Decision support system for predicting increased data on objects of motor vehicle name transfer (BBNKB I) using trend moment method (Case study: wheels 2 and wheels 4 in Samarinda)

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Abstract. Transfer of Motor Vehicle Title Fee (BBNKB I) is first-person vehicle ownership. From this BBNKB I data, we can predict the number of vehicles that will enter Samarinda with the trend moment method. Historical data used are UPTB data from January 2015 to December 2018. To determine the prediction results, the existing historical data are used and use the MAPE value to calculate the error value or inaccuracy of the predicted results. Applications that are built using NetBeans with a MySQL database connection, where calculation formulas are included in the application. The end result is the prediction of the number of vehicles for 2-wheeled vehicles in Samarinda in 2017 with an average MAPE value of 0.55%, in 2018 with an average MAPE value of 1.92% and 2019 with an average MAPE value of 1.31%. Then for 4-wheeled vehicles in Samarinda in 2017 with an average value of MAPE of 0.57%, in 2018 with an average value of MAPE of 0.77% and in 2019 with an average value of MAPE of 0.47%. MAPE criteria can be used to predict object data of BBNKB I wheels 2 and 4 wheels in Samarinda.

1. Introduction

The development of the number of vehicles is increasing from the previous year because access to get a vehicle is getting easier. Every year, the number of vehicles always increases due to the needs of the community. But behind the high demand for vehicles, there are some negative impacts of the increase in the number of vehicles.

Every newly purchased vehicle must pay the motor vehicle tax on the name of the motorized vehicle (BBNKB I) owned. Even though every year both 2-wheeled and 4-wheeled vehicles continue to grow but no one knows how likely the increase will be in the following years. Because it is undeniable, the demand for ownership is very much and production will continue which will result in higher congestion and increased air pollution.

So handling is needed to find out the results of an increase in the number of vehicles so that related parties can be helped by a system that can predict the increase in the number of vehicles in order to find out how many vehicles increase and make decisions related to solutions to handling such impacts air and other related effects.
With the above problems, a decision support system is needed to predict an increase in BBNKB I 2 wheels and 4 wheels in Samarinda and is expected to help related parties in knowing how much / likely the increase in vehicles that will come next year, especially in the Samarinda region.

2. Literature Review

2.1. Method Trend Moment

According to [1] in this application forecasting is done using the data of past requests/orders in the form of numerical so that it uses a quantitative approach with a periodic series model that is Trend Moment. Moment Trend is a method for finding trend lines with certain statistical and mathematical calculations in order to find out straight line functions instead of broken lines formed by historical data of the company. Thus the influence of subjective elements can be avoided. The same trend with moment can be seen in equation (1).

\[ Y = a + b X \] (1)

Whereas to calculate the values of a and b are used equations (2) and (3).

\[ \Sigma y = a.n + b.\Sigma x \] (2)

\[ \Sigma xy = a.\Sigma x + b.\Sigma x^2 \] (3)

Influenced by seasonal factors associated with periodic fluctuations and are relatively constant. Which where predictive values are obtained from the results of forecasting with the trend moment method will be corrected for seasonal effects using the season index as in equation (4).

\[ \text{Season index} = \frac{\text{Average demand for a particular month}}{\text{Average monthly demand}} \] (4)

To get the final forecast results after being influenced by the season index, equation (5) is used.

\[ Y^* = \text{Season index} \times Y \] (5)

The advantage of the trend moment method compared to other methods lies in the use of the X parameter used, so there is no difference whether the data used is an even-numbered or odd historical data, because the value in parameter X always starts with the value 0 as the first order.

2.2. Mean Absolute Percentage Error (MAPE)

The Mean Absolute Percentage Error (MAPE) is calculated using absolute errors in each period divided by the actual observation values for that period. Then, the average absolute percentage error. This approach is useful when the size or size of predictive variables is important in evaluating the accuracy of predictions. MAPE identifies how large the error in forecasting is compared to the real value in the series [2]. MAPE can be calculated as in equation (6).

\[ \text{MAPE} = \frac{1}{n} \sum_{t=1}^{n} \frac{|Y_t - \hat{Y}_t|}{Y_t} \times 100\% \] (6)

The value generated through this evaluation shows the forecasting ability as shown in the Mean Absolute Percentage Error criteria in Table 1 MAPE Criteria. Where the value of Mean Absolute Percentage Error below 20% is said to be good, and if less than 10% is stated to be very good [3].

| MAPE   | Understanding   |
|--------|----------------|
| < 10%  | Very Good      |
2.3. Decision Support System

Decision support systems are defined as a system intended to support managerial decision makers in certain situations. Decision support systems are intended to be a tool for decision makers to expand their capabilities, but not to replace their judgment [4].

2.3.1 Stages of Decision Support System Development

When doing modeling in SPK development, the following steps are performed:

a. Intelligence
   In this step, the target is determined and a procedure search is performed, data collection, problem identification, identification of ownership of the problem, until finally a problem statement is formed.

b. Design
   Formulate the model to be used and the criteria specified. After that, look for alternative models that can solve these problems. The next step is to predict the possible output. Then the model variables are determined.

c. Choice
   At this stage, the model selection will be carried out including the solution of the model. Next, a centric analysis is carried out, namely by replacing several variables.

d. Make SPK
   After determining the model, the next is implementing the SPK application [5].

2.4. Prediction

Prediction is a process of systematically estimating something that is most likely to occur in the future based on past and present information that is owned so that errors (the difference between something that happens with the results of estimates) can be minimized. The prediction does not have to give a definite answer to the event that will occur, but rather tries to find the answer as close as possible to what will happen [6].

2.5. Motor Vehicle

Motorized vehicles that are all vehicles and their comparison are used in all types of road, and are driven by technical equipment in the form of motors or other equipment which function to convert a particular energy resource into the motion of the motorized vehicle, including heavy equipment and tools large in operation using wheels and motors and not permanently attached and motorized vehicles operated in water. The vehicle is divided into 2 namely 2-wheeled vehicles and 4-wheeled vehicles.

2.5.1. Customs For Transferring Names Of Motorized Vehicles (BBNKB)

Motor Vehicle Transfer Fee (BBNKB) is a tax on the surrender of motorized vehicle ownership rights as a result of a two-party agreement or unilateral act or a condition that occurs due to buying and selling, exchange, grant, inheritance, or income into a business entity.

There are 2 types of taxes. Motor Vehicle Tax and Name Transfer Fee (BBN). Where there are 2 types of biofuel, namely BBNKB I (new purchases) and BBNKB II (buying used vehicles).

The tariff for the Motor Vehicle Transfer Fee is set as each, for the first handover of 10% and for the second handover and so on at 1%.

2.6. Database

The database is a set of tables that contain data and is a collection of fields or columns. The file structure that composes a database is Record and Field data [7].

| Percentage | Rating |
|------------|--------|
| 10% - 20%  | Good   |
| 20% - 50%  | Enough |
| >50%       | Bad    |
2.7. **MySQL**

MySQL is a database management software (DBMS) Structured Query Language (SQL) that is open source. SQL is a standard language for accessing databases and is defined by the ANSI / ISO SQL standard [8].

2.8. **Flowchart Diagram**

Flowchart or flow chart is a set of symbols or schemes that show or describe a series of program activities from start to finish. The essence of making a flowchart or flow chart illustrates the sequence of work steps of an algorithm [9].

2.9. **Black Box Testing**

Black Box Testing focuses on functional specifications of the software. Testers or testers can define a collection of input conditions and test the program's functional specifications [10].

3. **Research Methodology**

3.1. **Source of Data**

For data sources, literature studies are used in which methods are carried out by collecting and studying various reference sources, such as books on decision support systems, trend moment methods, and student research results in the form of theses, and looking for references from the internet relating to the problems being studied.

Then use the interview method where this method is done by direct interview with the parties concerned. The activity carried out was conducting an interview with the treasurer of the reception at the UPTB. Regional Revenue regarding how many units of vehicles there are each month.

3.2. **Research Variables**

The variables used in this study include alternatives and the criteria to be described as follows:

a. **Alternative**

The alternative used is the year of the vehicle and the type of vehicle purchased in which data was obtained from UPTB. Regional Income of East Kalimantan Province Samarinda. Which in the alternative category is the type of vehicle includes 2-wheeled vehicles and 4-wheeled vehicles.

b. **Criteria**

Assessment indicators or criteria used in Decision Support Systems To Predict Data Improvement Objects of Motor Vehicle Name Transfer Charges (BBNKB I) use this trend moment method which includes several criteria, namely:

(1) Year, where the year of the vehicle starts from 2015, 2016, 2017 and 2018.

(2) Number of vehicles, where the number of vehicles used is the number of vehicles from the actual data.

3.3. **Step Analysis**

The study steps to be carried out in this study are as follows:
Figure 1 Flowchart of Trend Moment Method Flow

It starts from historical data, then determines the value of \( y_i \) and \( x_i \), after that calculates the value of \( x_i \), then calculates the total vehicle data (\( y_i \)), after obtaining the value \( x_i \) and \( y_i \) then the total multiplication of \( (x_i \times y_i) \), then calculates the average from \( y_i \), then look for the value of \( b \) and the value of \( a \) from equation (2) and (3), after getting the value \('a & b'\) calculated by equation (1), then calculate the season index with equation (4), after getting the value from the season index, followed by counting to get the final forecast results after being influenced by the season index with equation (5) and finally if the forecasting/prediction results are known by calculating errors/errors using the MAPE method in equation (6).

4. Analysis And Results

The results of this study are a Decision Support System for Predicting Data Improvement of Vehicle Title Transfer Vehicles (BBNKB I) in Samarinda (Case Study: Wheel 2 and Wheel 4) based on the desktop to make decisions in predicting vehicles in Samarinda City using programming languages Java in accordance with the system design created.

a. Calculation Results Based on Trend Moment Method

To perform calculations using the trend moment method is divided into two types of vehicles, namely 2 wheels and 4 wheels, and each wheel is predicted from 2017, 2018 and 2019.

1) Increased Wheel Vehicle Object Data 2

a) Prediction of Wheel 2 Vehicle Object Data in 2017

(1) Look for the value of \( \sum y_i \) (number of data on 2-wheeled vehicles), \( \sum x_i \) (sum of time index), \( \sum x_i \times y_i \) (sum of multiplication between vehicle data and time index), \( \sum x_i^2 \) (sum of results \( x_i \) is raised 2), and the average vehicle.

(2) Then it is obtained \( \sum y_i = 41,649 \), \( \sum x_i = 276 \), \( \sum x_i \times y_i = 467,777 \), \( \sum x_i^2 = 4,324 \) and the average vehicle data = 1,735,375.

(3) Determine equations to get the values \( a \) and \( b \). Determination of the value of \( a \) using equation (2) and the value of \( b \) using equation (3).

To get the value of \( b \), it is done by eliminating equation (2) and equation (3).

\[
\Sigma y = a.n + b.\Sigma x \quad \Rightarrow \quad 41,649 = 24.a + 276.b \quad |x 23|
\]

\[
\Sigma xy = a.\Sigma x + b.\Sigma x^2 \quad \Rightarrow \quad 467,777 = 276.a + 4,324.b \quad |x 2|\]
957.927 = 552 a + 6.348 b  
935.554 = 552 a + 8.648 b  
22373 = -2300 b  
b = 22373/-2300 = -9.72739

To get the value of a, a value of b must be obtained, then Equation (2) is used. 
\[ \Sigma y = a.n + b.\Sigma x \]  
\[ => 41.649 = 24 a + 276 (b) \]  
\[ 41.649 = 24 a + 276 (-9.72739) \]  
a = 44334/24 = 1.847,24

(4) Determine the value of Y or Trend with equation (1). In the following equation, the calculation of 2-wheeled vehicle data is carried out in January 2017 using the results of previous calculations. It is known that the values of a (1,847,24) and b (-9,72739) and for the value of x (24) which is the time index calculated from January 2015 to January 2017. 
\[ Y = a + b.x \]   
\[ => Y = 1.847,24 + -9,72739 (x) \]  
\[ Y = 1.847,24 + -9,72739 (24) \]  
\[ Y = 1.847,24 + -233,457 \]  
\[ Y = 1.847,24 + -233,457 = 1.613,78261 \]  

(5) Determine the season index using equation (4), where the vehicle data in January 2015 were 2,652 and January 2016 was 1,660 units which were then divided by the amount of data. Then the average data is divided by the average overall vehicle data. 
\[ \text{Season index} = \frac{\text{Average demand for a particular month}}{\text{Average monthly demand}} \]  
\[ \text{Season index} = \frac{(2.652+1.160)}{2} \]  
\[ \text{Season index} = \frac{2.156}{1.735,375} = 1.24238 \]  

(6) Determine the outcome of the final forecast which is influenced by the season index equation (5). Where to get the value of Y * the value of the season index is taken then multiplied by the value of Y or the value of Trend. 
\[ Y* = \text{Season index} \times Y \]  
\[ Y* = 1.24238 \times 1.613,78261 \]  
\[ Y* = 2.005 \]

After the calculation is done to predict an increase in the data of object 2 wheeler BBNKB I vehicles in Samarinda from January 2017 to December 2017, the prediction results can be summarized in the table 2.

**Table 1 Wheel 2 Vehicle Object Data Prediction Results in 2017**

| Month    | Year | Number of Vehicles | Prediction Results |
|----------|------|--------------------|--------------------|
| January  | 2017 | 1.452              | 2.005              |
| February | 2017 | 1.086              | 1.652              |
| March    | 2017 | 1.647              | 1.502              |
| April    | 2017 | 1.737              | 1.573              |
| May      | 2017 | 2.230              | 1.295              |
| June     | 2017 | 2.175              | 1.801              |
| July     | 2017 | 2.392              | 1.194              |
| August   | 2017 | 4.280              | 1.973              |
| September| 2017 | 2.833              | 1.637              |
| October  | 2017 | 3.360              | 1.539              |
| November | 2017 | 2.957              | 1.253              |
| December | 2017 | 3.351              | 1.318              |
b) Prediction of Wheel 2 Vehicle Object Data in 2018

Table 2 Wheel 2 Object Data Prediction Results in 2018

| Month  | Year  | Number of Vehicles | Prediction Results |
|--------|-------|--------------------|--------------------|
| January| 2018  | 2.283              | 2.262              |
| February| 2018  | 2.435              | 1.936              |
| March  | 2018  | 2.786              | 2.394              |
| April  | 2018  | 2.486              | 2.699              |
| May    | 2018  | 2.509              | 2.992              |
| June   | 2018  | 1.160              | 3.569              |
| July   | 2018  | 2.740              | 3.160              |
| August | 2018  | 3.112              | 5.427              |
| September| 2018  | 2.869              | 4.464              |
| October| 2018  | 3.110              | 4.283              |
| November| 2018  | 2.773              | 3.887              |
| December| 2018  | 2.084              | 4.844              |

c) Prediction of Wheel 2 Vehicle Objects in 2019

Table 3 Wheel 2 Object Data Prediction Results in 2019

| Month  | Year  | Prediction Results |
|--------|-------|--------------------|
| January| 2019  | 2.193              |
| February| 2019 | 2.097              |
| March  | 2019  | 2.666              |
| April  | 2019  | 2.569              |
| May    | 2019  | 2.916              |
| June   | 2019  | 2.075              |
| July   | 2019  | 3.229              |
| August | 2019  | 4.703              |
| September| 2019  | 3.667              |
| October| 2019  | 4.207              |
| November| 2019  | 3.766              |
| December| 2019  | 3.610              |

2) Increased Wheel 4 Vehicle Object Data

a) Prediction of Wheel 4 Vehicle Objects in 2017

Table 4 Wheel 4 Object Data Prediction Results in 2017

| Month  | Year  | Number of Vehicles | Prediction Results |
|--------|-------|--------------------|--------------------|
| January| 2017  | 408                | 584                |
| February| 2017 | 447                | 459                |
| March  | 2017  | 474                | 569                |
| April  | 2017  | 396                | 527                |
| May    | 2017  | 405                | 418                |
| June   | 2017  | 309                | 509                |
| July   | 2017  | 392                | 385                |
b) Prediction of Wheel 4 Vehicle Objects in 2018

Table 5 Wheel 4 Object Data Prediction Results in 2018

| Month    | Year | Number of Vehicles | Prediction Results |
|----------|------|--------------------|--------------------|
| January  | 2018 | 470                | 432                |
| February | 2018 | 565                | 327                |
| March    | 2018 | 540                | 386                |
| April    | 2018 | 550                | 369                |
| May      | 2018 | 529                | 318                |
| June     | 2018 | 290                | 356                |
| July     | 2018 | 602                | 279                |
| August   | 2018 | 503                | 365                |
| September| 2018 | 480                | 318                |
| October  | 2018 | 565                | 319                |
| November | 2018 | 498                | 377                |
| December | 2018 | 466                | 322                |

c) Prediction of Wheel 4 Vehicle Objects in 2019

Table 6 Wheel 4 Object Data Prediction Results in 2019

| Month    | Year | Prediction Results |
|----------|------|--------------------|
| January  | 2019 | 502                |
| February | 2019 | 584                |
| March    | 2019 | 591                |
| April    | 2019 | 557                |
| May      | 2019 | 555                |
| June     | 2019 | 359                |
| July     | 2019 | 602                |
| August   | 2019 | 600                |
| September| 2019 | 544                |
| October  | 2019 | 616                |
| November | 2019 | 591                |
| December | 2019 | 577                |

b. Testing MAPE (Mean Absolute Percentage Error)

The accuracy of the results of predictions is done by testing the validation of the results of predictive calculations to ensure the results of the system are in accordance with the actual data of the vehicle. The method is done by using the Mean Absolute Percentage Error (MAPE) method. MAPE will measure absolute errors in each period. This can avoid problems in the interpretation of measurement accuracy against the magnitude of the actual value and predictive value.

1) BBNKB Vehicle Object Data Wheel 2

a) Prediction of Wheel 2 Vehicle Object Data in 2017

The calculation of the MAPE value for object data for BBNKB 2 wheel vehicles for each year has the actual number and results of predictions, namely January 2015 to December 2016 based on
formula 2.6 with the amount of data 24 data. Here is an illustration of how to calculate MAPE values for January 2017.

\[
\text{MAPE} = \left| \frac{\text{Actual Data} - \text{Predicted Data}}{\text{Actual Data}} \right| \times 100% \\
\text{Amount Of Data} \\
1.660 - 2.005 \\
1.660 \\
24 \\
\times 100% = 0.86% 
\]

Table 7 Mean Absolute Percentage Error 2 Wheel in 2017

| Month     | Year | Number of Vehicles | Prediction Results | MAPE |
|-----------|------|--------------------|--------------------|------|
| January   | 2017 | 1.452              | 2.005              | 0.86%|
| February  | 2017 | 1.086              | 1.652              | 0.38%|
| March     | 2017 | 1.647              | 1.502              | 0.03%|
| April     | 2017 | 1.737              | 1.573              | 0.35%|
| May       | 2017 | 2.230              | 1.295              | 0.59%|
| June      | 2017 | 2.175              | 1.801              | 0.73%|
| July      | 2017 | 2.392              | 1.194              | 0.58%|
| August    | 2017 | 4.280              | 1.973              | 0.20%|
| September | 2017 | 2.833              | 1.637              | 1.18%|
| October   | 2017 | 3.360              | 1.539              | 0.25%|
| November  | 2017 | 2.957              | 1.253              | 0.21%|
| December  | 2017 | 3.351              | 1.318              | 1.24%|

Average MAPE value 0.55%

b) Prediction of Wheel 2 Vehicle Object Data in 2018

Table 8 Mean Absolute Percentage Error 2 Wheel in 2018

| Month     | Year | Number of Vehicles | Prediction Results | MAPE |
|-----------|------|--------------------|--------------------|------|
| January   | 2018 | 2.283              | 2.262              | 2.33%|
| February  | 2018 | 2.435              | 1.936              | 3.26%|
| March     | 2018 | 2.786              | 2.394              | 1.89%|
| April     | 2018 | 2.486              | 2.699              | 2.31%|
| May       | 2018 | 2.509              | 2.992              | 1.42%|
| June      | 2018 | 1.160              | 3.569              | 2.67%|
| July      | 2018 | 2.740              | 3.160              | 1.34%|
| August    | 2018 | 3.112              | 5.427              | 1.12%|
| September | 2018 | 2.869              | 4.464              | 2.39%|
| October   | 2018 | 3.110              | 4.283              | 1.14%|
| November  | 2018 | 2.773              | 3.887              | 1.31%|
| December  | 2018 | 2.084              | 4.844              | 1.86%|

Average MAPE value 1.92%
c) Prediction of Wheel 2 Vehicle Object Data in 2019

Table 9 Mean Absolute Percentage Error 2 Wheel in 2019

| Month     | Year | Prediction Results | MAPE |
|-----------|------|--------------------|------|
| January   | 2019 | 2.193              | 0.16%|
| February  | 2019 | 2.097              | 0.58%|
| March     | 2019 | 2.666              | 0.18%|
| April     | 2019 | 2.569              | 0.14%|
| May       | 2019 | 2.916              | 1.28%|
| June      | 2019 | 2.075              | 3.29%|
| July      | 2019 | 3.229              | 0.74%|
| August    | 2019 | 4.703              | 2.13%|
| September | 2019 | 3.667              | 1.16%|
| October   | 2019 | 4.207              | 1.47%|
| November  | 2019 | 3.766              | 1.49%|
| December  | 2019 | 3.610              | 3.05%|

Average MAPE value 1.31%

2) BBNKB Vehicle Object Data Wheel 4

a) Prediction of Wheel 4 Vehicle Object Data in 2017

Table 10 Mean Absolute Percentage Error 4 Wheel in 2017

| Month      | Year | Number of Vehicles | Prediction Results | MAPE |
|------------|------|--------------------|--------------------|------|
| January    | 2017 | 408                | 584                | 0.40%|
| February   | 2017 | 447                | 459                | 0.16%|
| March      | 2017 | 474                | 569                | 0.54%|
| April      | 2017 | 396                | 527                | 0.21%|
| May        | 2017 | 405                | 418                | 0.13%|
| June       | 2017 | 309                | 509                | 0.87%|
| July       | 2017 | 392                | 385                | 0.15%|
| August     | 2017 | 478                | 452                | 0.68%|
| September  | 2017 | 402                | 374                | 1.07%|
| October    | 2017 | 423                | 412                | 0.75%|
| November   | 2017 | 441                | 497                | 1.11%|
| December   | 2017 | 444                | 434                | 0.77%|

Average MAPE value 0.57%

b) Prediction of Wheel 4 Vehicle Object Data in 2018

Table 11 Mean Absolute Percentage Error 4 Wheel in 2018

| Month     | Year | Number of Vehicles | Prediction Results | MAPE |
|-----------|------|--------------------|--------------------|------|
| January   | 2018 | 470                | 432                | 0.25%|
| February  | 2018 | 565                | 327                | 0.69%|
| March     | 2018 | 540                | 386                | 0.77%|
| April     | 2018 | 550                | 369                | 0.28%|
| May       | 2018 | 529                | 318                | 0.89%|
| June      | 2018 | 290                | 356                | 0.63%|
| July      | 2018 | 602                | 279                | 1.19%|
August 2018  503  365  0,98%
September 2018  480  318  0,86%
October 2018  565  319  1,02%
November 2018  498  377  0,59%
December 2018  466  322  1,14%

Average MAPE value  0,77%

c) Prediction of Wheel 4 Vehicle Object Data in 2019

| Month     | Year  | Prediction Results | MAPE  |
|-----------|-------|--------------------|-------|
| January   | 2019  | 502                | 0,28% |
| February  | 2019  | 584                | 0,14% |
| March     | 2019  | 591                | 0,39% |
| April     | 2019  | 557                | 0,05% |
| May       | 2019  | 555                | 0,21% |
| June      | 2019  | 359                | 1,002%|
| July      | 2019  | 602                | 0,004%|
| August    | 2019  | 600                | 0,81% |
| September | 2019  | 544                | 0,56% |
| October   | 2019  | 616                | 0,38% |
| November  | 2019  | 591                | 0,78% |
| December  | 2019  | 577                | 1,00% |

Average MAPE value  0,47%

5. Conclusion

Based on the results and discussion, it can be concluded as follows:

1. The Trend Moment method can be used to predict the increase in data objects of BBNKB I 2 wheels and 4 wheels in Samarinda.
2. Prediction results for increasing vehicle object data get an average MAPE value of 0.55% for 2 wheels in 2017, 1.92% for 2 wheels in 2018 and 1.31% for 2 wheels in 2019. And for average values 4-wheeled MAPE of 0.57% in 2017, 0.77% in 2018 and 0.47% in 2019. Where in both vehicles the average MAPE value is below 10% so that it is included in the criteria very well.

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