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## PART A

APPLIED
AND NATURAL
SCIENCES

PROORES
BAKU, AZERBAIJAN

*The nation's future success lies with science and education!*

***Heydar Aliyev***
*National Leader of Azerbaijan*

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## PART A. APPLIED AND NATURAL SCIENCES

### 1ST ISSUE

# ADJACENT MODEL OF IMPECUNIOUS HOUSEHOLD IN EAST JAVA USING STRUCTURAL EQUATION MODELING SPATIAL

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**ABSTRACT**

Structural Equation Modeling (SEM) depicts causality relation between the variable which cannot be explained at analysis of regression ordinary, so that can know how well an indicator variable determined of latent variable. Oftentimes in perception in a location base on perception in nearby other location (neighboring). So that to overcoming it, effect of spatial packed into the model. Thereby for statistical analysis of SEM having regional influence its variable used SEM spatial. In analysis of spatial SEM of nature of its variable of him have causality relation, measured indirectly by the variable of predictor and have influence of an aspect of spatial. This research use influence of effect spatial / dependence spatial into the model SEM (SEM spatial) with approach of partial least square (PLS). Any indicator which is weight for each variable of latent is valid and significant, with good reliability at all latent variable poorness, economic, human resource, health. Model auto regressive spatial at rho (SAR) in SEM is $\eta = \rho\eta_w + \Gamma x + \zeta$ and auto regressive spatial at error in SEM. $\eta = \lambda\eta_w + \Gamma x - \lambda\Gamma x_w + \zeta$. Results of test of Lagrange multiplier with weight matrix of queen were by model of spatial auto regressive at error. Assess R-Square ($R^2$) at poorness model is equal to 96%, economic model equal to 98.965% and for the model of SDM equal to 99.242%.

**Key words:** Poorness, Lagrange Multiplier, Neighboring, SEM, Spatial

## 1. INTRODUCTION

Structural Equation Modeling (SEM) represents a statistical technique which has the ability to analysis relation pattern between of latent and indicators variables. Where this method represents the development of multivariate analysis is factor analysis and regression. SEM has special capability in finishing problems entangling many equations of linear at latent variable [1] Latent variable is a construct in the imponderable structural equation model directly, but can be measured by one or more indicator variable. SEM also can depict causality relation between a variable which cannot be explained at analysis of ordinary regression, so that can know how well an indicator variable determined latent variable.

There are two important reason, which constitute using of SEM. First, SEM has an ability to estimate relation between variable having the character of relationship multiple. This relation is formed in the structural model which depicted through relation between endogenic latent variable with of exogenic latent. Both, SEM has an ability to depict relation pattern between variable of latent and indicator variables. Method of SEM function using maximum likelihood for the minimization of difference between formed by covariance matrix is sample data with formed by covariance matrix is prediction model [7]. Usage of SEM has assumption constitution that is normal multivariate and amount of big sample. Usage of small sample can yield bad parameter valuation even do not convergent So that one of the approach of which can be used by Partial Least Square (PLS). PLS represent analysis method which is powerful because do not require many size measures and assumption of sample do not have to be big [2].

Partial Least Square (PLS) is the first time developed by Herman Wold (1975) [3]. This model is developed alternatively if the theory constitution scheme of the weak model. PLS represent an analysis which is powerful because can be used in each data scale type and also more flexible assumption condition. PLS also can be used by when the basis for theory model is or tentative of measurement each variable of latent still newly, so that designed for the purpose of prediction [3]. Model in PLS cover three outer stage, namely model or measurement model, inner model or structural model and relation weight where value of latent variable can estimate [4].

In a few research oftentimes there is a variable influenced by regional aspect (spatial), hence in its development require to be considered by aspect of spatial at model [11]. Where perception in a location based on perception in nearby other location. So that effect of spatial packed into model. Thereby for statistical analysis of SEM having regional influence at its variable is used by SEM spatial. In analysis of spatial SEM is nature of its variable has causality relation, measured indirectly by the variable of predictor and have influence of an aspect of spatial. [5] introducing the effect of random structure of spatial single to calculate correlation between its variable, which applied at health case. Adopting confirmatory factor model of with correlation of spatial single between some social indicator [6]. Studying lag spatial in SEM and of spatial error model in SEM case of econometric [8]. SEM developed with structural model of spatial regression to know factors affecting to area disseminating drop behind in West Sumatera Provence [9]. Studied modeling structural equation of spatial (SEM Spatial) by applying at case of PDRB in East Java [10].

East Java Provence divided into the 29 regencies and 9 cities or administratively there are 38 regency/city and can be told to expand into the field of economics. However that way, in it still many societies which is life under poverty line [12]. In the year 2011 percentage of poverty in East Java Province at the same time resides in above percentage mark with poverty line of national level equal to 13,33%. Only poverty enclave still in around Lacquer Regency, Bangkalan Regency, Probolinggo, Sumenep, Pamekasan, Tuban, Pacitan, Town of Probolinggo, Bojonegero and Bondowoso. Where have percentage of poverty of super ordinate poverty line of Provence and National level.

Pursuant to breakdown of above, hence conducted by research used SEM spatial with approach of Partial Least Square (PLS) in forming structural model, which applied at poverty case in regency/city of East Java Provence year 2011,

where the latent variable used endogenic for example poverty, economic, health, and SDM. Thereby the target of in this research that is compiling the model to the data of poverty regency/city of East Java Provence year 2011 with method of Spatial SEM PLS. So that will be gotten by a poverty model by entangling location effect or of spatial among regions at regency/city of East Java Provence.

## 2. METHODOLOGY

The data used in this study it serves as the publication "Data and Information Poverty Regency / City of the Year 2011" if the results of the quarterly data is the National Socioeconomic Survey (SUSENAS). Information obtained include the percentage of the poor, the poverty gap index; poverty severity index, health, household expenses, employment, education and housing facilities. **Poverty:** The percentage of poor ($Y_1$), Poverty gap index ($Y_2$), Poverty severity index ($Y_3$); **Economy:** The percentage of poor people aged 15 years and above who do not work ($X_1$), The percentage of poor people aged 15 years and over who worked in the agricultural sector ($X_2$), Percentage of households who ever bought poor rice ($X_3$), An error occurred, please try again later. ($X_4$); **Human Resource (HR):** The percentage of poor people aged 15 years and above who do not complete primary school ($X_5$); Literacy Rate of poor people aged 15-55 years ($X_6$); The average length of school ($X_8$); **Health:** Percentage of Women using contraceptives in poor households ($X_9$), Toddlers percentage of poor households in the process of birth assisted by skilled health personnel ($X_{10}$), Percentage Toddlers in poor households that had been immunized ($X_{11}$), The percentage of poor households with per capita floor area of $\leq 8$ m$^2$ ($X_{12}$), The percentage of poor households who use their own latrines / joint ($X_{14}$), The percentage of poor households who received a health service ($X_{15}$), Life expectancy ($X_{16}$).

There are two stages and analysis methods used in achieving the goals of research. The first is to analyze the spatial SEM PLS, where the goal is to get a weighted factor score, weight or effect lies in the location of the indicator and the second is the spatial regression modeling in SEM PLS. Steps can be described as follows:

**The First Stage**

a. Develop a conceptual model based on the theory [13]
b. Construct a path diagram

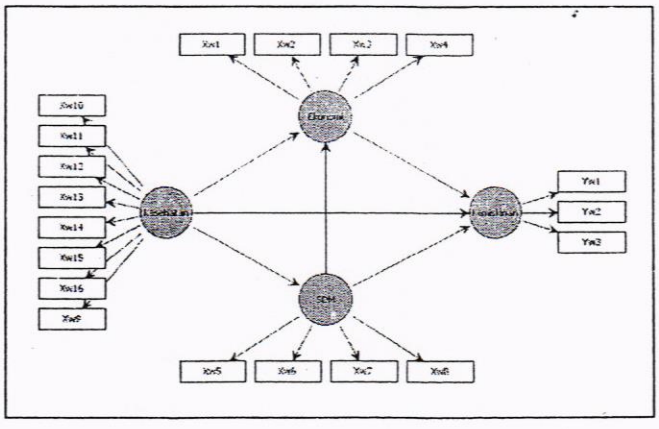

*Fig. 1. Path Diagram of Poverty*

$Y_{w1}$ value can be obtained by multiplying the weighted matrix **(W)** for East Java with $Y_1$ indicator. Location effects on indicators in each of these latent variables that distinguish the SEM PLS studies generally.

$Y_{w1\,(38x1)} = W_{(38x38)} \cdot Y_{1\,(38x1)}$

and acquired the same manner also weighted indicators for each latent variable.

c. Spatial modeling SEM PLS (test the validity of the model and the structural model outer / inner model).

d. Getting value weighted factor scores for each latent variable. Value-boboti ter factor scores will be used for the analysis of spatial regression modeling with structural equations.

**The Second Stage**

a. Determine the weighting matrix, the matrix weighted or weighted matrix for the regency/city in the province of East Java in this study is based on the relationship of contact-angle side (queen contiguity) [11]

b. To test the spatial effects to determine the spatial effects on spatial autoregressive models in rho (SAR) and the spatial autoregressive error. Test statistic used is the Lagrange multiplier test.

c. Formulate spatial regression models in structural equation [15]

d. Getting the value of spatial regression parameter estimation in structural equation (SEM PLS)

e. Interpret and summarize the results.

## 3. RESULTS AND DISCUSSION

### A. Mapping Poverty in East Java

Distribution of pockets of poverty in East Java still around Sampang, Jakarta, Probolinggo, Sumenep, Pamekasan, Tuban, Pacitan, Probolinggo City, Bojonegero and Bondowoso.

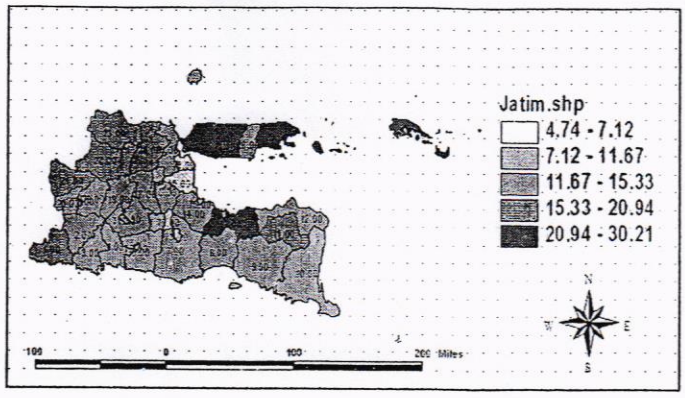


*Fig. 2. Distribution of the percentage of poor people in East Java*

And there is a fairly high diversity in a number of indicators on poverty latent variables, economic, human resources and health. This means that there are all slack between districts / cities in East Java province, according to the characteristics of the area itself. To clarify the picture of poverty in East Java in 2011 based on the indicators influencing mempe presented in the form of Boxplot in Figure 3 as follows:

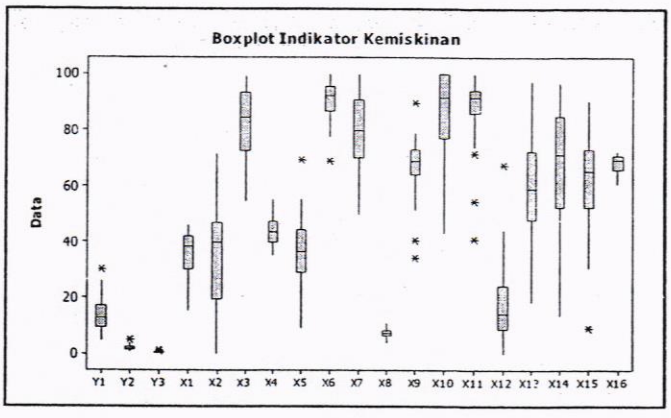


*Fig. 3. Boxplot Poverty Indicators*

**B. Spatial SEM Partial Least Square**

**• Validity and reliability on the Outer Model**

Based on Enclosure 1., shows that the estimated value of the loading on each latent variable is significant, as shown by the value of the t-statistic greater than t-table 1,960 *(2-tailed)* at a significance level of alpha 0.05. Enclosure 2., shows that all the blocks of the indicators that measure the construct of Health, Human Resources, Economy, and Poverty > 0.7. So that the latent variables of health, human resources, economics, and poverty is said to have good reliability.

**• Structural equation / inner models**

Based on result R Programme is known that there are three equations as follows:

Poverty = 1.338 Economy + 1.148 Human Resources – 1.564 Health
Economy = 1.377 Human Resources – 0.387 Health
Human Resources = 0.994 Health

Model poverty ($\eta_{w1}$) it can be seen that the economy has a positive and significant impact on poverty latent variables, HR also has a positive effect but not significant, while the health variable has a negative and significant effect on the model of poverty. For economic model ($\eta_{w2}$) known that the latent variable HR has a positive and significant effect on the latent variables in the economy and 95% confidence interval is t-statistic, the path coefficient estimates obtained by 1.377, while the latent health variable has a negative and significant effect with the estimated path coefficients for -0.387. And for HR models ($\eta_{w3}$) it can be seen that the latent health variable has a positive and significant correlation to HR at 95% confidence interval, as well as t-statistics with estimated path coefficients for 0,994.

Test value evaluation of structural equation model on Spatial SEM PLS can be seen from the value of goodness of fit or $R^2$. The results of this study data processing by using R R-square value ($R^2$) as shown in Table 1. below:

**Table 1.** R-Square ($R^2$) at endogen variables

| Latent Variables | R-square | Description |
|---|---|---|
| Human Resources | 0.988 | Good |
| Economy | 0.986 | Good |
| Poverty | 0.925 | Good |

R-square value ($R^2$) to HR for 0.988 which means that the model is able to explain the variation of HR in the incidence of poverty in East Java Province by 98.8%, amounting Economics 0.986 or 98.6% and models of poverty by 0,925 or 92.5%.

**C. Spatial Regression**

Based on the spatial autoregressive models in rho (SAR) in the SEM, $\eta = \rho\eta_w + \Gamma x + \zeta$ and the spatial autoregressive error in SEM, $\eta = \lambda\eta_w + \Gamma x - \lambda\Gamma x_w$, the representation of spatial regression models on rho autoregressive (SAR) in the SEM for further structural equation can be written in the form of sample units of measurement as follows:

$$l_1 = \rho_1 l_{w1} + \gamma_{12} l_2 + \gamma_{13} l_3 + \gamma_{14} l_4 + \zeta_1$$
$$l_2 = \rho_2 l_{w2} + \gamma_{23} l_3 + \gamma_{24} l_4 + \zeta_2$$
$$l_3 = \rho_3 l_{w3} + \gamma_{34} l_4 + \zeta_3$$

And representation of spatial autoregressive regression model on the error in the SEM structural equation can be written in the form of sample unit of measure as follows:

$$l_1 = \lambda l_{w1} + \gamma_{12} l_2 + \gamma_{13} l_3 + \gamma_{14} l_4 - \lambda\gamma_{12} l_{w2} - \lambda\gamma_{13} l_{w3} - \lambda\gamma_{14} l_{w4} + \zeta_1$$
$$l_2 = \lambda l_{w2} + \gamma_{23} l_3 + \gamma_{24} l_4 - \lambda\gamma_{23} l_{w3} - \lambda\gamma_{24} l_{w4} + \zeta_2$$
$$l_3 = \lambda l_{w3} + \gamma_{34} l_4 - \lambda\gamma_{34} l_{w4} + \zeta_3$$

where $l_1$ stating the value of poverty, $l_2$ stating the amount of economic value, $l_3$ stating the value of human resources and $l_4$ stating the value of health.

- **Determination of the spatial weight matrix**

East Java is a province consisting of 29 districts and 9 cities. Matrix weighted (weighted matrix) in East Java area in this study is based on the relationship of contact-angle side (queen contiguity). Side-angle intersection (queen contiguity) defines Wij = 1 for entities that sideways (common side) or vertex (common vertex) met with the region of concern, Wij = 0 for the other regions. Use of queen contiguity weights are based on the District / City in the province of East Java that is not symmetrical, so that observations in each region are side by side or the corners meet up with other regions, the weight would be worth one and the other areas were given a value of zero.

- **Test spatial model**

The output of the R Programme to test spatial model with lagrange multiplier test can be shown as follows:

**Table 2.** Identification of spatial effects for poverty models

| Endogen Variables Models | Test Spatial Dependency | Value | p_Value |
|---|---|---|---|
| poverty | Lagrange Multiplier (lag) | 1.1762 | 0.278 |
| | Lagrange Multiplier (error) | 17.6137 | 0.000 |
| economic | Lagrange Multiplier (lag) | 0.868 | 0.351 |
| | Lagrange Multiplier (error) | 9.5082 | 0.002 |
| human resources | Lagrange Multiplier (lag) | 3.7411 | 0.053 |
| | Lagrange Multiplier (error) | 14.2846 | 0.000 |

It can be concluded that the representation of spatial regression models in structural equation SEM to the next is the spatial autoregressive regression model in error, significant at the 5 percent significance level alpha, to poverty, economic and human resources.

- **The spatial autoregressive error in SEM to model poverty**

**Table 3.** Estimation of spatial autoregressive model parameters on the error to poverty

| Parameter | Coefficient | p_value | Description |
|---|---|---|---|
| Constant | 0.03991 | 0.387106 | Not significant |
| Economy | 1.711334 | 8.56E-07 | significant |
| Health | -0.954078 | 0.026703 | significant |
| HR | 0.207329 | 0.709262 | Not significant |
| Lag Economy | -1.112351 | 0.008082 | significant |
| lag.Health | 0.375565 | 0.448385 | Not significant |
| lag.HR | 0.120105 | 0.834865 | Not significant |
| Lamda | 0.54962 | 3.86E-05 | significant |
| $R^2$ = 0.96006 or 96.006% and $\hat{\sigma}^2$ = 0.036146 | | | |

Autoregressive spatial regression models to errors in structural equation SEM for poverty above can be interpreted that the health of the economy and significant at the 5% significance level, to HR is not significant at the 5% significance

level. As for the weighted economy (economic lagged) is significant at the 5% significance level, for the health of the weighted (lagged health) and weighted human resources (HR lagged) is not significant at the 5% significance level. This clicking indicated that the greater the value of the indicator of economic variables in a region of the positive impact on value addition of poverty in other regions that have the same characteristics. Known lambda value is significant at the 5% significance level, meaning that there is a link poverty in a region with other neighboring regions. R-square value (R2) in a model of poverty is equal to 0.96 or 96%, thus the spatial autoregressive model of the errors in structural equation SEM good.

- **The spatial autoregressive error in SEM for Economic model**

**Table 4.** Estimation of spatial autoregressive model parameters on the error for the economy

| Parameter | Coefficient | p_value | Description |
|---|---|---|---|
| Constant | -0.0149 | 0.5115 | Not Significant |
| Health | -0.07731 | 0.7167 | Not Significant |
| HR | 1.068104 | 3.73E-07 | Significant |
| lag.Health | -0.25963 | 0.2484 | Not Significant |
| lag.HR | -0.13019 | 0.661 | Not Significant |
| Lamda | 0.41664 | 7.72E-03 | Significant |
| $R^2$ = 0.98965 or 98.965% and $\hat{\sigma}^2$ = 0.0098081 | | | |

For economic model above can be interpreted that significant human resources at a significance level of 5%, for health is not significant at the 5% significance level. As for health lagged weighted or weighted health and human resources (HR lagged) is not significant at the 5% significance level. Know the value of lambda-significant at the 5% significance level, meaning that there are economic linkages in an area with other neighboring regions. R-square value (R2) in the economic model is equal to 98.965%, thus the spatial autoregressive model of the errors in structural equation SEM good.

- **The spatial autoregressive error in SEM to HR model**

**Table 5.** Estimation of spatial autoregressive model parameters on the error for HR

| Parameter | Coefficient | p_value | Description |
|---|---|---|---|
| Constant | 0.01888 | 0.302184 | Not Significant |
| Health | 1.00772 | < 2.2e-16 | Significant |
| lag.Health | -0.5232 | 0.000381 | Significant |
| lamda | 0.47954 | 9.35E-04 | Significant |
| $R^2$ = 0.99242 or 99.242% and $\sigma^2$ = 0.0070498 | | | |

For HR above can be interpreted that a significant health at a significance level of 5%. As for the weighted health or health lagged significant at the 5% significance level. Known lambda value is significant at the 5% significance level, meaning that there is a relationship between changes in indicators of human resources in an area with other neighboring regions. And the value of R-square ($R^2$) in a model of human resources amounted 99.242%, thus the spatial autoregressive model of the errors in structural equation SEM good.

## 4. CONCLUSION

It was found that the representation of spatial regression models in structural equation SEM is the spatial autoregressive regression model on the error.

a. For poverty variables obtained autoregressive spatial regression models in error are as follows.

$$l_1 = 0.04 + 0.55 \sum_{j=1,i\neq j}^{n} w_{ij}\, l_{1i} + 1.711 l_2 + 0.207 l_3 - 0.954 l_4 + 1.112 \sum_{j=1,i\neq j}^{n} w_{ij}\, l_{2i} - 0.120 \sum_{j=1,i\neq j}^{n} w_{ij}\, l_{3i} - 0.376 \sum_{j=1,i\neq j}^{n} w_{ij}\, l_{4i} + \zeta_i$$

R-square values obtained ($R^2$) on the model of poverty is equal to 0.96 or 96%, thus the spatial autoregressive regression model to errors in structural equation SEM good.

b. For economic variables obtained autoregressive spatial regression models in error are as follows.

$$l_2 = -0.015 + 0.417 \sum_{j=1,i\neq j}^{n} w_{ij} l_{2i} + 1.068 l_3 - 0.077 l_4 + 0.13 \sum_{j=1,i\neq j}^{n} w_{ij} l_{3i} + 0.26 \sum_{j=1,i\neq j}^{n} w_{ij} l_{4i} + \zeta_2$$

R-square ($R^2$) = 98.965%.

c. For HR variables obtained in the autoregressive spatial regression model error is as follows.

$$l_3 = 0.48 \sum_{j=1,i\neq j}^{n} w_{ij} l_{3i} + 1.007 l_4 + 0.523 \sum_{j=1,i\neq j}^{n} w_{ij} l_{4i} + \zeta_3$$

R-square ($R^2$) = 99.242%.

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**Enclosure**

1.T-test statistical significance bootstrap 400

| Latent Variables | $\hat{\lambda}_{jk}$ | $se(\hat{\lambda}_{jk})$ | $t = \frac{\hat{\lambda}_{jk}}{se(\hat{\lambda}_{jk})}$ |
|---|---|---|---|
| Health | 0.996 | 1.00E-03 | 9.96E+02 |
| | 0.994 | 1.87E-03 | 5.32E+02 |
| | 0.995 | 1.50E-03 | 6.63E+02 |
| | 0.749 | 7.98E-02 | 9.39E+00 |
| | 0.98 | 5.51E-03 | 1.78E+02 |
| | 0.946 | 1.97E-02 | 4.80E+01 |
| | 0.974 | 8.01E-03 | 1.22E+02 |
| | 0.997 | 1.08E-03 | 9.23E+02 |
| HR | 0.943 | 1.90E-02 | 4.96E+01 |
| | 0.997 | 9.12E-04 | 1.09E+03 |
| | 0.987 | 5.34E-03 | 1.85E+02 |
| | 0.988 | 4.12E-03 | 2.40E+02 |
| Economy | 0.97 | 8.65E-03 | 1.12E+02 |
| | 0.934 | 1.73E-02 | 5.40E+01 |
| | 0.997 | 8.82E-04 | 1.13E+03 |
| | 0.989 | 3.25E-03 | 3.04E+02 |
| Poverty | 0.996 | 1.28E-03 | 7.78E+02 |
| | 1.000 | 8.26E-05 | 1.21E+04 |
| | 0.997 | 1.19E-03 | 8.38E+02 |

2. Reliability Test Results (Composite Reliability)

| Latent Variables | Reliability *(Composite Reliability)* | Description |
|---|---|---|
| Health | 0.989 | Reliable |
| HR | 0.989 | Reliable |
| Economy | 0.986 | Reliable |
| Poverty | 0.998 | Reliable |