Forecasting Medicine Purchase Budget using Multiple Linear Regression Method: Case Study - For Ende Regency Health Office

Marianus Angelo Dasi Muda[1], Achmad Affandi[1] and Yoyon Kusnendar Suprapto[1]
[1]*Department of Electrical Engineering Institut Teknologi Sepuluh Nopember*

Keywords: planning, budgeting, forecasting, medicine, multiple linear regression, public health center, R square, Adjusted R Square, MAD, MSE, MAPE.

Abstract: In planning and budgeting for medicine purchases for the Ende regency health office, the pattern used is the pattern of medicine consumption and epidemiological patterns, which are supported by the existing budget and based on the medicine needs plan. This research focuses on forecasting the medicine budget based on the real use of medicines in 24 Ende regency public health centers. The use of multiple linear regression methods has a significant impact because there are other variables that also influence the budget. The 24 public health centers are divided into 3 categories namely for public health center city category, the results of the correlation R, R square and Adjusted R Square are 0.941, 0.886 and 0.871, MAD is 2560360, MSE is 10157921086788, MAPE is 5.73%, public health center outside the city and mountainous regions category, the results of the correlation R, R square and Adjusted R Square values are 0.793, 0.630 and 0.582, MAD is 5756562, MSE is 54447250606455, MAPE is 6.84% and public health center outside the city and coastal areas categories, the results of the correlation R, R square and Adjusted R Square values are 0.873, 0.762 and 0.731, MAD is 5315655, MSE is 61576610175327, MAPE is 9.16%.

1 INTRODUCTION

The existence of health facilities is one of the determinants of the health status of a country. Health care facilities are one of the tools and / or places that are used to carry out health service efforts either promotive, preventive, curative or rehabilitation carried out by the central government, regional government and / or the community. The Public health center is a health service facility that organizes the first level of Public Health and Health Efforts, prioritizing promotive and preventive efforts to achieve the highest degree of public health in its working area in order to support the realization of healthy districts. One of the main programs at the Public health center is a treatment or curative program. In fulfilling the health status of the people served by the public health center, medicines are one of the irreplaceable components. Access to medicines, especially essential medicines, is one of the human rights. The availability of medicines in the health services unit greatly affects the quality of health services. Therefore it is necessary to have good medicine management that aims to ensure the continuity and affordability of medicine services that are efficient, effective and rational. The process of medicine management consists of several stages, namely the planning stage, the procurement phase, the distribution phase and the use phase

Discussion of existing papers that are the references of scientific writing : Analysis of medicine needs in the Medicine Requirement Plan based on the Use Report and Medicine Request Sheet , budget. The result can reduce the average medicine supply to 93%(Rumbay, 2015) as well as representative and accountable studies (Anumerta and Mahendrawati, 2013).

The method for estimating the medicine needs is the consumption method and epidemiological method, based on the data sheet for the procurement of medicines (Safriantini et al., 2011) and uses SDLC systems development method (System Development Live Cycle)(Rahmawatie and Santosa, 2015). This study uses independent variables of research, namely doctors, pharmacists and patients. The value sought is the availability of medicines. By using linear regression. R2 and F Test results are 0.971 and 293,447(Prabowo and Satibi, 2016). A combination of artificial neural networks and multivariable linear regression analysis can show reasonable predictive accuracy for accurate electricity consumption

Muda, M., Affandi, A. and Suprapto, Y.
Forecasting Medicine Purchase Budget using Multiple Linear Regression Method: Case Study - For Ende Regency Health Office.
DOI: 10.5220/0009880501860192
In *Proceedings of the 2nd International Conference on Applied Science, Engineering and Social Sciences (ICASESS 2019)*, pages 186-192
ISBN: 978-989-758-452-7

and minimum costs for electricity generation in Indonesia(Jaisumroum and Teeravaraprug, 2017).This paper writes about utilizing a multi-variable linear regression analysis method to evaluate the level of use of IoT based on evaluating the quality of IoT experiences with 90% accuracy(Li et al., 2015). This paper describes the use of a multi-variable regression liner method to analyze the use of electric loads for 24 hours (a day) in the dry and rainy season in South Sulawesi, this analysis reaches the MAPE analysis, with the MAPE in the dry season which is 3, 52%, the MAPE in the rainy season is 4.34% by displaying each curve.(Amral et al., 2007). This paper explains the important points in estimating gold prices with multiple linear regression methods, This research was continued by obtaining a predictive value with RMSE of 53,583, using a confidence level of 95% or α = 0,05(Sekar et al., 2017). This paper describes the use of a multiple linear regression method to build a QSAR linear peptide model with leave-one-out crossing validation. The result of the discussion is the multiple correlation coefficient (R2) which is 0.991 and RMSE value for the estimated error is 0.062(Yin, 2011).

Therefore, in this paper discusses medicine budget forecasting using multiple linear regression methods with new features namely prescription, type medicine, total medicine, population density with a high accuracy of 95% or 5% error, which are divided into three categories of public health center in Ende regency : 1. City public health center category, 2. Public health centers outside the city and mountainous regions category, and 3. Public health centers outside the city and coastal areas categories. This research uses data mining for 24 public health center, 54 auxiliary public health center (pustu), 73 village health posts (poskesdes) and 75 village delivery posts (polindes). The prescription describes patients who get health services in the form of medicines from pharmacies, the type of medicine describes the average medicine used in the three categories of health centers. Total medicine usage describes the overall medicine used and population density is obtained from the average total population divided by the area in the three categories. The number of residents is related to the budget for medicine per person and the area in relation to the range of services available. By getting a correlation between the four independent variables and other statistical tests, it can be determined the predicted value of medicine purchases for the ende regency health office.

2 FUNDAMENTAL THEORY

Ende Regency has 21 districts and 24 public health centers, of which those 24 Public health centers are divided into three (3) categories, namely the city category, outside the city and mountainous regions and outside the city and coastal areas :

City public health center category : It is located in the regency capital area with a high average population and population density, heterogeneous in all aspects (education, economic, religious level), with coverage to adequate health facilities. They are ende city, kotaratu, onekore, rewarangga and rukunlima. Public health centers outside the city and mountainous regions category : It is located in areas outside the city and on mountains with a population which is not too much and the reach to health facilities is very limited, public health centers are near the market, the average height is 500 -1500 meters above sea level and temperature on average is 10 °C - 20 °C. They are located in detusoko, kelimutu, kotabaru, ndetundora, peibenga, riaraja, roga, saga, watuneso, watunggere, welamosa, wolojita and wolowaru. Public health centers outside the city and coastal areas categories: It is in areas outside the city and coastal areas and lowlands with a population that is not too much and the reach to health facilities is very limited, public health centers are near the market, the average height is 0 - 500 meters above sea level and the average temperature is 22 °C - 30 °C. Those are included in this category are ahmad yani, maubasa, maukaro, maurole, nangapanda and ngalupolo.

Based on the initial data mining used for dependent variables and independent variables namely : Y value : public health center medicine budget : a total of medicine data based on medicine use and medicine prices, X1: prescription: the total prescription data originating from the concerned pharmacy clinic, X2: total average type of medicine used, X3: total cumulative value of medicine use, X4: population density data,

The initial data mining for the category of city public health center in the city category can be seen in Figure 1.

No	The budget (Y)	Prescription (X1)	Type medicine (X2)	Total medicine (X3)	Population density (X4)
1	48219060	7555	81	269134	2635.28
2	40529814	7427	81	252128	2647.33
3	48279843	7569	83	280303	2660.08
4	55050795	8093	81	240920	2673.57
5	45061654	7820	85	247864	2687.84
6	-	-	-	-	-
32	71321115	9524	70	259451	2605.94
33	64433170	8720	71	218594	2600.04
34	49523075	7854	65	201929	2594.22
35	61184250	8877	68	208327	2588.47
36	50205824	8283	68	190435	2577.2

Figure 1: City area data correlation variables.

3 METHODOLOGY

The discussion in chapter 3 is divided into two (2) important parts, namely the flow of research and the formulation of multiple linear regression.

3.1 Flow of Research

This study was divided into several stages, namely data retrieval, preprocessing, weighting, classification, evaluation and representation in the form of real data on medicine use, prescriptions, types of medicines, medicine prices per usage, and population density, which formed the variables used in multiple linear regression. The research methodological flow chart can be seen in Figure 2.

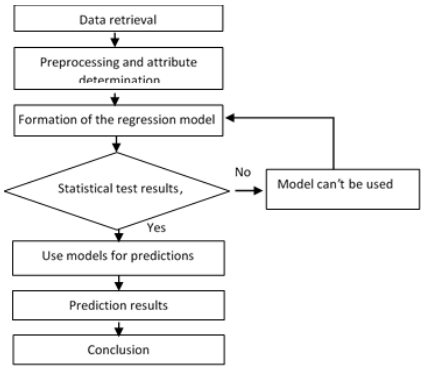

Figure 2: Research flow.

- Data retrieval stage. Retrieving raw data for medicines and prescriptions on 24 Public health centers in the Ende regency.
- Preprocessing and attribute determination stage..
- Formation of the regression model stage.
- Statistical test results and analysis stage. Stages are carried out in accordance with statistical rules with a confidence level of 95% or $\alpha = 0.05$ correlation test, T test, F test, correlation coefficient test, multi collinearity test (VIF), autocorrelation test (Durbin-Watson test), make the best equation for multiple linear regression.
- Use models for predictions. Perform R test, R Square, Adjusted R Square, MAPE

3.2 Multiple Linear Regression

Multiple linear regression is a regression analysis that explains the relationship between dependent variables and factors that affect more than one independent variable (free). The purpose of multiple linear regression analysis is to measure the intensity of the relationship between two or more variables, contain predictions of the value of Y based on the value of X.

Stages in multiple linear regression :

a The form of the regression equation, can be seen in equations (1) to look for projection or predictive values according to the coefficients that refer to equations (2).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon \quad (1)$$

matrix form y = x β

$$Y^{-} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n \quad (2)$$

b Correlation coefficient
Correlation is a term used to measure the strength of relationships between variables, the equation can be seen in equation (3)

$$R = \sqrt{\frac{\beta 1 \Sigma x 1y + \beta 2 \Sigma x 2y}{\Sigma y 2}} \quad (3)$$

c Coefficient of Determination
Multiple regression testing which includes more than two variables to find out the proportion of total diversity in the independent variable Y can be explained by dependents (X) which are in multiple regression equation models together and can be seen in the equation (4).

$$R^2 = \frac{\beta 1 \Sigma x 1y + \beta 2 \Sigma x 2y}{\Sigma y 2} \quad (4)$$

d Partially and Multiple Regression Test
The t test is used to partially test each variable. The t test refers to equation (5)

$$T = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad (5)$$

The f test multiple regression needs to be done to find out whether a group of independent variables simultaneously have an influence on dependent variables. f statistics is used and can be seen in equation (6).

$$F = \frac{r^2(n-m-1)}{m(1-r^2)} \quad (6)$$

e Multycollenirity and autocorrelation test.
Multicollinearity test and autocorrelation test can be seen in the equation (7) and (8).

$$VIF = \frac{1}{1-R_i^2} \quad (7)$$

$$D = \frac{\Sigma_{t=2}^{n}(e_t - e_{(t-1)})^2}{\Sigma_{t=1}^{n} et^2} \quad (8)$$

f Performance criteria
Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Absolute Percentage Error (MAPE), in comparing the optimal performance of a prediction can be calculated based on equation (9), (10),(11),

$$MAD = \frac{\Sigma_{k=1}^{n}(yr-yf)^2}{n} \quad (9)$$

$$MSE = \frac{1}{n}\Sigma_{k=1}^{n}(yr-yf)^2 \quad (10)$$

$$MAPE = 100x\frac{\Sigma_{k=1}^{n}|\frac{yr-yf}{yr}|}{n} \quad (11)$$

Where : y,y1,y2,yn are dependent variables. β_0 , β_1, β_n, β_m are the intercept parameter and the independent variable regression coefficient. X1 , X2, Xn are dependent variables.
ε is an error variable. Y^-, $Y1^-$, $Y2^-$, Yn^- are the predicted value of the dependent variables sought. n, k are amount of data, m is number of variables, yr is experiment value, yf is predictive value.

4 RESULT AND DISCUSSION

By using the forecasting method using multiple linear regression, OLS (Ordinary Least Square) enter with the Simple Seasonal, Winters' Additive, Arima the model that meets the statistical requirements is obtained.:

4.1 Public Health Center City Category

- Value R, R Square, adjusted R Square, Durbin Watson. Correlation (R) simultaneously (together) between prescription variables (X1), medicine types (X2), medicine use (X3) and population density (X4) on medicine budget (Y) of 0.941 and correlation coefficient (R square) amounting to 88.6 % and free autocorrelation test because the value of Dubin Watson 2.040 meets the existing conditions, where D > dl and 4-D > du, dl = 1.2953. du = 1.65387, then 2,040 > 1.2953 and 1.96 > 1.65387, can be seen in the Figure 3.

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.941[a]	.886	.871	3434573.548	2.040
a. Predictors: , population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget				

Figure 3: Value of simultan correlation.

- The value of the regression constant, the standard error, the value of t > t table (2.04), the sig value < 0.05, fulfills some of the existing equations and the collinearity / VIP test is fulfilled because the VIF value is < 10, it can be seen in Figure 4.

Model	Coefficients B	t	Sig.	VIF
(Constant)	-62490876.102	-2.094	.045	
Prescriptions[a]	12199.096	11.625	.000	1.681
medicine types[a]	-223782.776	-2.533	.017	1.288
medicine use[a]	62.783	3.200	.003	1.397
population density[a]	6625.336	.668	.509	1.602
a. Predictors: population density, recipes, medicine use, medicine types b. Dependent Variable: Budget				

Figure 4: Value of partial correlation.

- Test the value of Value f is fulfilled because the value of f results > f table (60.159 > 2.67), the value of sig is fulfilled with a value of 0.000. There can be seen in Figure 5.

Model	Sum of Squares	F	Sig.
Regression	2838611171883511.	60.159	.000[b]
Residual	365685159121912.25		
Total	3204296331005423.0		
a. Predictors: population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget			

Figure 5: Value of performance criteria.

- The regression equation can be seen in equation (12), based on the value B in Figure 4.

$$Y = -62490876.102 + 12199.096.X1 - 223782.776.X2 + 62.783.X3 + 6625.336.X4 \quad (12)$$

- The results of values on forecasting meet the existing standard equations : MAD is 2560360, MSE is 10157921086788 and MAPE is 5.73%. They based on the calculation of the comparison formula of real values and predictive values. Ideal error value is a small error value or close to zero. The existing MAD, MSE and MAPE values indicate that the predictive value for the multiple linear regression equation are ideal, can be seen in the Figure 6.

No	Nilai real	Nilai prediksi Y	MAD |error|	MAPE
1	48219060	45903544.7	2315515.302	4.80%
2	40529814	43354208.01	2824394.011	6.97%
6	-	-	-	
35	61184250	60812147.84	372102.1611	0.61%
36	50205824	52367903.84	2162079.842	4.31%
			92172977.38	2.064125068
		MAD	2560360	MAPE
		MSE	10157921086788	5.73%

Figure 6: Model fit statistics.

- Graphs of observation (y value, budget) and fit values (predictive value) based on the value of MAPE 5.73 % for time series data can be seen in the Figure 7.

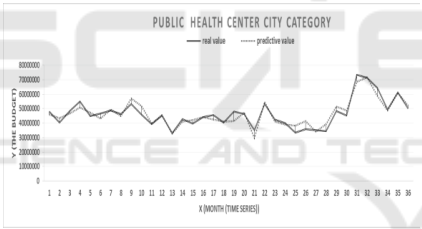

Figure 7: Graph of real data real and prediction data

4.2 Public Health Center Outside the City and Mountainous Regions Category

- Value R, R Square, adjusted R Square, Durbin Watson.
  Correlation (R) simultaneously (together) between prescription variables (X1), medicine types (X2), medicine use (X3) and population density (X4) on medicine budget (Y) of 0.793 and correlation coefficient (R square) amounting to 63% and free autocorrelation test because the value of Dubin Watson 1.136 meets the existing conditions where D > dl and 4-D > du, dl = 1.2953. du = 1.65387, then 1.136 < 1.2953 and 2.864 > 1.65387, can be seen in the Figure 8.

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.793[a]	.630	.582	7951670.593	1.136
a. Predictors: , population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget				

Figure 8: Value of simultan correlation.

- The value of the regression constant, the standard error, the value of t > t table (2.04), the sig value < 0.05, fulfills some of the existing equations and the collinearity / VIP test is fulfilled because the VIF value is < 10, it can be seen in Figure 9.

Model	Coefficients *B*	t	Sig.	VIF
(Constant)	375176606.262	1.907	.066	
Prescriptions[a]	7305.106	4.265	.000	1.198
medicine types[a]	235143.306	1.210	.235	1.650
medicine use[a]	120.541	3.262	.003	1.634
population density[a]	-3598451.153	-1.994	.055	1.651
a. Predictors: population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget				

Figure 9: Value of partial correlation.

- Test the value of Value f is fulfilled because the value of f results > f table (13.174 > 2.67), the value of sig is fulfilled with a value of 0.000. There can be seen in 10.

Model	Sum of Squares	F	Sig.
Regression	3331914110480461.0	13.174	.000[b]
Residual	1960101021832358.8		
Total	5292015132312820.0		
a. Predictors: population density, prescription, medicine use, medicine types b. Dependent Variable: Budget			

Figure 10: Value of performance criteria.

- The regression equation can be seen in equation (13), based on the value B in Figure 9.

$$Y = 375176606.262 + 7305.106.X1 + 235143.306.X2 + 120.541.X3 - 3598451.153.X4 \quad (13)$$

- The results of values on forecasting meet the existing standard equations : MAD is 5756562, MSE is 54447250606455 and MAPE is 6.84%. They based on the calculation of the comparison formula of real values and predictive values. Ideal error value is a small error value or close to zero.

The existing MAD, MSE and MAPE values indicate that the predictive value for the multiple linear regression equation are ideal, can be seen in the Figure 11.

No	Nilai real	Nilai prediksi Y	MAD |error|	MAPE
1	103940176	93980650.89	9959525.113	9.58%
2	107572946	91571616.23	16001329.77	14.87%
6	-	-	-	
35	81955727	78760497.88	3195229.123	3.90%
36	79632725	75201763.53	4430961.468	5.56%
			207236232.9	2.4619 01597
		MAD	5756562	MAPE
		MSE	5444725 0606455	6.84%

Figure 11: Model fit statistics.

- Graphs of observation (y value, budget) and fit values (calculation results /predictive value) based on the value of MAPE 6.84 % for time series data can be seen in the Figure 12.

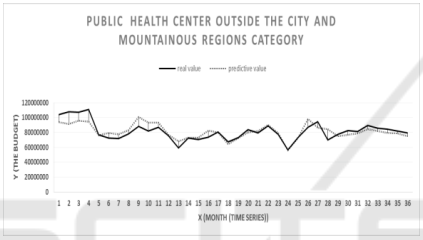

Figure 12: Graph of real data real and prediction data

4.3 Public Health Center Outside the City and Coastal Areas Categories

- Value R, R Square, adjusted R Square, Durbin Watson.
  Correlation (R) simultaneously (together) between prescription variables (X1), medicine types (X2), medicine use (X3) and population density (X4) on medicine budget (Y) of 0.873 and correlation coefficient (R square) amounting to 76.2 % and free autocorrelation test because the value of Dubin Watson 1.591 meets the existing conditions, where D > dl and 4-D > du, dl = 1.2953. du = 1.65387, then 1.591 > 1.2953 and 2.409 > 1.65387, can be seen in the Figure 13.

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.873[a]	.762	.731	8456259.309	1.591
a. Predictors:, population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget				

Figure 13: Value of simultan correlation.

- The value of the regression constant, the standard error, the value of t > t table (2.04), the sig value < 0.05, fulfills some of the existing equations and the collinearity / VIP test is fulfilled because the VIF value is< 10, can be seen in Figure 14.

Model	Coefficients B	T	Sig.	VIF
(Constant)	30930866.822	.374	.711	
Prescriptions[a]	7706.693	6.766	.000	1.189
medicine types[a]	-103285.543	-.794	.433	1.200
medicine use[a]	110.412	4.451	.000	1.270
population density[a]	-153373.230	-.441	.663	1.048
a. Predictors: population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget				

Figure 14: Value of partial correlation.

- Test the value of Value f is fulfilled because the value of f results > f table (24.823 > 2.67), the value of sig is fulfilled with a value of 0.000. There can be seen in Figure 15.

Model	Sum of Squares	F	Sig.
Regression	7100224620778033.0	24.823	.000[b]
Residual	2216757966311770.5		
Total	9316982587089804.0		
a. Predictors:, population density, prescriptions, medicine use, medicine types b. Dependent Variable: Budget			

Figure 15: Value of performance criteria.

- The regression equation can be seen in equation (14), based on the value B in Figure 14.

$$Y = 30930866.822 + 7706.693.X1 - 103285.543.X2 + 110.412.X3 - 153373.230.X4 \quad (14)$$

- The results of values on forecasting meet the existing standard equations : MAD is 5315655, MSE is 61576610175327 and MAPE is 9.16%. They based on the calculation of the comparison formula of real values and predictive values. Ideal error value is a small error value or close to zero. The existing MAD, MSE and MAPE values indicate that the predictive value for the multiple linear regression equation are ideal, can be seen in the Figure 16.

No	Nilai real	Nilai prediksi Y	MAD |error|	MAPE
1	50830899	53763555.59	2932656.588	5.77%
2	49159310	54613811.56	5454501.558	11.10%
6	-	-	-	
35	47159436	43116116.96	4043319.043	8.57%
36	47598659	41653257.54	5945401.465	12.49%
			191363578.5	3.2963 21777
		MAD	5315655	MAPE
		MSE	6157661 0175327	9.16%

Figure 16: Model fit statistics.

- Graphs of observation (y value, budget) and fit values (results / predictive value) based on the value of MAPE 9.16 % for time series

data can be seen in the Figure 17.

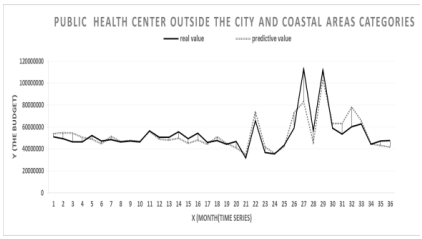

Figure 17: Graph of real data real and prediction data

4.4 Forecasting Results for the Public Health Center Category

- Example forecasting value of x1, x2, x3, x4 public health city center category can be seen in Table 14, with forecasting value for 5 months in 2020, based on the MAPE value in Figure 2, Figure 12, Figure 17, and on equation (12),(13) and (14).

Data (month)	$\bar{X}1$	$\bar{X}2$	$\bar{X}3$	$\bar{X}4$
Jan-20	7756	47	132981	2540.01
Feb-20	8093	53	135296	2539.99
Mar-20	7888	52	154604	2539.99
Apr-20	8234	50	144206	2539.98
May-20	8395	52	156980	2539.97

Figure 18: Forecasting values.

- Forecasting budget values for each category can be seen in Table 15 based on equation (12),(13) and (14).

Data (month)	Category I (a)	Category II (b)	Category III (c)
Jan-20	46784888	78839641	68261698
Feb-20	49698497	88062123	79821642
Mar-20	48633679	85247973	82282978
Apr-20	52649248	86693786	70182338
May-20	54967660	76188429	88279115

Figure 19: Budget forecasting values.

Where : a. Category I is forecasting of medicine use budget for public health city center category b. Category II is forecasting of medicine use budget for public health center outside the city and mountainous regions category c. Category III is forecasting of medicine use budget for public health center outside the city and coastal areas categories

5 CONCLUSIONS

Forecasting the medicine purchase budget with four variabel independent : X1: prescription, X2: total average type of medicine used, X3: total cumulative value of medicine use, X4: population density data for public health center city category, the results of the correlation R, R square and Adjusted R Square are 0.941, 0.886 and 0.871, MAD is 2560360, MSE is 10157921086788, MAPE is 5.73%, public health center outside the city and mountainous regions category, the results of the correlation R, R square and Adjusted R Square values are 0.793, 0.630 and 0.582, MAD is 5756562, MSE is 54447250606455, MAPE is 6.84% and public health center outside the city and coastal areas categories, the results of the correlation R, R square and Adjusted R Square values are 0.873, 0.762 and 0.731, MAD is 5315655, MSE is 61576610175327, MAPE is 9.16%.

REFERENCES

Amral, N., Ozveren, C., and King, D. (2007). Short term load forecasting using multiple linear regression. In *2007 42nd International universities power engineering conference*, pages 1192–1198. IEEE.

Anumerta, L. and Mahendrawati, E. (2013). Pengembangan sistem manajemen persediaan obat terintegrasi antar gudang farmasi kesehatan dan puskesmas di kabupaten sidoarjo. In *Jurnal Posiding Seminar Nasional Manajemen Teknologi*, volume 17.

Jaisumroum, N. and Teeravaraprug, J. (2017). Forecasting uncertainty of thailand's electricity consumption compare with using artificial neural network and multiple linear regression methods. In *2017 12th IEEE Conference on Industrial Electronics and Applications (ICIEA)*, pages 308–313. IEEE.

Li, L., Rong, M., and Zhang, G. (2015). An internet of things qoe evaluation method based on multiple linear regression analysis. In *2015 10th International Conference on Computer Science & Education (ICCSE)*, pages 925–928. IEEE.

Prabowo, P. and Satibi, P. G. (2016). Analysis of factors affecting the availability of medicines at the jkn era in rsud dr, soedono madiun. *Journal of Management and Pharmacy Practice*, 6(2):213–218.

Rahmawatie, E. and Santosa, S. (2015). Sistem informasi perencanaan pengadaan obat di dinas kesehatan kabupaten boyolali. *Pseudocode*, 2(1):45–52.

Rumbay, I. N. (2015). Analisis perencanaan obat di dinas kesehatan kabupaten minahasa. *Jikmu*, 5(5).

Safriantini, D., Ainy, A., Mutahar, R., et al. (2011). Analysis planning and procurement of drugs at public health center (phc) pembina palembang. *Jurnal Ilmu Kesehatan Masyarakat*, 2(1):30–38.

Sekar, K., Srinivasan, M., Ravidiandran, K., and Sethuraman, J. (2017). Gold price estimation using a multi variable model. In *2017 International Conference on Networks & Advances in Computational Technologies (NetACT)*, pages 364–369. IEEE.

Yin, J. (2011). Prediction of ace inhibitor tripeptides activity based on amino acid descriptors (e) from multiple linear regression model. In *2011 5th International Conference on Bioinformatics and Biomedical Engineering*.