



## MULTIVARIATE REGRESSION ANALYSIS WITH KICC METHOD IN MEASURING OF SOCIETY WELFARE IN SOUTH SULAWESI

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### Abstract

The level of society welfare is a shared hope in advancing a region. The welfare indicators of an area depend on economic growth that affects the income level and the level of regional development progress. The aim of this study is to determine the multivariate regression analysis in measuring level of the society welfare and know the factors that affect the level of society welfare in South Sulawesi. The research method used is applied research multivariate regression analysis with selection the smallest KICC (*Kullback's Information Criterion Corrected*) value on the economic field. The result of multivariate regression analysis with KICC method that the correlation between the predictor variables of income percentage from taxes, retribution, acceptance of natural resource, investment, balancing fund and development fund to the percentage of regional income, economic growth, significant simultaneously. While partially, the results of acceptance of natural resource do not significantly affect the percentage of regional income, economic growth and the level of regional progress, so that regional income from the natural resource results need added again in improving public's welfare. The level of accuracy of information data predictor variable to response variable in the multivariate regression is  $\eta^2_{\Delta} = 0.9729$  or 97,29%.

**Keywords:** multivariate regression, KICC method, society welfare

### 1. Introduction

The welfare is a condition where the fulfillment of all forms of basic necessities, such as food, clothing, housing, education, and health care. This kind of understanding placement welfare as the goal of a development activity. For example, the purpose of development is to improve the society welfare level. Meaning of welfare as a tool to achieve development goals (Suhartono, 2009). In social policy, social welfare leads to service to meet the society needs, this is the term used in the idea of a prosperous country. Social welfare demands the fulfillment of

primary needs, secondary needs and tertiary needs. Welfare indicator in a region have influenced by the amount of regional income, the magnitude of economic growth and regional progress. These welfare indicators come from various sectors such as taxes, retribution, natural resource, investment, equity funds and development funds (Mudrajad, 2004).

The amount of income from various sectors affecting the economic indicators, will determine the level of welfare of each region, so it takes the right control and analysis so that the competition of each region will be healthy. The solution of the problem is a mathematical model that can be used to control and predict the variables that need to be controlled as an illustration of the welfare of districts and cities in South Sulawesi. The selected mathematical model is a multivariate regression with KICC (*Kullback's Information Criterion Corrected*) method.

The multivariate regression analysis is appropriate to model welfare society levels the district and cities in South Sulawesi because multivariate regression contain more than one response variable that correlates with one or more predictor variables. This, in accordance with the concept of welfare that has several indicators that have influenced by several other factors. Use of this model, supported by research ever conducted Riskiyanti and Wulandari (2011), Liu (2012) and Lestari (2016). From these studies, factors affecting wellbeing can be determined from factors that influence life expectancy, infant mortality rate, and malnutrition status. For example, if malnutrition increases in society means the government fails to provide prosperity or welfare.

Based on the magnitude of the relationship between response variables and predictor variables obtained it can be called that the model can explain the data information. So according to the description the author submits the title of Multivariate Regression Analysis with KICC method in Measuring of society Welfare in South Sulawesi. The aim of this study is to determine the multivariate regression analysis in measuring level of the society welfare and know the factors that affect the level of society welfare in South Sulawesi.

## 2. Methodology

The type of research used is applied research with quantitative data. The data used from the Central Statistics agency (BPS) of South Sulawesi Province in 2015. The response variable is the percentage of total regional income ( $Y_1$ ), economic growth ( $Y_2$ ), and level of regional progress ( $Y_3$ ). The predictor variable comprises the regional revenue of the tax sector ( $X_1$ ), retribution ( $X_2$ ), acceptance of natural resources ( $X_3$ ), investment ( $X_4$ ), balance funds ( $X_5$ ) and development fund ( $X_6$ ). The research procedure is (1) Look for the average, maximum and minimum value. (2) Form parameters of multivariate regression equation and select the best model with KICC model. (3) Testing the model significance. (4) Determine the relationship between variables in the model, and (5) Interpreted multivariate regression models that obtained.

## 3. Findings and Discussion

### 3.1 Descriptive Statistics

Table 1 below is descriptive statistics for response variables. The response variable in this research is percentage of total regional income ( $Y_1$ ), economic growth ( $Y_2$ ), and level of regional progress ( $Y_3$ ).

**Table 1.** Descriptive statistics for response variables

Variable	Average	Minimum	Maximum
$Y_1$	4.1658	2.67	12.05
$Y_2$	7.6858	5.23	10.16
$Y_3$	7.1791	5.10	8.81

While in Table 2 is descriptive statistics for predictor variables. The predictor variable comprises the regional revenue of the tax sector ( $X_1$ ), retribution ( $X_2$ ), acceptance of natural resources ( $X_3$ ), investment ( $X_4$ ), balance funds ( $X_5$ ) and development fund ( $X_6$ ).

**Table2.** Descriptive statistics for predictor variables

Variable	Average	Minimum	Maximum
X <sub>1</sub>	4.1670	0.35	60.43
X <sub>2</sub>	4.1654	0.72	18.61
X <sub>3</sub>	4.1666	0.48	47.23
X <sub>4</sub>	4.1658	0.88	10.44
X <sub>5</sub>	4.1658	2.87	7.72
X <sub>6</sub>	4.1658	0.55	10.50

**3.2 Formation of Mutivariate Regression Model**

a. Freedom test between response variables

The test used to determine the freedom between response variables is *Bartlett Sphericity* test, with hypothesis, H<sub>0</sub>: Interresponse variables are *independent* and H<sub>1</sub>: Interresponse variables are *dependent*. Statistics test (Rencher, 2002),

$$\begin{aligned} \chi^2_{hitung} &= -\left(n - 1 - \frac{2q + 5}{6}\right) \ln |R| \\ &= -\left(24 - 1 - \frac{(2)(3) + 5}{6}\right) \ln \begin{vmatrix} 1 & 0.110 & 0.142 \\ 0.110 & 1 & 0.325 \\ 0.142 & 0.325 & 1 \end{vmatrix} \\ &= -\left(23 - \frac{11}{6}\right) \ln(0.872) \\ &= -(21,1667)(-0.1370) \\ &= 2.8998 \end{aligned}$$

$$\chi^2_{tabel} = \chi^2_{0.05, \frac{1}{2}3(3-1)} = \chi^2_{0.05, 3} = 7.815$$

Based on the results obtained from Bartlett Sphericity test, it can be seen that  $\chi^2_{hitung} < \chi^2_{tabel}$  (2.8998 < 7.815) then fail to reject H<sub>0</sub> so inter response variable is independent or free.

b. Testing the multivariate normal distribution of response variables

The examination of normal multivariate distribution can be done by making *q-q plot* from value  $d_i^2$ . If the results *q-q plot* value  $d_i^2$  for response variables show the more 50% which has value  $d_i^2 < \chi^2_{3;0,5}$  then the decision is to fail to reject H<sub>0</sub>. Value  $d_i^2$  and *q-q plot* obtained from testing using SPSS software. With hypothesis H<sub>0</sub>: Normally distributed multivariate data and H<sub>1</sub>: Data is not multivariate normal distribution. Statistics test:

$$\chi^2_{tabel} = \chi^2_{3, \frac{1}{2}} = 2.366$$

Table 3 obtained conditions where  $d_i^2 < \chi^2_{tabel} = 2.366$  to 19 observations or 79.1667% from 24 observations. So, failed to refuse H<sub>0</sub> meaning that the data is normally multivariate distribution.

**Table3.** Statistics test  $d_i^2$  respons variable

$i$	$d_i^2$	$i$	$d_i^2$
1	3.5158	13	1.7700
2	3.6447	14	0.6655
3	0.4910	15	1.2775
4	0.5451	16	2.2541
5	2.2021	17	0.7825
6	0.4245	18	0.8638
7	0.7060	19	0.7691
8	9.2646	20	1.0506

9	4.1992	21	0.3948
10	1.1942	22	0.2020
11	1.8684	23	2.0448
12	4.9080	24	0.9620

c. Estimasi of Multivariate Regression Parameters

Regression multivariate model of the equation  $\mathbf{Y}_{(n \times q)} = \mathbf{X}_{n \times (p+1)} \boldsymbol{\beta}_{(p+1) \times q} + \boldsymbol{\varepsilon}_{(n \times q)}$ ,  $\boldsymbol{\beta}$  is a matrix of regression parameters with size  $(p+1) \times q$ , estimation  $\hat{\boldsymbol{\beta}} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{Y}$ . Before making parameter estimation  $\hat{\boldsymbol{\beta}}$ , first for matrix  $\mathbf{Y}_{(n \times q)}$  and  $\mathbf{X}_{n \times (p+1)}$ , where  $n$  is sum observation,  $q$  is sum response variable and  $p$  is sum predictor variable (Rencher, 2002).

Notice following steps:

Step 1:  $\mathbf{X}^T \mathbf{X}$

$$\mathbf{X}^T \mathbf{X} = \begin{bmatrix} 0.0240 & 0.1000 & 0.1000 & 0.1000 & 0.1000 & 0.1004 & 0.1000 \\ 0.1000 & 3.7800 & 1.2981 & 0.4154 & 0.8245 & 0.6382 & 0.7811 \\ 0.1000 & 1.2981 & 0.7832 & 0.2591 & 0.5072 & 0.4818 & 0.4782 \\ 0.1000 & 0.4154 & 0.2591 & 2.6141 & 0.7029 & 0.4206 & 0.4471 \\ 0.1000 & 0.8245 & 0.5072 & 0.7029 & 0.5676 & 0.4405 & 0.4775 \\ 0.1004 & 0.6382 & 0.4818 & 0.4206 & 0.4405 & 0.4476 & 0.4531 \\ 0.1000 & 0.7811 & 0.4782 & 0.4471 & 0.4775 & 0.4531 & 0.5642 \end{bmatrix}$$

Step 2:  $(\mathbf{X}^T \mathbf{X})^{-1} = \frac{1}{|\mathbf{X}^T \mathbf{X}|} \text{adj}(\mathbf{X}^T \mathbf{X})$

$$(\mathbf{X}^T \mathbf{X})^{-1} = \begin{bmatrix} 1.5803 & 0.0305 & -0.0069 & 0.0075 & -0.0743 & -0.3311 & 0.0064 \\ 0.0305 & 0.0014 & -0.0021 & 0.0001 & -0.0018 & -0.0039 & -0.0010 \\ -0.0069 & -0.0021 & 0.0095 & 0.0009 & -0.0021 & -0.0084 & 0.0039 \\ 0.0075 & 0.0001 & 0.0009 & 0.0008 & -0.0024 & -0.0019 & 0.0006 \\ -0.0743 & -0.0018 & -0.0021 & -0.0024 & 0.0172 & 0.0105 & -0.0037 \\ -0.3311 & -0.0039 & -0.0084 & -0.0019 & 0.0105 & 0.0962 & -0.0135 \\ 0.0064 & -0.0010 & 0.0039 & 0.0006 & -0.0037 & -0.1035 & 0.0122 \end{bmatrix}$$

Step 3:  $\mathbf{X}^T \mathbf{Y}$

$$\mathbf{X}^T \mathbf{Y} = \begin{bmatrix} 99.9800 & 184.4600 & 172.3000 \\ 899.0663 & 756.7849 & 739.9180 \\ 546.5783 & 749.9099 & 730.7842 \\ 428.4535 & 835.2430 & 702.1846 \\ 470.0491 & 786.6521 & 730.4221 \\ 463.2000 & 778.7747 & 725.3372 \\ 479.4485 & 791.7367 & 730.7519 \end{bmatrix}$$

Step 4:  $(\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{Y}$

$$(\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{Y} = \begin{bmatrix} -0.3344 & 4.4695 & 5.3478 \\ 0.0835 & -0.0549 & -0.0510 \\ -0.0146 & -0.0948 & 0.0518 \\ 0.0063 & -0.0050 & -0.0288 \\ -0.0211 & 0.2028 & 0.1853 \\ 1.0305 & 0.6160 & 0.2091 \\ -0.0089 & 0.1053 & 0.0725 \end{bmatrix} = [\hat{\boldsymbol{\beta}}_1 : \hat{\boldsymbol{\beta}}_2 : \hat{\boldsymbol{\beta}}_3]$$

After completing the estimation we will get the following results:

$$\hat{\mathbf{Y}} = \mathbf{X} \hat{\boldsymbol{\beta}}$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix} = \begin{bmatrix} 1 \\ X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \end{bmatrix} \begin{bmatrix} \hat{\beta}_{01} & \hat{\beta}_{11} & \hat{\beta}_{21} & \hat{\beta}_{31} & \hat{\beta}_{41} & \hat{\beta}_{51} & \hat{\beta}_{61} \\ \hat{\beta}_{02} & \hat{\beta}_{12} & \hat{\beta}_{22} & \hat{\beta}_{32} & \hat{\beta}_{42} & \hat{\beta}_{52} & \hat{\beta}_{62} \\ \hat{\beta}_{03} & \hat{\beta}_{13} & \hat{\beta}_{23} & \hat{\beta}_{33} & \hat{\beta}_{43} & \hat{\beta}_{53} & \hat{\beta}_{63} \end{bmatrix}$$

Based on the above form we get the multivariate regression model as follows:

$$\hat{Y}_1 = -0.3344 + 0.0835X_{i1} - 0.0146X_{i2} + 0.0063X_{i3} - 0.0211X_{i4} + 1.0305X_{i5} - 0.0089X_{i6}$$

$$\hat{Y}_2 = 4.4695 - 0.0549X_{i1} - 0.0948X_{i2} - 0.0050X_{i3} + 0.2028X_{i4} + 0.6160X_{i5} + 0.1053X_{i6}$$

$$\hat{Y}_3 = 5.3478 - 0.0510X_{i1} + 0.0518X_{i2} - 0.0288X_{i3} + 0.1853X_{i4} + 0.2091X_{i5} + 0.0725X_{i6}$$

where  $i = 1, 2, \dots, 24$ .

- d. Selection the best model with KICC method

The KICC value obtained from the equation  $KICC = n(\ln|\hat{\Sigma}| + q) + \frac{d(3n-p-q-1)}{n-p-q-1}$  (Sarah, 2015)

**Table 4.** The KICC value of predictor variable

No	Predictor	KICC	No	Predictor	KICC
1	X <sub>1</sub>	121.5497	31	X <sub>2</sub> X <sub>6</sub>	108.5705
2	X <sub>2</sub>	137.1329	32	X <sub>3</sub> X <sub>4</sub>	91.4489
3	X <sub>3</sub>	119.4041	33	X <sub>3</sub> X <sub>5</sub>	105.9137
4	X <sub>4</sub>	150.3305	34	X <sub>3</sub> X <sub>6</sub>	90.8441
5	X <sub>5</sub>	164.7953	35	X <sub>4</sub> X <sub>5</sub>	136.8401
6	X <sub>6</sub>	149.7257	36	X <sub>4</sub> X <sub>6</sub>	121.7705
7	X <sub>1</sub> X <sub>2</sub>	80.3945	37	X <sub>5</sub> X <sub>6</sub>	136.2353
8	X <sub>1</sub> X <sub>3</sub>	62.6681	38	X <sub>1</sub> X <sub>2</sub> X <sub>3</sub>	21.5129
⋮	⋮	⋮	59	⋮	⋮
26	X <sub>1</sub> X <sub>5</sub>	108.0593	60	⋮	⋮
27	X <sub>1</sub> X <sub>6</sub>	92.9897	61	X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> X <sub>5</sub> X <sub>6</sub>	-20.5373
28	X <sub>2</sub> X <sub>3</sub>	78.2489	62	X <sub>1</sub> X <sub>2</sub> X <sub>4</sub> X <sub>5</sub> X <sub>6</sub>	10.3889
29	X <sub>2</sub> X <sub>4</sub>	106.4061	63	X <sub>1</sub> X <sub>3</sub> X <sub>4</sub> X <sub>5</sub> X <sub>6</sub>	-7.3375
30	X <sub>2</sub> X <sub>5</sub>	123.6401		X <sub>2</sub> X <sub>3</sub> X <sub>4</sub> X <sub>5</sub> X <sub>6</sub>	8.2433
				X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> X <sub>4</sub> X <sub>5</sub> X <sub>6</sub>	-48.4927

Based on Table 4 we selected the 63 value as the best model because it has the smallest KICC value of -48.4927 for all predictor variables available.

### 3.3 Testing Multivariate Regression Model

In the multivariate regression analysis there are parameter tests and assumption of residual assumptions to be performed.

- a. Testing of significance model simultaneously

Testing of model simultaneously was performed to determine whether the overall parameters were significant in the model, using the *Wilk's Lambda test*. With Hypothesis H<sub>0</sub>:  $\hat{\beta}_{11} = \hat{\beta}_{12} = \hat{\beta}_{13} = \dots = \hat{\beta}_{63} = 0$  (model is not significant) and H<sub>1</sub>: at least one  $\hat{\beta}_{pq} \neq 0$  (model is significant), where  $p = 1, 2, 3, 4, 5, 6$  and  $q = 1, 2, 3$ . Statistics test (Rencher, 2002),

$$\Lambda_{hitung} = \frac{|E|}{|E + H|} = \frac{|Y^T Y - \tilde{\beta}^T X^T Y|}{|Y^T Y - n\bar{y}\bar{y}^T|}$$

$$= \frac{\begin{vmatrix} 0.7211 & -0.3339 & 0.2336 \\ -0.3399 & 21.3964 & 4.2759 \\ 0.2336 & 4.2759 & 16.0659 \\ -1.5079 & 0.6616 & 0.5830 \\ 0.6616 & 0.6250 & 1.1172 \\ 0.5830 & 1.1172 & 0.7708 \end{vmatrix}}{0.0271}$$

Obtained value  $\Lambda_{hitung}$  is 0.0271, then compared with the table value *Wilk's Lambda*  $\Lambda_{0.05, 3, 6, 17}$  is 0.229. Because value  $\Lambda_{hitung} < \Lambda_{0.05, 3, 6, 17}$  (0.0271 < 0.229), then H<sub>0</sub> refused so that predictor variable significantly influence the response variable.

- b. Testing of significance model partially

Testing of model partially aims to see the significant influence of each predictor variable on partially response variables. Hypothesis H<sub>0</sub>:  $\hat{\beta}_{pq} = 0$  (regression parameter p variable predictor to the q variable response has not significant effect) and H<sub>1</sub>:  $\hat{\beta}_{pq} \neq 0$  (regression

parameter  $p$  variable predictor to the  $q$  variable response has significant effect) where  $p = 1,2,3,4,5,6$  and  $q = 1,2,3$ . Decision test when meet  $Pvalue < \alpha$ , where  $\alpha$  value used is **0.05**, then the decision is  $H_0$  refuse. After performing partial model test using SPSS software, the following results:

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.421	.475		38.754	.000
	x1	.146	.038	.636	3.866	.001

a. Dependent Variable: Y

**Figure 1.** Coefficient of respnt variable Y with predictor variable  $X_1$

Based on Figure 1 obtained  $P$  value value for predictor variabel  $X_1$  is **0.001**. Because  $value < \alpha$  (**0.001 < 0.05**), then  $H_0$  is rejected so regression parameter  $p$  predictor to  $q$  respon significantly influence predictor variable  $X_1$  to respnt variable  $Y_1, Y_2$  and  $Y_3$  partially.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	17.614	.741		23.766	.000
	x2	.340	.130	.488	2.622	.016

a. Dependent Variable: Y

**Figure 2.** Coefficient of respnt variable Y with predictor variable  $X_2$

Figure 2 obtained  $P$  value value for predictor variabel  $X_2$  is **0.016**. Because  $value < \alpha$  (**0.016 < 0.05**), then  $H_0$  is rejected so regression parameter  $p$  predictor to  $q$  respon significantly influence predictor variable  $X_2$  to respnt variable  $Y_1, Y_2$  and  $Y_3$  partially.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.912	.631		29.993	.000
	x3	.029	.060	.100	.473	.641

a. Dependent Variable: Y

**Figure 3.** Coefficient of respnt variable Y with predictor variable  $X_3$

Figure 3 obtained  $P$  value value for predictor variabel  $X_3$  is **0.641**. Because  $value > \alpha$  (**0.641 > 0.05**), then  $H_0$  is rejected so regression parameter  $p$  predictor to  $q$  respon notsignificantly influence predictor variable  $X_3$  to respnt variable  $Y_1, Y_2$  and  $Y_3$  partially.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.703	.966		17.294	.000
	x4	.559	.199	.514	2.814	.010

a. Dependent Variable: Y

**Figure 4.** Coefficient of respnt variable Y with predictor variable  $X_4$

Based on Figure 4 obtained  $P$  value value for predictor variabel  $X_4$  is **0.010**. Because  $value < \alpha$  (**0.010 < 0.05**), then  $H_0$  is rejected so regression parameter  $p$  predictor to  $q$  respon significantly influence predictor variable  $X_4$  to respnt variable  $Y_1, Y_2$  and  $Y_3$  partially.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.452	1.355		7.713	.000
	x5	2.059	.315	.813	6.538	.000

a. Dependent Variable: Y

**Figure 5.** Coefficient of respont variable Y with predictor variable X<sub>5</sub>

Figure 5 obtained *P value* for predictor variabel X<sub>5</sub> is **0.000**. Because *value* <  $\alpha$  (**0.000 < 0.05**), then H<sub>0</sub> is rejected so regression parameter *p* predictor to *q* respont significantly influence predictor variable X<sub>5</sub> to respont variable Y<sub>1</sub>, Y<sub>2</sub> and Y<sub>3</sub> partially.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.231	.899		18.065	.000
	x6	.672	.185	.612	3.626	.001

a. Dependent Variable: Y

**Figure 6.** Coefficient of Y respont variable with X<sub>6</sub> predictor variable

Figure 6 obtained *P value* for predictor variabel X<sub>6</sub> is **0.016**. Because *value* <  $\alpha$  (**0.016 < 0.05**), then H<sub>0</sub> is rejected so regression parameter *p* predictor to *q* respont significantly influence predictor variable X<sub>6</sub> to respont variable Y<sub>1</sub>, Y<sub>2</sub> and Y<sub>3</sub> partially.

c. Testing of residual asumption identical

Testing of residual asumption identical used *Box's M* test with criteria test  $u < \chi^2_{tabel} = \chi^2_{\alpha, \frac{1}{2}(k-1)p(p+1)}$ . Hypothesis H<sub>0</sub>:  $\Sigma_1 = \Sigma_2 = \Sigma_3 = \Sigma$  (varian-covarian matrix residual homogen) and H<sub>1</sub>: at least one  $\Sigma_i \neq \Sigma_j$  for  $i \neq j$  (varian-covarian matrix residual heterogen).

Statistics test (Rencher, 2002):

$$u = -2(1 - c_1) \ln M$$

$$= -2(1 + 0.0036)(-28.3975)$$

$$= 56.9995$$

$$\chi^2_{tabel} = \chi^2_{0.05, \frac{1}{2}(3-1)6(6+1)} = \chi^2_{tabel} = \chi^2_{0.05, 42} = 58.259$$

Because of  $u < \chi^2_{tabel}$ , than failed to refuse H<sub>0</sub> that means the variant-covariant matrix residual is homogeneous and can be inferred residual identical

d. Testing of residual asumption independent

For testing of residual asumption independent used *Barlett Sphericity* test. With hypothesis H<sub>0</sub>: Residual data is independent and H<sub>1</sub>: Residual data is dependent.

Statistics test (Rencher, 2002):

$$\chi^2_{count} = -\left(n - 1 - \frac{2q + 5}{6}\right) \ln |R|$$

$$= -\left(24 - 1 - \frac{(2)(3) + 5}{6}\right) \ln \begin{vmatrix} 1 & -0.085 & 0.069 \\ -0.085 & 1 & 0.231 \\ 0.069 & 0.231 & 1 \end{vmatrix}$$

$$= -\left(23 - \frac{11}{6}\right) \ln(0.932)$$

$$= -(21,1667)(-0.0704)$$

$$= 1.4901$$

$$\chi^2_{tabel} = \chi^2_{0.05, 3} = 7.815$$

Based on *Bartlett Sphericity* test, obtained  $\chi_{hitung}^2 < \chi_{tabel}^2$  ( $1.4901 < 7.815$ ) than failed to refuse  $H_0$  so residual data is independent.

e. Testing of residual assumption multivariate normal distribution

Testing of residual assumption multivariate normal distribution was performed by the same procedure with testing response variable multivariate normal distribution. With hypothesis  $H_0$ : Residual multivariate normal distribution and  $H_1$ : Residual not multivariate normal distribution.

Statistik test (Riskiyanti, 2011):

$$\chi_{tabel}^2 = \chi_{3, \frac{1}{2}}^2 = 2.366$$

**Table 5.** Statistics test for  $d_i^2$  residual

$i$	$d_i^2$	$i$	$d_i^2$
1	3.0717	13	0.6438
2	2.5465	14	0.4860
3	2.0679	15	1.2015
4	1.1891	16	3.2668
5	2.0264	17	1.0731
6	0.1632	18	0.2443
7	1.6052	19	0.0922
8	7.0922	20	1.2227
9	3.2185	21	1.4570
10	1.6572	22	0.0085
11	1.1268	23	0.7837
12	9.4898	24	0.2658

Based on Table 5 obtained  $d_i^2 < \chi_{tabel}^2 = 2.366$  to 18 observation or 75% from 24 observation. So can be concluded that residual multivariate normal distribution.

### 3.4 Relations Between Variable in Model

Multivariate regression, the measure used in determining the relationship between the response variable and the predictor is *Eta Square Lambda* as follows (Mardiantor, 2013):

$$\begin{aligned} \eta_{\Lambda}^2 &= 1 - \Lambda_{count} \\ &= 1 - 0.0271 \\ &= 0.9729 \\ &= 97.29\% \end{aligned}$$

Value  $\eta_{\Lambda}^2 = 0.9729$  has the meaning that predictor variables are able to explain accuracy of data is 97.29% on response variable, while 2.71% explained by other predictor variables that has not been studied, so that all the variables contained in the model are sufficiently influential to measure the society welfare of districts and cities in South Sulawesi.

### 4. Conclusion

1. Testing of multivariate regression model simultaneously that predictor variable (X) significant effect to response variable (Y). And testing of model partially, only predictor variable ( $X_3$ ) has not significant effect to response variable (Y). While, predictor variable ( $X_1, X_2, X_4, X_5$  and  $X_6$ ) the all significant effect to response variable (Y). Therefore, variable  $X_3$  is regional income from the natural resource (SDA) results need added again in improving public's welfare.
2. The level of accuracy of information data predictor variable to response variable in the multivariate regression is  $\eta_{\Lambda}^2 = 0.9729$  or 97,29%. While, the rest 2.71% explained by other predictor variables that have not been studied.

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