



POPULATION PROJECTION AND FACTOR ANALYSIS AFFECTING POPULATION GROWTH IN THE CITY MEDAN USING NON LINEAR TRENDS POLYNOMIC METHOD

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ABSTRACT

Non-linear trend is a measure of trend that has a model with quadratic equations, cubic and so on. The purpose of this research is to determine the population projection in Medan using a non-linear trend of the polynomial method (parabolic trend / quadratic trend) and to determine the factors that influence population growth in the city of Medan. From the results of data processing using the non-linear trend of the polynomial method, it is obtained that the projected number of population in 2029 will be 2645501 people, with The total male population is 1314713 and the female population is 1330788. When compared with the population in previous years, it can be seen that until 2029 the population in Medan will increase. Based on the research results from the factor analysis, it is known that the factors that are formed from the factor analysis process can be concluded that all the factors formed affect the population growth rate of Medan. The factors formed are birth (fertility), death (mortality) and migration.

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1. INTRODUCTION

Population is the number of people living in an area at a certain time and is the result of demographic processes, namely fertility, mortality, and migration. Population is also an object as well as a subject in development. The decrease or increase in population in an area has a close relationship with the development of its technology. The higher the technology owned by a population group, the wider the livelihood for population growth. Every new income in the field of technology has a huge influence on population development. This study proposes a non-linear trend method because the data used are long-term data and are based on historical data plots which are known to be non-continuous and non-linear. The non-linear trend is a measure of the tendency that has a model with an equation of the power of two, power of three and so on.

2. RESEARCH METHODE

2.1 Data Collection

The data collection stage starts from collecting data on the population of the city of Medan in 2009-2019 at the Central Bureau of Statistics of the city of Medan. The research data is secondary data obtained through censuses and surveys.

2.2 Data Processing

a. Data processing in projecting the population in the city of Medan is to use a non-linear trend polynomial to the power of two (parabolic trend), the formula used is:

$$\hat{Y} = a + bX + cX^2$$

b. Analysis of population growth factors in the city of Medan with a questionnaire. In this case the number of questionnaires tested is 100 respondents. After the data from the respondents were obtained, a factor analysis was carried out using SPSS 20.

c. The interview method in this study was used to obtain information and explanations about the methods used by the BPS in the city of Medan in projecting the population in the city of Medan.

2.3 Draw conclusions

In this case, a comparison of the results of the population projections carried out by researchers with population data from the Central Statistics Agency of the city of Medan is carried out.

3. RESULT AND ANALYSIS

3.1 Population Projection

Data processing in projecting the population in the city of Medan is to use a non-linear trend polynomial squared method (parabolic trend). The equation of the parabolic trend line is as follows :

$$a \sum X + b \sum X^2 + c \sum X^3 = \sum XY$$

$$a \sum X^2 + b \sum X^3 + c \sum X^4 = \sum X^2 Y$$

a. Analysis of female population data

After the value of a is known, all the constants for the quadratic trend equation are known. Then enter all the known constants into the quadratic trend equation, as follows :

$$\hat{Y} = a + bX + cX^2 = 1101394,341 + 9992,327X + 353,375X^2$$

So it is known that the quadratic trend equation $\hat{Y} = 1101394,341 + 9992,327X + 353,375X^2$.

The quadratic trend equation is used to project the population in the city of Medan. Next, project the population of the city of Medan with the known quadratic trend equation, as follows:

Table 1 Data Analysis of the Projected Results of the Number of Female Population

Year	X	$\hat{Y} = 1101394,341 + 9992,327X + 353,375X^2$
2015	1	1111740.043
2016	2	1122792.495
2017	3	1134551.697
2018	4	1147017.649
2019	5	1160190.351
2020	6	1174069.803
2021	7	1188656.005
2022	8	1203948.957
2023	9	1219948.659
2024	10	1236655.111
2025	11	1254068.313
2026	12	1272188.265
2027	13	1291014.967

2028	14	1310548.419
2029	15	1330788.621

b. Analysis of male population data

After the value of a is known, then all the constants for the quadratic trend equation are known.

Then enter all the known constants into the quadratic trend equation, as follows:

$$\hat{Y} = a + bX + cX^2$$

$$= 1074027,833 + 9455,527X + 439,344X^2$$

So it is known that the quadratic trend equation $\hat{Y} = 1074027,833 + 9455,527X + 439,344X^2$. The quadratic trend equation is used to project the population in the city of Medan. Next, project the population of the city of Medan with quadratic trend equation that has been known, as follows:

Table 2 Data Analysis of the Projected Results of the Male Population

Year	X	$Y = 1074027.833 + 9455.527X + 439.344X^2$
2015	1	1083922.704
2016	2	1094696.263
2017	3	1106348.51
2018	4	1118879.445
2019	5	1132289.068
2020	6	1146577.379
2021	7	1161744.378
2022	8	1177790.065
2023	9	1194714.44
2024	10	1212517.503
2025	11	1231199.254
2026	12	1250759.693
2027	13	1271198.82
2028	14	1292516.635
2029	15	1314713.138

So that the results obtained:

Table 3 Results of Medan City Population Projection

Tahun	Perempuan	Laki-laki	Jumlah
2015	1111740	1083922	2195662
2016	1122729	1094696	2217425
2017	1134551	1106348	2240899
2018	1147017	1118879	2265896
2019	1160190	1132289	2292479
2020	1174069	1146577	2320646
2021	1188656	1161744	2350400
2022	1203948	1177790	2381738
2023	1219948	1194714	2414662
2024	1236655	1212517	2449172
2025	1254068	1231199	2485267
2026	1272188	1250759	2522947
2027	1291014	1271198	2562212
2028	1301548	1292516	2594064

2029	1330788	1314713	2645501
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From table 3, it can be seen that the projected population in 2029 will be 2645501 people, with a male population of 1314713 people and a female population of 1330788 people. When compared with the population in previous years, it can be seen that until the year 2029 the population in the city of Medan will increase.

3.2 Analysis of Factors Affecting Population Growth in Medan City.

Analysis of factors affecting population growth in the city of Medan using a questionnaire distributed to several residents in the sub-districts in Medan. In this case the number of questionnaires tested is 100 respondents. To find out the frequency distribution, each question is given a score or value with the criteria of a score of 5 if the respondent's answer is E, 4 if the respondent's answer is D, 3 if the respondent's answer is C, 2 if the respondent's answer is B and 1 if the respondent's answer is A.

The KMO and Bartlett's test table shows that the KMO Measure of Sampling Adequacy (MSA) number is 0.629. Because the value of $0.629 > 0.5$ this indicates the adequacy of the sample. The KMO and Bartlett's test numbers seen in the chi-square value are 328,615 with a significance value of 0.000, this indicates that there is a correlation between variables and is feasible for further processing.

Especially in the (anti-image correlation) section, a number marked (a) indicates the MSA amount of a variable. Variabel X1 0.693, X2 0.603, X3 0.653, X4 0.650, X5 0.609, X6 0.601, and X7 0.653. The MSA value of each variable is > 0.5 , then all variables can be processed further.

The magnitude of the X1 variable is 0.682, this means that about 68.2% of the variance of the X1 variable can be explained by the formed factors. The magnitude of the X2 variable is 0.901, this means that about 90.1% of the variance of the X2 variable can be explained by the formed factors. Likewise for other factors. The smaller the value of communalities means the weaker the relationship with the factors formed.

Variable X1 has an eigenvalue of 2.473 and variable X2 of 2.389. To determine how many components/factors are used in order to explain the total diversity, it can be seen from the large eigenvalue, the component with eigenvalue > 1 is the component used. The 'cumulative %' column shows the cumulative percentage of variance that can be explained by the factor.

The amount of diversity that can be explained by the X1 variable is 35.33% and X2 is 34.127%. Both variables can explain the total diversity of 69.460%. Based on the reasons for the eigenvalues of the two factors which is more than 1 and the cumulative percentage of the two variables is 69.460%, it can be concluded that the two factors are sufficient to represent the diversity of the original variables.

Variable X1 correlation value of variable X1 with factor 1 is 0.761 and correlation with factor 2 is 0.321. Variable X2 correlation value of X2 variable with factor 1 is 0.920 and factor 2 is 0.233. Component transformation matrix shows that in component 1 the correlation value is $0.951 > 0.5$, and in component 2 the correlation value is $0.951 > 0.5$. Because the correlation value of all components > 0.5 , then the two factors formed can be concluded that it is feasible to summarize the seven variables analyzed.

From the factors formed from the factor analysis process, it can be concluded that all the formed factors affect the population growth rate of the city of Medan.

3.3 Interview result

From the results of the author's interview with one of the employees of the statistical center of the city of Medan, it was concluded that population data from the 2010 population census and population census data in 2000 obtained population growth. After the population growth is obtained, that growth is used to project the number of population in 2011 to 2014. In 2015 SUPAS (Inter-Census Population Survey) was held.

The purpose of holding SUPAS is to replace the previous value of population growth, so that in 2016 to 2020 population growth will be obtained again. In 2020 a population census was held, after obtaining the data compared to 2010 there was a population growth trend for 10 years. This data will be used to project the population in 2021. The population growth is calculated using an arithmetic progression and the growth is considered linear.

4. CONCLUSION

Based on the results of the research from factor analysis, it is known that the factors formed from the factor analysis process can be concluded that all the formed factors affect the population growth rate of the city of Medan. The factors formed are birth (fertility), death (mortality) and migration.

Population projections are estimates of the population based on the results of the population census, not only valid after the population census but may be valid for several decades after the population census. The population data is used as the main reference material for consideration in the preparation of population projections so as to provide an overview to local governments in preparing further development plans in relation to their responsibilities in improving the socio-economic conditions of the people through planned development.

The data used for the projection of the population in the city of Medan is data on the population in the city of Medan from 2009 to 2019 which was obtained from the Central Statistics Agency for the city of Medan. From the results of data processing using a non-linear trend using the polynomial method, the projected population in 2029 is 2645501 people, with a male population of 1314713 people and a female population of 1330788 people. When compared with the population in previous years, it can be seen that until the year 2029 the population in the city of Medan will increase.

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