SYSTEM PREDICTION PRODUCTION PT.VICO INDONESIA USING METHOD HOLT WINTERS

[1]RIYAN SUKMA SASONGKO,[2] EKO PRASETYO, [3]RANI PURBANINGTYAS

[123] Informatic Engineering, Faculty of Engineering,

Bhayangkara University Of Surabaya

Jl. Ahmad Yani 114, Surabaya, East Java, 60231

E-mail: riyanipang@gmail.com

ABSTRACT

Problem that Taken in this study is the process of forecasting oil and gas production in accordance so that companies can know the prediction of the amount of oil and gas in the future. The method used to determine production prediction is Holt-Winters forecasting method. In testing the system will do the comparison of alpha, beta and gamma. Using the alpha value = 0.2, beta = 0.1 and gamma 0.5 to get better multiplicative forecast for oil and gas data. And to get the smaller error difference compared to the smaller alpha (α), beta (β) and gamma (γ) then the smaller the difference will be. The Multiplexative Spring Method and the Seasonal Additive Method are good enough for oil and gas production data

Keywords : *Forecasting, Holt Winter's, Multiplicative Seasonal Method, Additive Seasonal Method*

1. INTRODUCTION

PT. VICO Indonesia is a company engaged in the field of oil and gas. PT. VICO Indonesia has operated in Sanga-Sanga Production Sharing Contract (PSC), located in Kutai Basin of East Kalimantan and covers an area of approximately 1,700 square kilometers, for more than 40 years. This has resulted in more than 12.6 TCF of gas and 0.4 billion barrels of liquid from production fields in Badak, Mutiara, Semberah, Nilam, Pamaguan, Lampake and Berau. In drilling not only oil and gas are drawn from the bowels of the earth but there is also water and condensate. Then there will be a filtering process that will separate water, condensate, oil and gas.

Forecasting is an activity to predict what will happen in the future. There are many types of forecasting. For example smoothing method, Jenkins Box method and trend projection method with regression. However, since the data is seasonal the most suitable method is the exponential smoothing method of Holt-Winters which sees in terms of seasonality in a data.

If this final project aims to implement Holt-Winters method to predict oil and gas production in PT. VICO Indonesia is based in Semberah, East Kalimantan using data from 2011, 2012, 2013, 2014 and 2015. With this implementation in order to provide an overview of production in PT.VICO Indonesia.

2. ANALYSIS AND DESIGN SYSTEM

To cope Increasing or decreasing the amount of oil and gas currently required a forecasting application that can help in improving the effectiveness of company performance. In building a forecasting application, it needs accurate data, validity, data adequacy and can describe time series. Therefore, it is necessary to perform several stages of analysis such as:

a. Collecting data oil and gas From 2011 to 2015.
b. Enter the data amount of oil and gas into the application system for forecasting.

The following is data on the amount of oil and gas at PT.VICO Indonesia in the samberah plant.

*Table 2.1 data Oil and gas PT. VICO Indonesia monthly.*

DATE	SEMBERAH PRODUCTION 2011		SEMBERAH PRODUCTION 2012		SEMBERAH PRODUCTION 2013		SEMBERAH PRODUCTION 2014		SEMBERAH PRODUCTION 2015	
	GAS PRODUCTION	CRUDE OIL	GAS PRODUCTION	CRUDE OIL	GAS PRODUCTION	CRUDE OIL	GAS PRODUCTION	CRUDE OIL	GAS PRODUCTION	CRUDE OIL
	MMSCF	BARREL	MMSCF	BARREL	MMSCF	BARREL	MMSCF	BARREL	MMSCF	BARREL
januari	899.585	53479	838.141	37527	1848.109	36534	2463.508	52188	1096.081	32572
februari	792.986	45012	796.565	38295	1553.06	34891	2135.059	47806	1183.477	32611
maret	824.761	45219	916.477	39036	1544.733	33744	2192.922	52500	1480.195	31303
april	818.462	41810	816.163	38070	1674.342	37441	1877.378	35934	1703.366	43884
mei	849.551	41930	1040.81	42351	1735.626	38068	2156.098	45351	1946.584	74266
juni	824.509	42154	873.799	49036	1404.525	32236	2084.884	47674	2136.215	98099
juli	824.373	43213	937.315	48908	1752.005	40294	2115.385	38751	3007.317	112416
agustus	793.44	45575	975.33	46241	1669.306	38375	2082.681	35507	2995.915	99111
september	909.174	44203	1031.574	42078	1497.53	33343	1805.016	48961	2516.687	69428
oktober	972.538	48238	1659.165	41612	1848.848	35193	1841.866	114137	2199.132	126803
november	944.314	45960	1778.538	36831	2028.689	36628	1541.189	39491	1922.193	111960
desember	900.041	48168	1767.858	34437	2237.889	40106	1345.896	24471	2064.95	92176
TOTAL	10353.734	544961	13431.735	494422	20794.662	436853	23641.882	582771	24252.112	924629

From data oil and gas above can be determined value *alfa* (α) sebesar 0.2 , nilai *beta* (β) 0.1 and *gamma* (γ) 0.5. Forecasting is done using the method *Holt Winters* With a seasonal multiplication factor (*Multiplicative Seasonal*) , Because the existing data are fluctuating always decrease and increase in every month and method of smoothing Exponential *Holt-Winters* With Seasonal Addition Method (*Additive Seasonal Method*) Which is used for constant seasonal variations.

2.2 Flowchart

Part plot system (*flowchart*) is a part of Which explains in detail the steps of the system process. To start this system the admin is required to login first then input the data of oil or gas, then specify the value *alfa (α), Beta (β)* and *Gamma (γ),* Then do the calculation using *Holt – Winter's*, After that calculate the level of forecasting errors using MSE and SSE, then out the calculation of forecasting the amount of oil and gas.
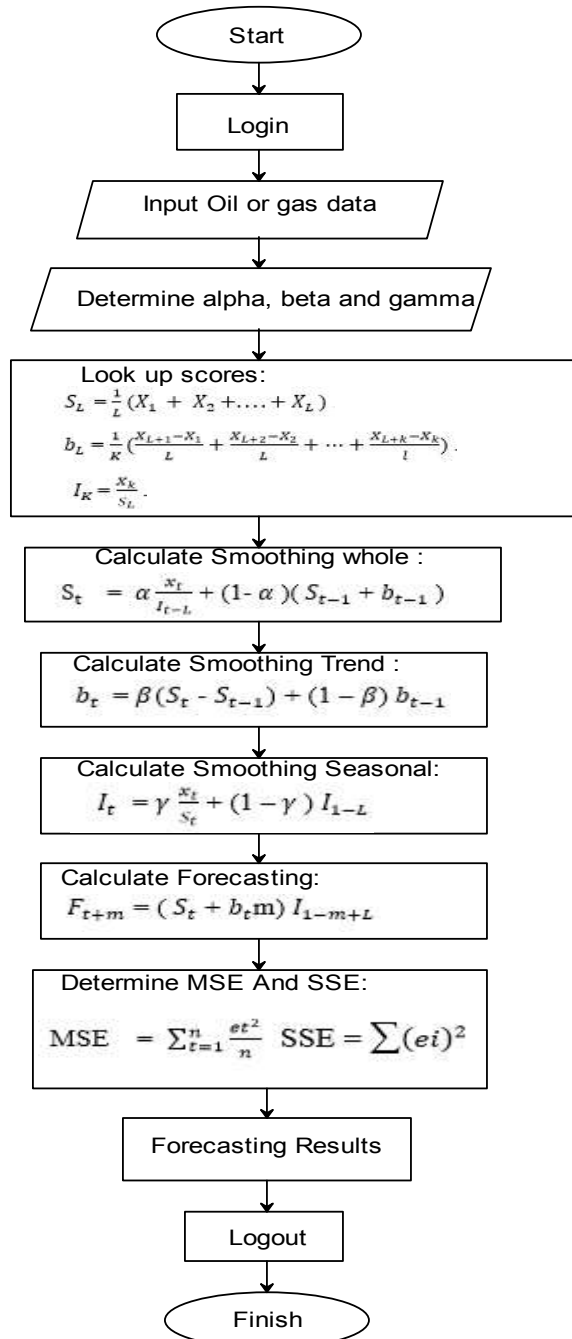
2.2.1 Flowchart System
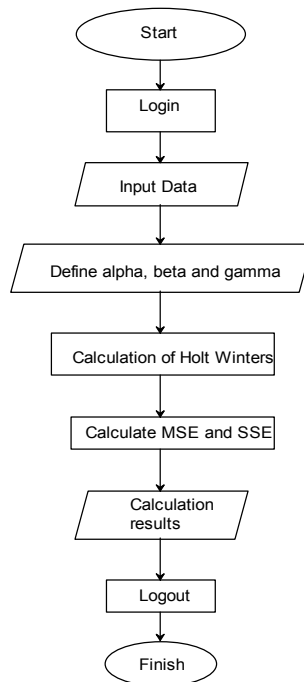
Picture 2.1 Flowchart system Forecasting for Oil and Gas

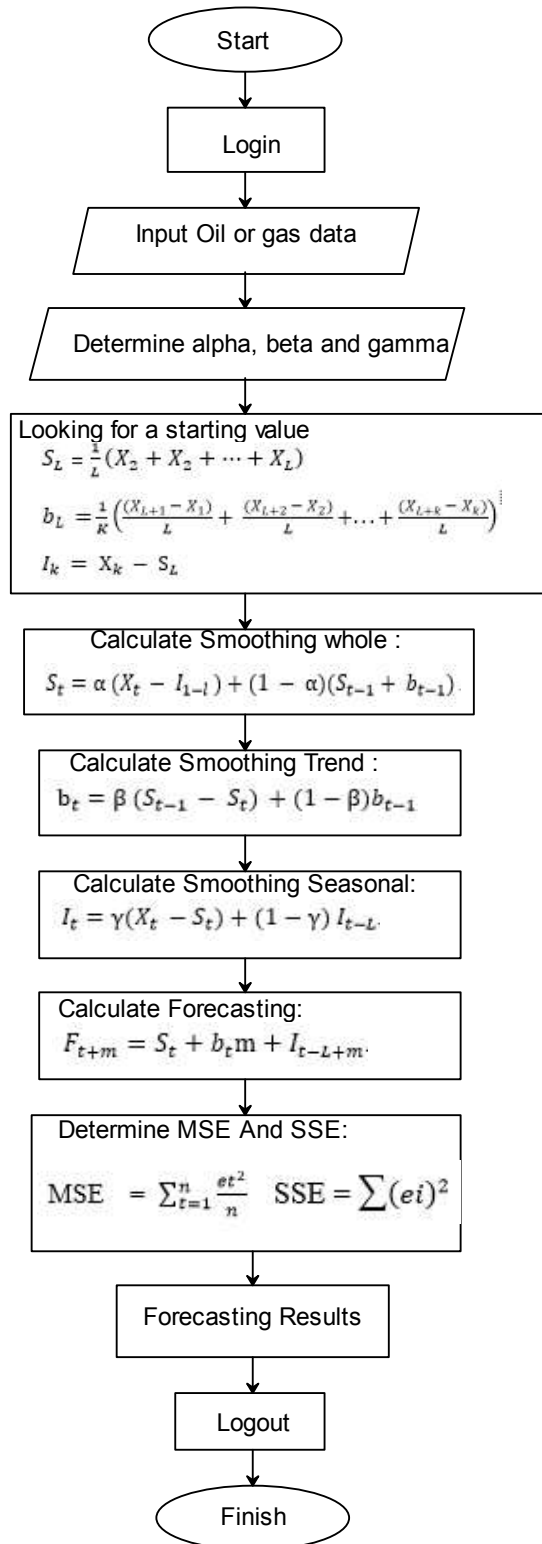**2.2.2 Flowchart Program (*Multiplicative Seasonal Method*)**

Picture following describes the flow of forecasting by method *Holt Winter's* Using seasonal multiplication adjustment factors (*Multiplicative Seasonal Method*).

Start

Login

Input Oil or gas data

Determine alpha, beta and gamma

Look up scores:
$$S_L = \frac{1}{L}(X_1 + X_2 + \dots + X_L)$$
$$b_L = \frac{1}{K}\left(\frac{X_{L+1}-X_1}{L} + \frac{X_{L+2}-X_2}{L} + \dots + \frac{X_{L+k}-X_k}{l}\right).$$
$$I_K = \frac{x_k}{S_L}.$$

Calculate Smoothing whole :
$$S_t = \alpha\frac{x_t}{I_{t-L}} + (1-\alpha)(S_{t-1} + b_{t-1})$$

Calculate Smoothing Trend :
$$b_t = \beta(S_t - S_{t-1}) + (1-\beta)b_{t-1}$$

Calculate Smoothing Seasonal:
$$I_t = \gamma\frac{x_t}{S_t} + (1-\gamma)I_{1-L}$$

Calculate Forecasting:
$$F_{t+m} = (S_t + b_t m)I_{1-m+L}$$

Determine MSE And SSE:
$$\text{MSE} = \sum_{t=1}^{n}\frac{et^2}{n} \quad \text{SSE} = \sum(ei)^2$$

Forecasting Results

Logout

Finish

Picture 2.2 Flowchart Application Forecasting Oil and Gas

2.2.3 Flowchart Program (*Additive Seasonal Method*)

Picture following describes the flow of forecasting by Method Additions Seasonal (*Additive Seasonal Method*).

Start

Login

Input Oil or gas data

Determine alpha, beta and gamma

Looking for a starting value

$$S_L = \frac{1}{L}(X_2 + X_2 + \cdots + X_L)$$

$$b_L = \frac{1}{K}\left(\frac{(X_{L+1} - X_1)}{L} + \frac{(X_{L+2} - X_2)}{L} + \ldots + \frac{(X_{L+k} - X_k)}{L}\right)$$

$$I_k = X_k - S_L$$

Calculate Smoothing whole :

$$S_t = \alpha(X_t - I_{1-l}) + (1 - \alpha)(S_{t-1} + b_{t-1})$$

Calculate Smoothing Trend :

$$b_t = \beta(S_{t-1} - S_t) + (1 - \beta)b_{t-1}$$

Calculate Smoothing Seasonal:

$$I_t = \gamma(X_t - S_t) + (1 - \gamma)I_{t-L}$$

Calculate Forecasting:

$$F_{t+m} = S_t + b_t m + I_{t-L+m}$$

Determine MSE And SSE:

$$MSE = \sum_{t=1}^{n}\frac{et^2}{n} \quad SSE = \sum(ei)^2$$

Forecasting Results

Logout

Finish

Picture 2.3 Application Forecasting Oil and Gas

`2.3 Calculation *Holt Winter's* Using Seasonal Multiplication (*Multiplikative Seasonal Method*) Of the oil data.

1) Here is a calculation forecasting *Holt Winter's* Using multiplication seasonal, To get the initial value of the period to

$$S_L = \frac{1}{L}(X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10}$$

$$+ X_{11} + X_{12})$$

$$= \frac{1}{12}(53497 + 45012 + 45219 + .41810 + 41930 + 42154 + 43213 + 45575$$

$$+ 44203 + 48238 + 45960 + 48168)$$

$$= \frac{544961}{12}$$

$$= 45413,42$$

$$b_L = \frac{1}{K}(\frac{X_{L+1}-X_1}{L} + \frac{X_{L+2}-X_2}{L} + \frac{X_{L+3}-X_3}{L} + \frac{X_{L+4}-X_4}{L} + \frac{X_{L+5}-X_5}{L} + \frac{X_{L+6}-X_6}{L} + \frac{X_{L+7}-X_7}{L} + \frac{X_{L+8}-X_8}{L} + \frac{X_{L+9}-X_9}{L} + \frac{X_{L+10}-X_{10}}{L} + \frac{X_{L+11}-X_{11}}{L} + \frac{X_{L+12}-X_{12}}{L})$$

$$= \frac{1}{12}(\frac{37527-53479}{12} + \frac{38295-45012}{12} + \frac{39036-45219}{12} + \frac{38070-41810}{12} + \frac{42351-41930}{12} + \frac{49036-42154}{12} + \frac{48908-43213}{12} + \frac{46241-45575}{12} + \frac{42078-44203}{12} + \frac{41612-48238}{12} + \frac{36831-45960}{12} + \frac{34437-48168}{12})$$

$$= \frac{77867}{12}$$

$$= 540,743$$

2) Example calculation to find the initial value (I_K) For period 25th from 2011 to 2012 data is as follows :

$$I_K = \frac{X_k}{S_L}$$

$$I_1 = \frac{53479}{45413,42}$$

$$= 1,18$$

   Using the same formula used to calculate until December of 2016.

Here is an example calculation to get the next value:

1) Determine the overall smoothing value (S_t) Period 25 From data 2011 and 2012.
$$S_t = \alpha\frac{x_t}{I_{t-L}} + (1-\alpha)(S_{t-1} + b_{t-1})$$
$$= 0,2\frac{53479}{1,18} + (1-0,2)(45413,42 + 540,743)$$
$$= 45846,01$$

   With The same way of calculation is used to calculate until December of 2016.

2) Specifies the value for smoothing *trend* (b_t) periode 25 from data year 2011 and 2012.
$$b_t = \beta(S_t - S_{t-1}) + (1-\beta)b_{t-1}$$

$$= 0,1(45846,01 - 45413,42) + (1-0,1)540,743$$

$$= 529,93$$

Using the same method used to calculate the next period until December 2016.

3) Specifies the seasonal smoothing value (I_t) period 25 from data 2011 and 2012.
$$I_t = \gamma\frac{x_t}{S_t} + (1-\gamma)I_{1-L}$$

$$= 0{,}5 \frac{53479}{45846{,}01} + (1 - 0{,}5) *1{,}18$$

$$= 1{,}17$$

Using the same method used to calculate the next period until the period of 61, January until December 2016.

4) Examples calculation forecasting s (F_{t+m}) Period 25 From data 2011 and 2012.
   $F_{t+m} = (S_t + b_t \text{m}) I_{1-m+L}$

   $$= (45846{,}01 + 529{,}93)+1{,}17$$

   $$= 54354{,}81$$

Using the same method used to calculate the next period until December of 2016.

Here is a comparison table of real data for 2013 with forecasting results for 2013.

Tabel 2.2 Oil and Gas Forecasting Results of 2013 Using Seasonal Multiplication Factor.

Month	Oil Year 2013			Gas Year 2013		
	Actual Data	Forecasting Results	e	Actual Data	Forecasting Results	e
January	36534	54354.81	17820.81	1848.109	931.38	916.73
February	34891	49152.45	14261.45	1553.06	866.88	686.18
March	33744	47106.48	13362.48	1544.733	858.96	685.78
April	37441	44127.18	6686.18	1674.342	850.88	823.46
May	38068	42960.41	4892.41	1735.626	866.27	869.36
June	32236	42610.95	10374.95	1404.525	856.27	548.26
July	40294	43119.43	2825.43	1752.005	851.33	900.68
August	38275	44793.56	6518.56	1669.306	829.28	840.03
September	33343	4627.20	11284.20	1497.53	892.03	605.50
October	35193	47062.16	11869.16	1848.848	957.35	891.50
November	36628	46644.98	10016.98	2028.689	966.19	1062.50
December	40106	47836.93	7730.93	2237.889	941.41	1296.48
Total error value			117643.52	Total error value		10126.44

To see more clearly the forecast error rate *Holt Winter's* With a seasonal multiplication component (*Multiplicative Seasonal*) Using the following MSE and SSE formulas:

$$\text{MSE} = \sum_{t=1}^{n} \frac{et^2}{n}$$

Based on the above formula, the calculation of the value of MSE oil from the results of 2013 is:

MSE $\quad = \sum_{t=1}^{n} \frac{e_t^2}{n}$

MSE $\quad = \frac{1354596939.4472415}{12}$

$\quad = 112883078.2872701$

$$SSE = \sum (ei)^2$$

Based on the above formula, the calculation of SSE oil values from 2013 data are:

SSE $\quad = \sum (ei)^2$

SSE $\quad = 1354596939.4472415$

4.4 Calculation *Holt Winter's* Using Seasonal Additions (*Additive Seasonal Method*) Of the oil data.

1) How to Find the Initial Value S_L and B_L in Additive Same as Multiplikative.
2) Example calculation to find the initial value (I_K) Period 25 is as follows:

$\quad I_k = X_k - S_L.$

$\quad I_1 = 53479 - 45413{,}42$

$\quad I_1 = 8065{,}58$

     Using the same formula is used to calculate the next period until December of 2016.

     Here is an example calculation to get the next value.

3) Determine Value For Smoothing (S_t) Period 25 for 2013

$\quad S_t = \alpha (X_t - I_{1-l}) + (1 - \alpha)(S_{t-1} + b_{t-1}).$
$\quad\quad = 0{,}2 * (53479 - 8065{,}58) + (1 - 0{,}2)(45413{,}42 + 540{,}743)$
$\quad\quad = 45846{,}01$

     By the way the same calculation is used to calculate the next period until December of 2016.

4) Specifies the value for smoothing *trend* (b_t) period of 25 years 2013

$\quad b_t = \beta (S_{t-1} - S_t) + (1 - \beta) b_{t-1}$

$\quad\quad = 0{,}1 (45413{,}42 - 45846{,}01) + (1 - 0{,}1) 540{,}743$

$\quad\quad = 443{,}41$

     Using the same method is used to calculate the next period until, December 2016.

5) Determine value smoothing seasonal (I_t) Period of 25 for the year 2013

$\quad I_t = \gamma (X_t - S_t) + (1 - \gamma) I_{t-L}$

$\quad\quad = 0{,}5 (53479 - 45846{,}01) + (1 - 0{,}5) * 8065{,}58$

$\quad\quad = 7849{,}29$

     Using the same method used to calculate the next period until December of 2016.

6) Example of forecasting calculation (F_{t+m}) To look for a period of 25 for the year 2013.

$\quad F_{t+m} = (S_t + b_t m) I_{1-m+L}$

$\quad\quad = (45846{,}01 + 443{,}41) + 7849{,}29$

$\quad\quad = 54138{,}71$

Using the same method used to calculate the next period until December of 2016.

Here is a comparison table of real data for 2013 forecasting results with 2013.

Tabel 4.6 Forecasting Oil and Gas Results 2013 Using Season Summation Factors

Month	Oil Year 2013			Gas Year 2013		
	Actual Data	Forecasting Results	Actual Data	Forecasting Results	Actual Data	Nilai e
January	36534	54138.71	17604.706	1848.109	926.74	921.36640
February	34891	49199.94	14308.944	1553.06	863.77	689.29345
March	33744	47320.81	13576.805	1544.733	854.97	689.76734
April	37441	44532.08	7091.0809	1674.342	845.48	828.86651
May	38068	43437.08	5369.0809	1735.626	857.77	877.85709
June	32236	43065.89	10829.892	1404.525	846.36	558.16835
July	40294	43470.14	3176.1433	1752.005	840.44	911.56392
August	38275	44943.75	6668.74916	1669.306	819.00	850.30585
September	33343	44682.67	11339.6681	1497.53	876.71	620.82124
October	35193	46891.46	11698.4553	1848.848	935.17	913.67484
November	36628	46411.68	9783.68175	2028.689	941.25	1087.4406
December	40106	47493.63	7387.62601	2237.889	917.82	1320.0683
Total error value			118834.83	Total error value		10269.19

3. RESULT AND DISCUSSION

From the data obtained can be concluded that use *Holt-Winters Multiplikative seasonal methot* More accurate in predicting oil and gas production data year 2016 at PT.VICO Indonesia *plan* samberah. This is a forecasting chart using Alfa = 1 beta = 1 gamma = 1:
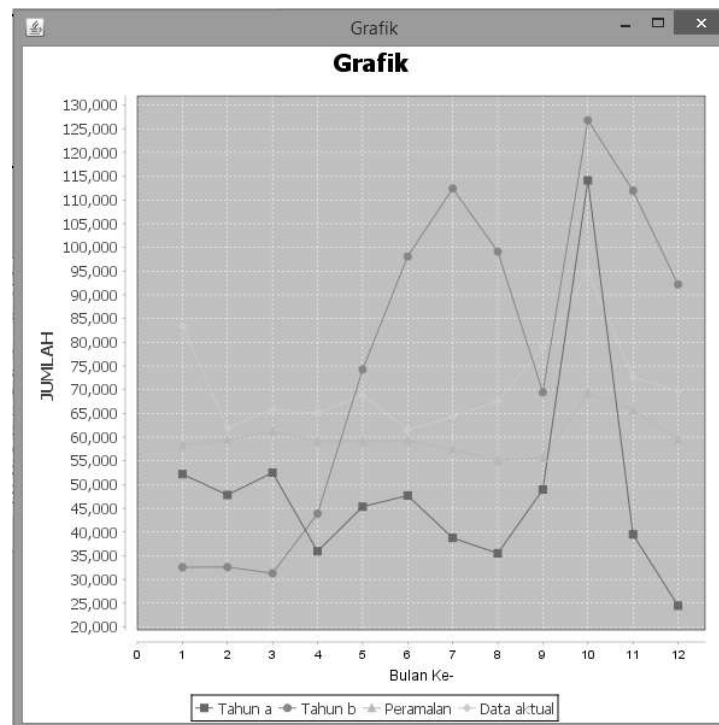
Picture 3.1 Chart Forecasting 2016

4. CONCLUSION

In this study obtained some conclusions, among others is :

1) Implementation of built systems has been through a trial process that produces predictions of oil and gas production in PT.VICO Indonesia by using Holt winter's method as a reference calculation accuracy.
2) Holt Winter's method is well implemented to predict oil and gas production data in PT.VICO Indonesia.
3) From the implementation of forecasting system that has been built using the value of alpha = 0.2, beta = 0.1 and 0.5 gamma obtained results of MSE and SSE value in 2016 from oil and gas production data.
    a) For production oil data multiplikative value MSE = 18066.640309, and Results SSE = 406999015.6245.
    b) For production data gas multiplikative value MSE = 220.252258, and Results SSE = 70580.3967956.
    c) For production data oil additive value MSE = 21820.737, and Results SSE = 552153360.134.
    d) For production data gas additive value MSE = 224.837, and Results SSE = 71403.923.
4) To get smaller difference (error value) in oil and gas production prediction system in this application is by reducing the value of alpha, beta and gamma.

From the data obtained can be concluded that using Holt-Winters Multiplikative seasonal methot more accurate in predicting data of oil and gas production in 2016 in PT.VICO Indonesia in plan samberah.

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