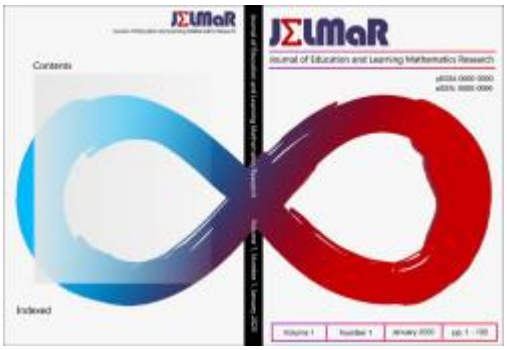

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Identification of Mean Years of Schooling as a Control for RPJMD: A Spatial Autocorrelation Approach

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***Abstract**: This article will identify the mean years of schooling in East Java as a control for achieving RPJMD. Inequality in the development of education leads to inequalities between the regions of East Java. This is due to the different regional characteristics, it is, therefore, necessary to respond to it by carrying out a regional mapping based on the education indicators listed in the RPJMD of each region using a statistical analysis approach, namely spatial autocorrelation. The variable that becomes the indicator in this study is the Mean Years of Schooling (MYS), the unit of observation being the regencies/cities of East Java. The results of the research that has been conducted can be concluded that the mean years of schooling for the population of East Java Province is seven years where urban areas have a better average length of schooling than in districts, and there are only nine areas in East Java that have MYS exceeding the RPJMD target. In the Global Moran's I test, there is a positive autocorrelation or cluster pattern that exhibits similar characteristics in adjacent locations, and the results of the local Morans' show that there are nine regions that have spatial relationships with their most significant areas relatives based on the MYS indicator. These areas are Bondowoso Regency, Bangkalan Regency, Pamekasan Regency, Gresik Regency, Jember Regency, Probolinggo Regency, Sampang Regency, Sidoarjo Regency and Surabaya City.*

Keyword: mean years of schooling, spatial autocorrelation, spatial analysis

INTRODUCTION

The level of education of a community can reflect the level of well-being of the community in an area (Ogundari & Aromolaran, 2014). Education is a necessity that must be satisfied as to the basic capital for the progress of the nation (Hanushek & Woessmann, 2020). Therefore, providing a full and equitable education to the entire population is one of the goals of development, including the provincial government of East Java. The efforts of the government of East Java to educate its people are contained in the Regional Medium Term Development Plan (RPJMD).

The RPJMD is a regional development planning document for five years that contains an elaboration of the vision, mission, and program of the head of the region about the Long-Term National Development Plan (RPJP) and in taking into account the National Medium-Term Development Plan (RPJMN) (Dariah et al., 2019). Term National Medium-Term Development Planin Article 1 Chapter 4 Law Number 17 of 2007 relating to "National Medium-Term Development Plan 2005-2025". The RPJMD contains the orientation of regional financial policies, regional development strategies, general policies, and programs of work units of regional apparatuses, interregional apparatuses, regional programs accompanied by work plans within the regulatory framework and the framework indicative funding.

In the 2014-2019 East Java Provincial RPJMD, one indicator is central to the development of the East Java Provincial Government in the area of education, namely improving access to quality primary and secondary education. This indicator is made up of aspects of the Mean Years of Schooling (MYS), the net enrollment rate (NER), and the gross enrollment rate (GER). This indicator is intended to be achieved to ensure access to quality primary and secondary education in East Java. However, the reality on the ground indicates that there is an imbalance in the distribution of educational development in the province of East Java (Soejoto et al., 2016), this is caused by regional characteristics that vary from each other, so it needs to be addressed by making a regional map based on the education indicators listed in the RPJMD for each region. This is intended as a monitoring of achievements and information for the government concerned for the evaluation of policymaking.

Educational mapping is one of the providers of information useful for decision-making. The overview of a condition in a certain area becomes the starting point for educational development. In the long term, the resulting policies aim to increase the availability, affordability, quality, relevance, equity, and certainty of obtaining educational services in East Java province in particular and Indonesia in general. Therefore, statistical analysis is needed to map the area based on the education indicators of each region of East Java Province. In this study, the mapping focuses on one indicator, namely the mean years of schooling (MYS). This indicator is an indicator that is central to the success of the RPJMD East Java to increase access to quality education access to primary and secondary education by the RPJMD East Java 2014-2019.

In this study, to map the districts/cities of East Java based on the MYS indicator, spatial analysis was used. Spatial data analysis is an analysis related to the influence of location (Watson, 2013). This is based on the first law, on the geography proposed by Anselin and Rey (2010: 17) which states that everything is interconnected, but something close has more influence than something far. In spatial data, observations in one place often depend on observations in other nearby (neighboring) places (Bottasso, 2014). The important role of location for spatial data, both in an absolute sense (coordinates) and in a relative sense (spatial arrangement, distance) has major implications for how they should be treated in statistical analysis, as discussed in detail in Anselin (1995). Localization gives rise to two classes of spatial effects: spatial dependence and spatial heterogeneity. The first, often also called spatial autocorrelation or spatial association, follows directly from Tobler's First Law of Geography (1979) (Miller, 2004).

Spatial autocorrelation is a spatial analysis to determine the pattern of relationships or correlations between locations (observations). Some tests for spatial autocorrelation are Moran's I, Geary's ratio, and local spatial autocorrelation indicator (LISA) (Anselin, 2019). This method is very important for obtaining information about the distribution pattern of the characteristics of an area and the interrelationships between the locations within it. In addition, this method is also used for the identification of spatial modeling. Several studies related to spatial autocorrelation or spatial analysis have been carried out including by Vidyattama (2014), Bekti (2017), Al Azies (2019), and Anisa (2020), but the application to the case of the mean years of schooling in East Java has never been carried out, so this research will be the first research, which applies spatial autocorrelation in the case of the mean years of schooling in East Java.

METHOD

The type of data used in this study is secondary data about the mean years of schooling districts/cities in East Java Province in 2017. In this study, the unit of observation was 38 regions in East Java Province consisting of 29 regencies and nine cities sourced from the

Central Bureau of Statistics of East Java Province. The variables used in this study were the mean years of schooling data in Java Province. The steps for data analysis are as follows.

1. Conduct a descriptive analysis of the mean years of schooling in East Java.
2. Determine the spatial weight matrix, to obtain connectivity between regions (Qu & Lee, 2015).
3. Determine the statistical value of the Moran index and test the hypothesis, then make the Moran scatter plot (Anselin, 2019) to discover the model of the relationship. The point cloud consists of four quadrants (Figure 1) (Zhukov, 2010), namely:
   a. Quadrant I (HH, high-high), indicates a location that has a high observed value surrounded by a location that has a high observed value.
   b. Quadrant II (LH, low-high), indicates a location that has a low observation value surrounded by locations that have a high observation value.
   c. Quadrant III (LL, low-low), shows locations that have low observation values surrounded by locations that have low observation values.
   d. Quadrant IV (HL, high-low), displays locations that have high observation values surrounded by locations that have low observation values

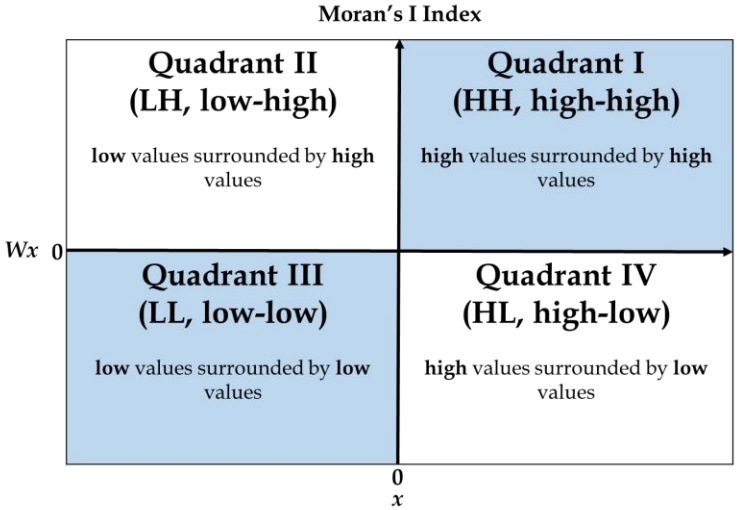

Figure 1. Quadrants of Moran Scatterplot (modified from Anselin, 1998)

4. Look for the statistical value of the Local Indicator of Spatial Autocorrelation (LISA) index (Lee & Wong, 2001).
5. Mapping the spatial relationship of East Java regions in terms of the mean years of schooling using LISA test results
6. Draw a conclusion

RESULT AND DISCUSSION

An Overview of The Mean Years of Schooling (MYS) In East Java

An Overview of the mean years of schooling (MYS) in East Java is presented in descriptive statistics (Figure 2), the average East Java population receives up to seven years of education (7.34), which means that the average East Java population does only finish their education up to primary school. There are 47% of the districts/cities in East Java that have MYS values higher than the provincial MYS values, consisting of ten districts and nine cities.

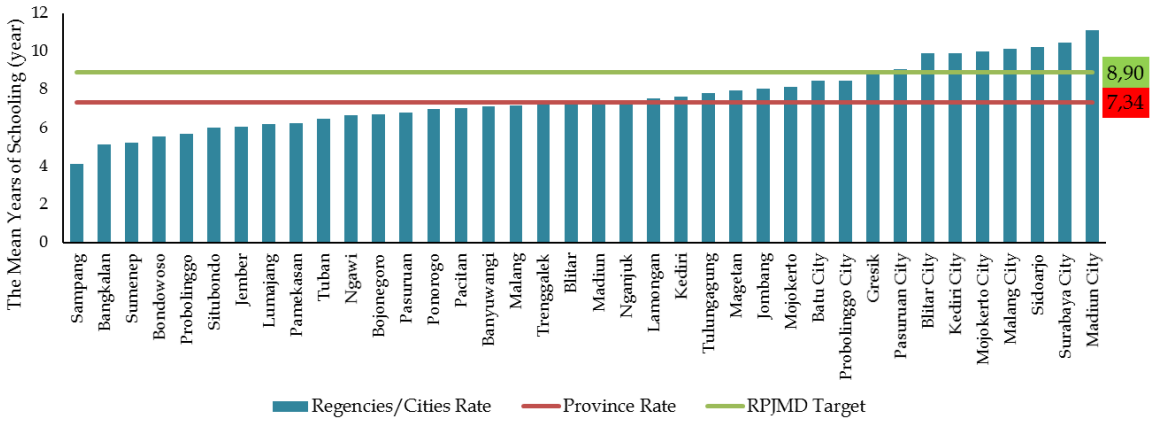

Figure 2. An Overview of The Mean Years of Schooling in East Java 2017

In addition, based on Figure 2, it can also be seen that the mean years of schooling in East Java Province is also still below the RPJMD 2017 target (8.90) and only 24% (9 regions) of the total area of East Java. have MYS scores exceeding the target. In the RPJMD, the areas sequentially based on their MYS values are Gresik Regency, Pasuruan City, Blitar City, Kediri City, Mojokerto City, Malang City, Sidoarjo Regency, Surabaya City, Madiun City.

Spatial Weighting Matrix Results

In spatial analysis to determine the existence of spatial autocorrelation (Wang et al., 2016), the main component needed is a location map which serves to determine the relationship between regions, which will facilitate the assignment of weights to each location or district. From the map (Figure 3) of East Java province, it is known that there are 38 regions in East Java, so the spatial weighting matrix becomes 38x38.

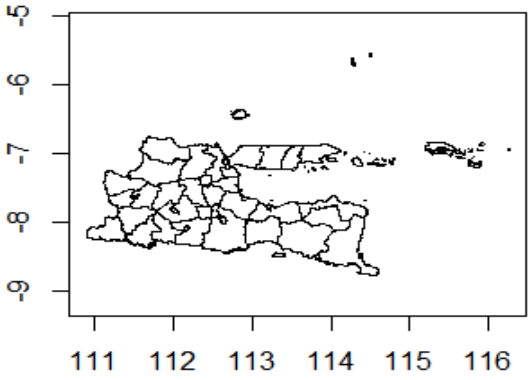

Figure 3. Location Map of East Java Province

The matrix weighting method used is queen contiguity. Standardize the contiguity matrix W (standard weighting matrix). Based on the spatial weighting matrix, one can see the number of neighboring locations belonging to each district (Figure 4). Regency/city connectivity in East Java uses the "queen contiguity" side-angle intersection.

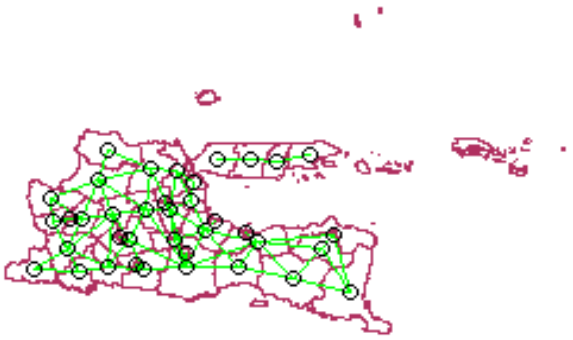

Figure 4. Regency/City connectivity plots in East Java

Figure 5 is a summary of Figure 4 which describes the number of neighbors between regions. Based on Figure 5 The connectivity of districts/cities in East Java can be seen using the queen contiguity weight matrix.

Figure 5. Graph of the number of Neighbors between regions

There are 8 districts/cities that only have one neighbor, namely Bangkalan Regency, Sumenep Regency, Kediri City, Blitar City, Malang City, Probolinggo City, Pasuruan City, and Mojokerto City. Regions that have two to four neighbors each have six regencies/cities and the most neighbors are Malang Regency with nine neighbors.

Morans' I Index Test with Moran Scatterplots

The Morans' I index is used to measuring the spatial dependence or spatial autocorrelation (spatial autocorrelation) of a variable between observations or locations (Abdulhafedh, 2017). This analysis provides a single measure for an attribute in a region as a whole. The value of the global Moran index (I)> 0 indicates that there is a positive spatial autocorrelation, which means that the data model forms clusters. Meanwhile, if we know that the global Moran index (I) = 0, we say that there is no spatial autocorrelation and for the global Moran index (I) <0 the autocorrelation value is negative (Chen, 2013), which means the pattern is scattered. The assumptions and test statistics used to test for spatial dependencies or spatial autocorrelation (spatial autocorrelation) are as follows.

H_0 : There is no spatial autocorrelation

H_1 : There is a spatial autocorrelation

Table 1. Global Moran Index of MYS

Morans' I Index	I_0	$P_{\text{-value}}$
0.43276	-0.02702	0.00022*

Note: *)Significance α = 5%

Based on the results (Tabel 1) of the Morans' index test, it shows that at a significant level (α) of 5%, there is spatial autocorrelation in the East Java MYS in 2017. Indeed, the p-value is below the significant level, therefore Hypothesis H0 is rejected. Morans' I value of 0.43276, which is greater than the Io value, indicates that there is a positive autocorrelation or cluster pattern and has similar characteristics at adjacent locations. This positive autocorrelation is also visible on the graph of figure 6 which shows that the regression line points to the right.

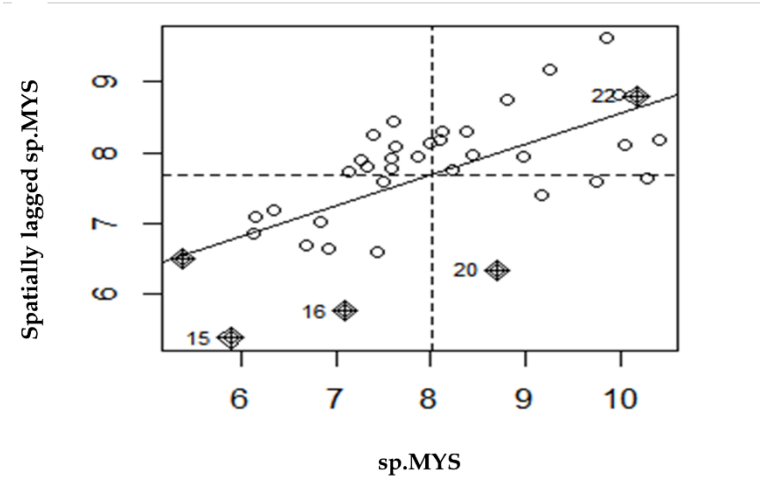

Figure 6. Moran Scatterplot of The Mean Years of Schooling (MYS) in East Java

Moran Scatterplot is presented in Figure 6, the observation points are spread between quadrants I, II, III, and IV. Moran Scatterplot analysis obtained the following results:

1. Quadrant I, HH (high-high), indicates that the area with high values is surrounded by high values observations. There are 14 regencies/cities in Quadrant I, including Pasuruan City.
2. Quadrant II, LH (Low-High), indicates that areas with low observation values are surrounded by areas with high observation values. there are up to ten regencies/cities, one of which is in Quadrant II is Blitar Regency.
3. Quadrant III, LL (Low-low) indicates that areas with low observation values are surrounded by areas with low observation values. There are 10 regencies/cities in Quadrant III, including Lamongan Regency and Bangkalan Regency.
4. Quadrant IV, HL (High-Low) indicates that areas with high observation values are surrounded by areas with low observation values. There are 4 regencies/cities in Quadrant IV, one of which is Malang City.

Results Local Indicator of Spatial Autocorrelation

Global Morans' test results show that there is an autocorrelation or spatial relationship between MYS indicators in East Java. In addition, the Moran scatterplot also describes how the pattern of relationships between existing regencies/cities is described. To discover the importance of local spatial autocorrelation, one must use Local Moran. From this test, we will obtain the significance of the relationship locally in each regency/city and visualized in the mapping in Figure 7.

Figure 7 shows that Bondowoso Regency, Bangkalan Regency, Pamekasan Regency, Gresik Regency, Jember Regency, Probolinggo regency, Sampang regency, Sidoarjo regency, and Surabaya city depend on the indicator of average duration of schooling with a confidence level of 95%. This is because the results of the Local Indicator of Spatial Autocorrelation are significant. Thus, it can be concluded that the area has a spatial relationship with the closest area in terms of average years of schooling between the regions of East Java.

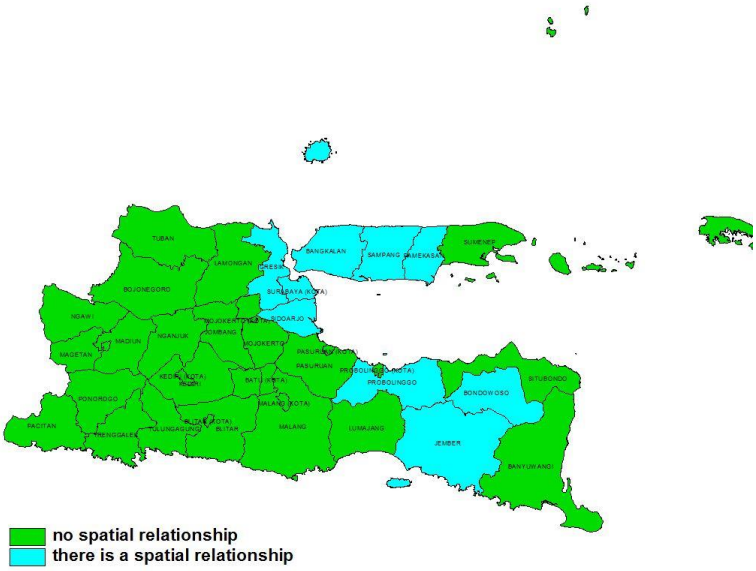

Figure 7. Mapping Results Local Indicator of Spatial Autocorrelation

CONCLUSION

Based on the results of the study, several conclusions were reached, including:

1. The distribution of the mean years of schooling for the population of East Java Province is seven years or only up to primary education. Urban areas have higher mean years of schooling than district areas, and more than 50 percent of areas in East Java have a lower MYS than the provincial MYS. In addition, nine East Java regions exceeded the RPJMD target for its MYS indicator.
2. The results of the Global Moran's I test on mean years of schooling data in East Java in 2017 show a positive autocorrelation or cluster pattern and have similar characteristics in adjacent locations. The results of the importance of the local spatial autocorrelation are obtained through the results of local Moran, there is 24 percent of the areas of East Java that have spatial links in the MYS indicator, these areas are the regency of Bondowoso, Bangkalan Regency, Pamekasan Regency, Gresik Regency, Jember Regency, Probolinggo Regency, Regency Sampang, Sidoarjo Regency, and Surabaya City depend on the mean years of schooling indicator which has a spatial relationship with the closer. The mapping results further reinforce the fact that the area is geographically adjacent to each other.

REFERENCES

Abdulhafedh, A. (2017). A Novel Hybrid Method for Measuring the Spatial Autocorrelation of Vehicular Crashes: Combining Moran's Index and Getis-Ord G i* Statistic. Open Journal of Civil Engineering, 7(02), 208.) https://doi.org/10.4236/OJCE.2017.72013

Al Azies, H., Cholid, F., & Trishnanti, D. (2019). Pemetaan Faktor-Faktor yang Mempengaruhi Stunting pada Balita dengan Geographically Weighted Regression (GWR). *semnaskes 2019*, 156-165.

Anisa, H. A. N., & Syamsudin, T. S. (2020). The Distribution and Analysis of Spatial Autocorrelation of Fruit Fly (Bactrocera sp.) on Red Chili Cultivation in Cirebon, West Java, Indonesia. *Health and Biosciences*, 1(2), 17-31.

Anselin, L. (1995). Local indicators of spatial association—LISA. *Geographical analysis*, 27(2), 93-115.

Anselin, L. (1998). Spatial Econometrics: Methods and Models; Kluwer Academic Publishers: Boston.

Anselin, L. (2019). The Moran scatterplot as an ESDA tool to assess local instability in spatial association (pp. 111-126). Routledge.

Bekti, R. D., Irwansyah, E., & Kanigoro, B. (2017). Ordinary Kriging and Spatial Autocorrelation Identification to Predict Peak Ground Acceleration in Banda Aceh City, Indonesia. In Proceedings of the Computational Methods in Systems and Software (pp. 318-325). https://doi.org/10.1007/978-3-319-67621-0_29

Bottasso, A., Conti, M., Ferrari, C., & Tei, A. (2014). Ports and regional development: a spatial analysis on a panel of European regions. Transportation Research Part A: Policy and Practice, 65, 44-55.). https://doi.org/10.1016/j.tra.2014.04.006

Chen, Y. (2013). New approaches for calculating Moran's index of spatial autocorrelation. PloS one, 8(7), e68336. https://doi.org/10.1371/journal.pone.0068336

Dariah, A. R., Mafruhat, A. Y., & Hendrakusumah, E. (2019). Framework of sustainable development planning in Indonesia. In Journal of Physics: Conference Series (Vol. 1375, No. 1, p. 012028). IOP Publishing. https://doi.org/10.1088/1742-6596/1375/1/012028

Hanushek, E. A., & Woessmann, L. (2020). Education, knowledge capital, and economic growth. The economics of education, 171-182. https://doi.org/10.1016/b978-0-12-815391-8.00014-8

Lee, J., & Wong, D. W. (2001). Statistical analysis with ArcView GIS. John Wiley & Sons.

Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. Annals of the Association of American Geographers, 94(2), 284–289. http://www.jstor.org/stable/3693985

Ogundari, K., & Aromolaran, A. B. (2014). Impact of education on household welfare in Nigeria. International Economic Journal, 28(2), 345-364. https://doi.org/10.1080/10168737.2013.811279

Qu, X., & Lee, L. F. (2015). Estimating a spatial autoregressive model with an endogenous spatial weight matrix. *Journal of Econometrics*, 184(2), 209-232.

Soejoto, A., Subroto, W. T., Rachmawati, L., & Sholikah, N. M. (2016). Education inequality effect on poverty and economic growth: Empirical study in province of East Java. *International Journal of Applied Business and Economic Research*, 14(6), 4087-4103.

Vidyattama, Y. (2014). Issues in applying spatial autocorrelation on Indonesia's provincial income growth analysis. *The Australasian Journal of Regional Studies*, 20(2), 375-402.

Wang, J. F., Zhang, T. L., & Fu, B. J. (2016). A measure of spatial stratified heterogeneity. Ecological Indicators, 67, 250-256. https://doi.org/10.1016/J.ECOLIND.2016.02.052

Watson, D. (2013). Contouring: a guide to the analysis and display of spatial data. Elsevier.

Zhukov, Y. M. (2010). Applied Spatial Statistics in R, Section 4 Spatial Point Processes Spatial Data and Basic Visualization in R. *Statistics*, 1-18.