# TRIP ASSIGNMENT MODELING FOR TRANSPORTATION IN DENPASAR CITY USING PTV VISUM SOFTWARE

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## ABSTRACT

Mapping and macro transportation modelling are methods used to obtain an overview and analysis of transportation conditions at the macro level, encompassing all road segments in urban areas. Critical constraints on road segments can be identified through this process. Macro transportation modelling serves as a tool for studying the implementation of problem-solving policies, allowing the anticipated outcomes to be analysed through simulations in transportation modelling. This research has a specific goal: to understand the travel patterns of the population in the city of Denpasar. Calibration and validation processes in the PTV Visum modelling are conducted to test the validity of the created macrosimulation model. The trip assignment results are generated through PTV Visum modeling. The research methodology involves quantitative analysis using household interview surveys, traffic counting, correlational studies, and macrosimulation modelling. Calibration is performed by calculating the beta coefficient value (with specific calculated values), time matrices, and distance matrices to measure travel impedance functions. Validation is conducted by evaluating the Generalised Exponential Horn (GEH) value, which is less than 5, to ensure the alignment between travel output in the model and field survey data from traffic counting. From the analysis of a sample of 2,725 households, a total of 2,165,876 daily trips were obtained. Types of trips include movements from internal to internal zones (2,115,602 trips), from internal to external zones (28,799 trips), from external to internal zones (19,319 trips), and from external to external zones (2,159 trips) per day. Roads with the highest traffic volume in a single day include Hasanudin Street (42,524 pcu/hour), Diponogoro Street (42,282 pcu/hour), Sudirman Street (31,062 pcu/hour), Sutoyo Street (30,180 pcu/hour), and Sumatra Street (23,515 pcu/hour).

Keywords: macrosimulation; transportation modeling; visum software

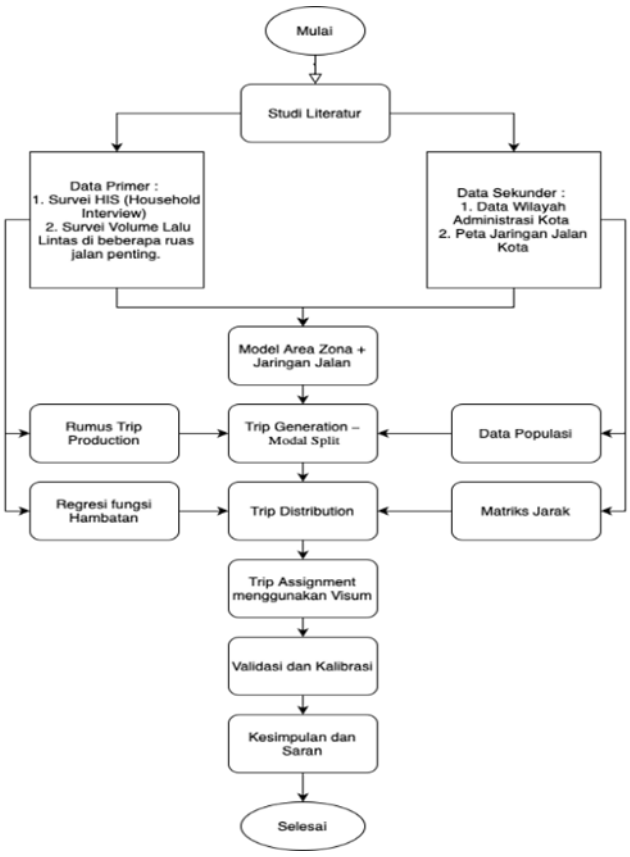
## INTRODUCTION

Central AgencyStatisticsDenpasar City in Denpasar City in Figures 2022, states that there is an increase in population by 0.18% from the previous year. This population growth will affect the demand for transportation in urban areas. The higher the number of vehicles on the road will affect the level of road service on the road section. The length of Denpasar City roads has not changed from the previous year, namely in 2020 the length of Denpasar City roads was 579.30 km, this means there will be no additional road lengths in Denpasar City in 2021, in 2022 there will be additional road sections in the city Denpasar becomes 1,179.8 km. This is what causes traffic jams on several roads in urban areas. Many of the road sections experiencing these problems have reached a critical condition that requires more attention to be immediately handled by the government in accordance with macro transportation mapping and modeling which is used to obtain an overview and analysis of transportation conditions that map all road sections in urban areas.

## METHOD

In this research, the Denpasar City Area will be used to calculate transportation modeling using the PTV Visum macrosimulation. Primary and secondary data were used in this research. Direct observations in the field by conducting household interview surveys, Traffic Counting and observing traffic engineering management are primary data sources. Secondary data comes from the Bappeda Service agency, such as the Road Network Map and RTRW for Denpasar

City. Current facts and hypotheses were identified through this data collection process. The PTV Visum modeling application is used to process data that produces trip assignment analysis of traffic trips in Denpasar City. A flowchart of the research is shown here.

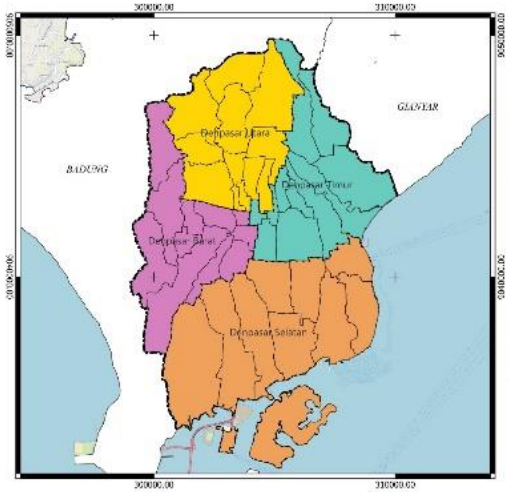



Picture1. Research Flow Chart

## RESULTS AND DISCUSSION

### Study Area Conditions

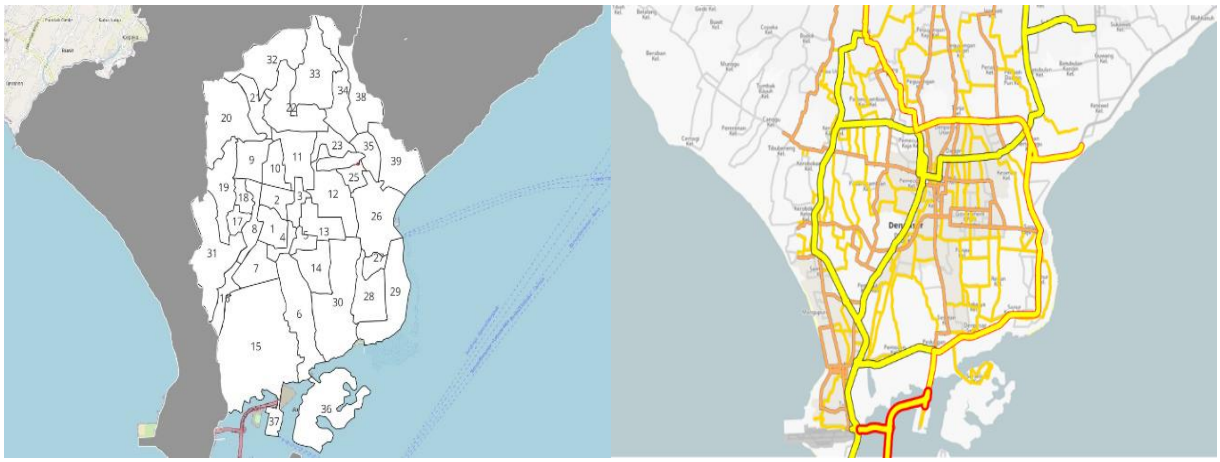
Denpasar City is the capital of Bali Province which has an area of 127.78 km2. Geographically, Denpasar City is located at 8°35'31" - 8°44'49" South Latitude and 115°10'23" - 115°16'27" East Longitude. Based on the Denpasar City Regional Spatial Plan, Part Four Planning Area, article 4 paragraph (2), administratively it consists of 4 (four) sub-district areas which consist of 44 villages with a population of 652,728 people.




Picture 2. Denpasar City Administration Map

**Data Models**

Based on previously determined zoning criteria, in this research the City of Denpasar is divided into 41 (seventy-one) zones consisting of 39 (thirty-nine) internal zones and 2 (two) external zones. Denpasar City activities are concentrated at one point, the Central Business District (CBD) which is located in Dauh Puri Kauh, Pemecutan Kelod, Dauh Puri Kelod, and Dauh Puri. The road network system, as intended in Article 16 paragraph (1) letter a, which includes public roads, includes 10 national roads, 13 arterial roads, 27 collector roads, 43 local roads, and the Bali Mandara Toll Road network.



Picture 3 Map of Traffic Zone Division and Road Network Map of Denpasar City

**Household Interview Survey Sample**

Determining the research sample using sample calculation analysis based on the methodBruton (1985). The population in the Denpasar City research area is classified as 500,000 to 1,000,000 people. The sample size that can be determined is 1 in 20 amounting to 5%, namely 36,330 people and the minimum sample size is 1 in 70 amounting to 1.5%, namely 10,899 people. It was determined that a sample of 1.51% of the population would be taken, to which 0.1% was then added as a correction. With this, the number of family heads that will be obtained in the survey both via online and offline forms is 2,725 family heads.

**Trip Generation Analysis**

Trip Generation consists of two parts: Trip Production and Trip Attraction. Trip Attraction uses the attraction strength value for each sub-district or village zone which is multiplied by the total trip generation. This interesting value is obtained from the assumption that the number of people going to places of education (schools) and industry (factories), because the survey was conducted at the peak of the morning and the Denpasar City area is mostly an industrial center. However, a production trip is a trip from the place of origin to the housing location assigned to a particular land. Correlation and regression tests were carried out to determine the influence between family size, vehicle ownership and family income. Then, to test the hypothesis from a nominal population with a large sample, the Chi-Square test was carried out to evaluate the results of the two tests. Judging from the results of the statistical analysis, the relationship between the travel variable and the population variable is r = 0.763; the travel variable with the vehicle ownership variable is 0.766; the travel variable with the income variable is r= 0.738. Among the variables X1, X2, and X3 that have a strong correlation with the number of trips (Y) is X2. Thus, the variable used in the regression analysis is X2 (vehicle ownership). Through the determination test, an R Square value of 0.971 was obtained. The R square in question is a coefficient that shows the relationship between the independent variables and the pattern of the dependent variable. From the R square value obtained, it can be concluded that variations in all independent variables can influence changes in the dependent variable by 97.1%. Thus, this result is significant at Alpha (a) 5% based on the F-Test test results. Interpretation of the Regression Model obtained by the regression equation in zone 4 of Denpasar City, namely:

Y = 0.408 + 2.904X1 + 0.077X2 + 0.003X3

Next, similar stages were carried out in all internal generation zones in the Denpasar City study area. The results of the Chi-Sqare test for all zones showed that the hypothesis results per zone were acceptable.

**Trip Distribution Analysis**

The number of trips spread from one region to another can be calculated using the Trip Distribution (TD) method. The sample OD matrix will be used to collect data on average trips per family, average trips per person, and population trips in the Denpasar City study area. This data will be collected through a household interview survey. Below is a sample table of the number of person trips/day.

Table1.
Sample Number of Person Trips/day

| Internal-Internal | Internal external | External-Internal | External-External |
|---|---|---|---|
| 31763 | 177 | 175 | 21 |

Next, to obtain the OD of the population of trips per day, multiply the OD of the sample of trips per day by the expansion factor. To obtain the expansion factor, you can use the following formula:

Expansion Factor (E) = ……(2)$\frac{100}{s}$

Where, s is the number of samples obtained from household interviews.

From the results of multiplying by the expansion factor, the number of trips per person population/day can be obtained which can be seen in the table below.

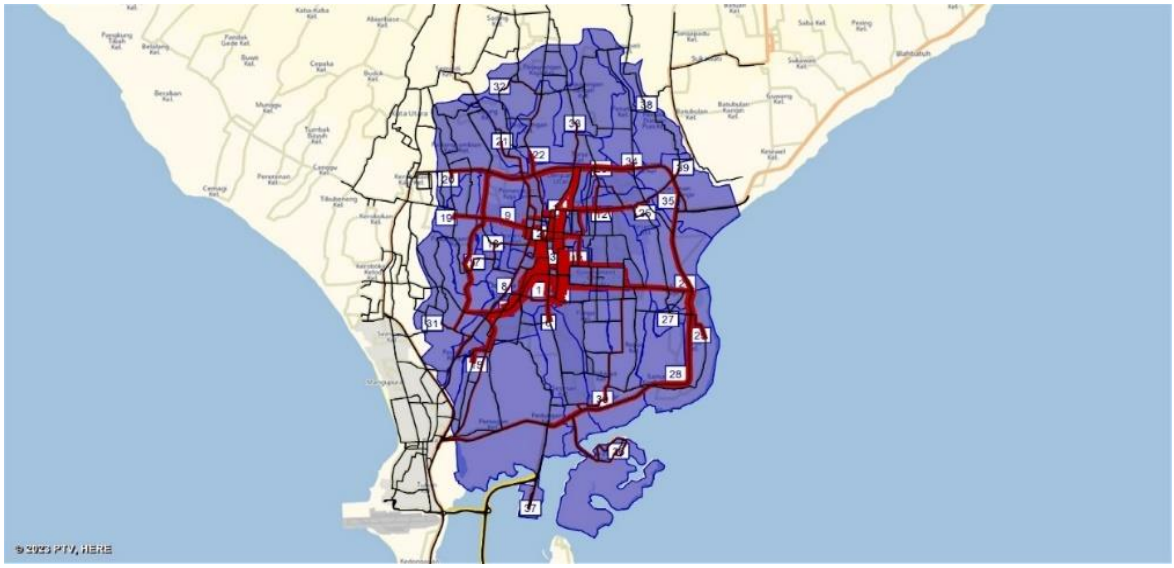
Table2.
Population Number of Person Trips/day

| Internal-Internal | Internal external | External-Internal | External-External |
|---|---|---|---|
| 2115602 | 28799 | 19319 | 2159 |

In this research, the DCGR model is used to calculate the origin-destination matrix. The analysis we use to find the beta value in this research uses a matrix of distance and travel time between zones. By using the resistance function, the beta value is obtained at 0.06.

**Development of Trip Assignment Model with PTV Visum**

Trip assignment is choosing a transportation method to identify factors that influence the choice of route between the starting location and destination. To calculate trip assignment, the equilibrium assignment method can be used. This method is a method of analyzing traffic travel patterns that is used to determine how traffic volume is distributed throughout the transportation network. The main goal is to keep the transportation network balanced between supply (road capacity) and demand (number of vehicles). This method seeks to understand how people choose their travel routes based on the time and costs associated with various travel options, where people who own a vehicle are more likely to choose the shortest travel route.



Picture 4. Denpasar City Trip Assigment Modeling Results

**Validation and Calibration Test**

Validation was carried out by adjusting the results of trip assignment modeling with traffic counting surveys on several sections. The GEH limit value used is < 5. So, if the calculated GEH value between the vehicle volume model and the traffic counting results is less than 5, then the model results can be said to be valid. However, if the GEH value is more than 5 then the model results are not valid and calibration needs to be carried out until the results are valid. The calibration carried out is by converting daily trips into peak hour trips. Calibration was carried out on 3 samples of main road sections. In addition, calibration is also carried out by setting the impedence using the beta coefficient value of 0.061 which was obtained in the trip distribution calculation in the previous subchapter.Click or tap here to enter text.

Table 4.
Validation Test After Calibration

| Link | From Node Number | Name | T.C | PrT Volume [Veh] (AP) | %-Deviation | GEH |
|---|---|---|---|---|---|---|
| 17966 | 367 | Gatot Subroto Bypass Road | 3130 | 3338 | 6% | 3.7 |
| 194 | 510 | | 3130 | 3289 | 5% | 2.8 |
| 195 | 2113 | | 3130 | 3289 | 5% | 2.8 |
| 48798 | 4721 | | 3130 | 3400 | 8% | 4.7 |
| 44734 | 39134 | | 3130 | 3338 | 6% | 3.7 |
| 46172 | 1693 | Ngurah Rai Bypass Road | 4152 | 4282 | 3% | 2 |
| 7032 | 1820 | | 4152 | 4343 | 4% | 2.9 |
| 7029 | 6739 | | 4152 | 4367 | 5% | 3.3 |
| 7031 | 6742 | | 4152 | 4343 | 4% | 2.9 |
| 7030 | 6845 | | 4152 | 4343 | 4% | 2.9 |
| 22650 | 4525 | Imam Bonjol Street | 4585 | 4590 | 0% | 0.1 |
| 41633 | 12736 | | 4585 | 4670 | 2% | 1.3 |
| 41605 | 45115 | | 4585 | 4912 | 7% | 4.7 |
| 41642 | 48268 | | 4585 | 4539 | -1% | 0.7 |
| 41641 | 48268 | | 4585 | 4427 | -3% | 2.4 |

The table above is the final validation result from PTV Visum after calibration with an impedence value of 0.061, indicating that the results of the validation have been declared valid, because the GEH value on the section in Denpasar City is already below 5.

**Critical Road Section**

SAfter the calibration and validation process was carried out, the output results from PTV Visum were obtained in the form of ranking of road sections with the highest volume in the Denpasar City area. The following are the results of the highest volume ranking for Denpasar City.

Table 5.
Most Critical Road Sections

| Section Name | Volume (pcu/hour) |
|---|---|
| Hasanuddin Street | 42524 |
| Diponogoro Street | 42282 |
| Sudirman street | 31062 |
| Sutoyo Street | 30180 |
| Sumatra Road | 23515 |

Viewed from the 10 roads with the highest volume levels. From the 10 road sections with the highest volume, the 5 most critical road sections with the highest traffic volume per day are obtained. The following is a table of the 5 most critical road sections with the highest traffic volume per day.

## CONCLUSION

From this research it was found that: From the results of the Home Interview (HI) survey, a matrix of origin and destination in one day was obtained with a population of people traveling in a day totaling 2,108,976 trips/day. In this research, calibration was carried out by setting impedence using a beta coefficient value of 0.061 which was obtained in trip distribution calculations using the FCGR method, using time and distance matrix calculations between zones. Validation uses 3 road sections in Denpasar City, namely Jalan Bypass Gatot Subroto, Jalan Bypass Ngurah Rai, and Jalan Imam Bojol through the GEH test where the three road sections below obtained a score below 5 so they can be said to be valid. The trip assignment calculation process applies the equilibrium assignment method.The main aim of using this method is to achieve a balance between supply (road capacity) and demand (number of vehicles) in the transportation network.The results of the post-mortem output were obtained

from 5 roads with the highest volume, namely Jalan Hasanudin with a total volume of 42,524 pcu/hour, Jalan Diponogoro with a total volume of 42,282 pcu/hour, Jalan Sudirman with a total volume of 31,062 pcu/hour, Jalan Sutoyo with a total volume of 30,180 pcu / hour, and Jalan Sumatra with a total volume of 23515 pcu / hour.

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