows that headways have less variation at high traffic flow levels because vehicles are more confined, limiting each vehicle's speed choice.

At all locations, for vehicle pair of 2-wheeler-car (the leading vehicle is a 2-wheeler and the following vehicle is a car), the best fitted frequency distribution is Burr. For locations 1, 2, and 5, Dagum (4P) is the best fitted frequency distribution for the vehicle pair 2W-2W. But for location 3 and location 4, the best fitted distributions are Log-Logistic (3P) and Generalized Gamma, respectively. Generalized Pareto is the best fitted distribution for the vehicle pair of car-2w at the locations 1, 3, and 5. For location 2, Gumbel Max is the best fitted frequency distribution for a vehicle pair of car-2w. at locations 1, 2, and 3, vehicle pair of 3w-car follows the Weibull distribution and for location 5, vehicle pair of 3w-car follows the Burr(4P) distribution.

### 5.2. Variation in Mean Time Headway for the Same Leading and Following Vehicle Pairs

Case (1): Variation in mean time headway with respect to different vehicle-pairs when the same category of vehicle is leading.

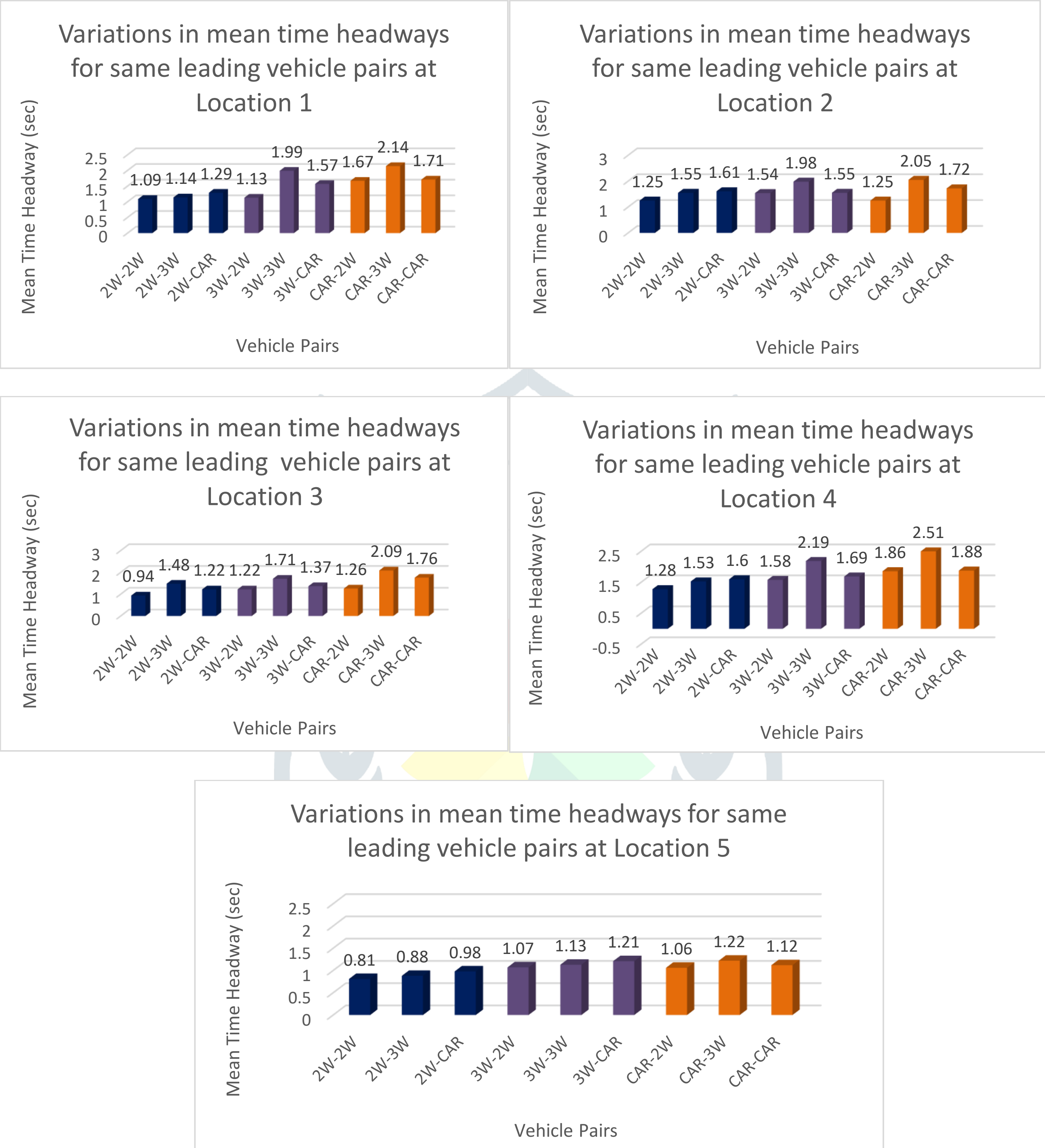



**Figure 5.2 Variations in mean time headway for same leading vehicle pairs at selected locations**

For different locations, a graphical representation of mean time headway in seconds versus different vehicle pairs when the same category of vehicle is leading is shown. At all the locations (except location 3), when the leading vehicle is a 2-wheeler, there is an increment in mean time headway when the following vehicle's size is increased. The 3-wheeler maintains higher headway while following the 3-wheeler (except location 5) and car at every location. This means that vehicles with inferior dynamic characteristics maintain greater headway with the leading vehicle. When the leading vehicle is a 2-wheeler, 3-wheeler, or car, the 2-wheeler (following vehicle) maintains the smallest headway among the three.

Case (2): Variation in mean time headway with respect to different vehicle-pairs when the same category of vehicle is following.

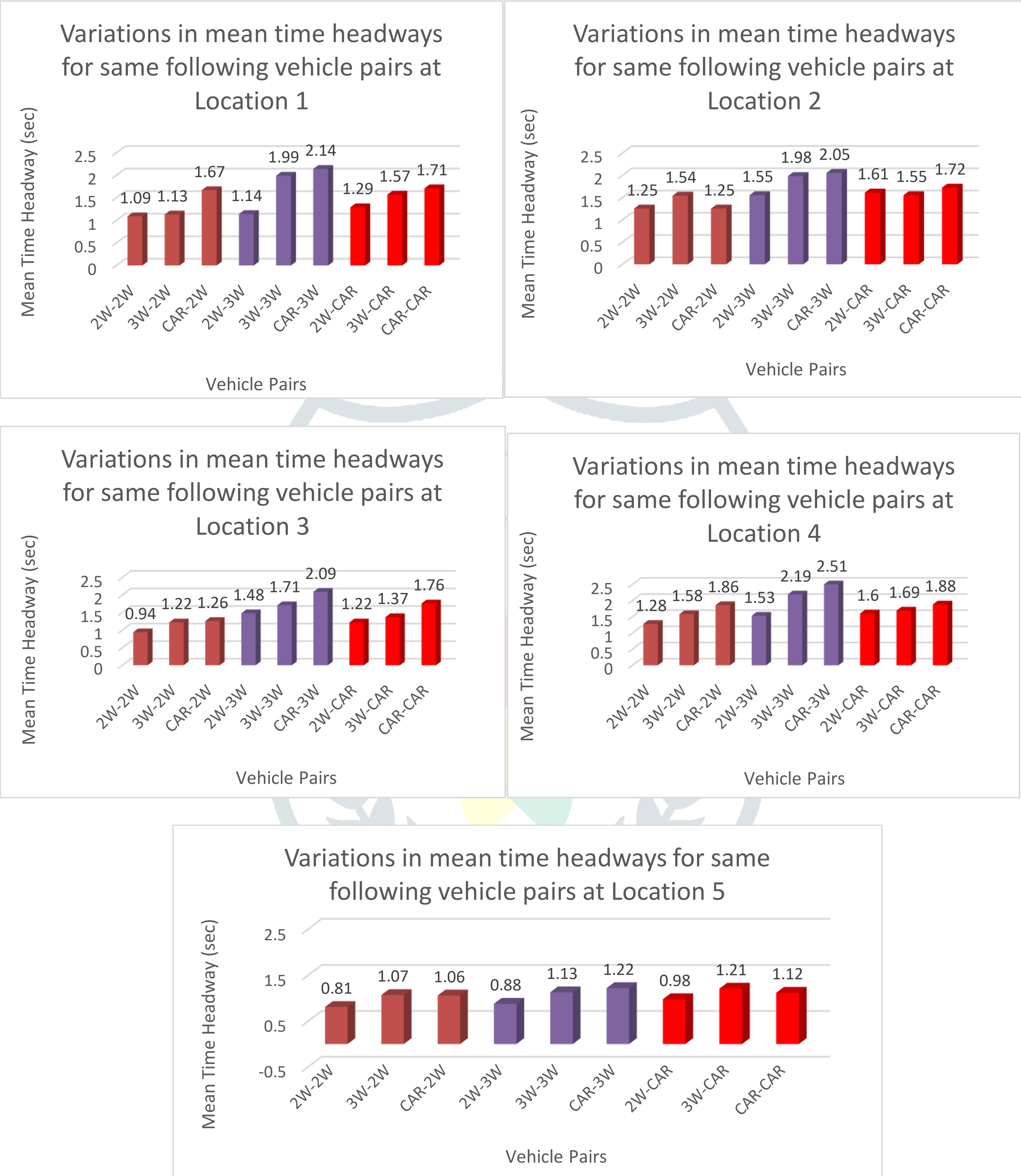



**Figure 5.3: Variations in mean time headway for same following vehicle pairs at selected locations**

For different locations, a graphical representation of mean time headway in seconds versus different vehicle pairs when the same category of vehicle is following is shown. It has been discovered that a vehicle's headway-maintaining behavior is influenced by the static qualities of the leading vehicle. Vehicles tend to adhere to the 2-wheelers more tightly while maintaining a greater spacing from 3-wheelers and cars. When a car follows another vehicle, mean headways increase. It supports the theory that, following vehicles maintain a larger separation from the lead vehicle as the lead vehicle's dimensions increase, owing to the fact that larger dimensions of leading vehicles obstruct following drivers' ability to look beyond the leading vehicles, causing them to maintain a larger separation.

## VI. Conclusion

In this study, a video graphic survey was conducted to obtain the time headway data, and a statistical test was conducted in EasyFit 5.6 software to analyse the headway distribution pattern. The Kolmogorov-Smirnov test (K-S test) is adopted at the 5% significance level ($\alpha_0$). At University Road, near Sahjanand College (location 1) and RTO Road (location 4), the best fitted frequency distribution is Dagum (4P) and Generalized Extreme Value, respectively. For Pearson 5 distribution, the null hypothesis test is rejected as the P-value falls below the significance level ($\alpha_0$) at both the locations [the P-value for Pearson 5 distribution at location 1 is 0.01013 and for location 4 is 0.02295]. At the C.G. Road (location 2) and Ambawadi Road, near Parimal Garden (location 3), Burr and Pearson 5 are the best fitted distributions, respectively. And at the Delhi-Darwaja, Kasturba-Gandhi Road, near Kalupur Station (location 5), Generalized Extreme Value is the best fitted frequency distribution.

The mean time headway for moderate traffic flow is higher than heavy traffic flow for the different vehicle pairs. It means that as traffic flow increases, the mean and median values of all vehicle type-specific headways fall, because headways become relatively stable at high flow levels. For higher traffic flow levels, the standard deviation of time headway is lower than the moderate traffic flow levels for different vehicular pairs. This shows that headways have less variation at high traffic flow levels because vehicles are more confined, limiting each vehicle's speed choice.

At all locations, for vehicle pairs of 2-wheeler-car (the leading vehicle is a 2-wheeler and the following vehicle is a car), the best fitted frequency distribution is Burr. For locations 1, 2, and 5, Dagum (4P) is the best fitted frequency distribution for the vehicle pair 2-wheeler-2-wheeler. Generalized Pareto is the best fitted distribution for the vehicle pair of car-2-wheeler at the locations 1, 3, and 5. At locations 1, 2, and 3, vehicle pairs of 3-wheeler-car follow the Weibull distribution.

The 3-wheeler maintains higher headway while following the 3-wheeler and car. This means that vehicles with inferior dynamic characteristics maintain greater headway with the leading vehicle. When the leading vehicle is a 2-wheeler, 3-wheeler, or car, the 2-wheeler (following vehicle) maintains the smallest headway among the three. Following vehicles maintain a larger separation from the lead vehicle as the lead vehicle's dimensions increase, owing to the fact that larger dimensions of leading vehicles obstruct following drivers' ability to look beyond the leading vehicles, causing them to maintain a larger separation.

## VII. Acknowledgement

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