SYSTEM PREDICTION PRODUCTION PT.VICO INDONESIA USING METHOD HOLT WINTERS

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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 Multiplicative 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 semberah plant.
Table 2.1 data Oil and gas PT. VICO Indonesia monthly.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>CRUDE OIL</td>
<td>GAS PRODUCTION</td>
<td>CRUDE OIL</td>
<td>GAS PRODUCTION</td>
</tr>
<tr>
<td></td>
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<td>BARREL</td>
<td>MMSCF</td>
<td>BARREL</td>
<td>MMSCF</td>
</tr>
<tr>
<td>January</td>
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<td>838.141</td>
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</tr>
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<td>761.554</td>
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<td>705.103</td>
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</tr>
<tr>
<td>March</td>
<td>826.565</td>
<td>43219</td>
<td>664.477</td>
<td>36056</td>
<td>1544.733</td>
</tr>
<tr>
<td>April</td>
<td>816.465</td>
<td>41810</td>
<td>816.163</td>
<td>39070</td>
<td>1674.342</td>
</tr>
<tr>
<td>May</td>
<td>849.551</td>
<td>41070</td>
<td>1040.81</td>
<td>42531</td>
<td>1735.658</td>
</tr>
<tr>
<td>June</td>
<td>826.509</td>
<td>45214</td>
<td>873.799</td>
<td>46016</td>
<td>1404.575</td>
</tr>
<tr>
<td>July</td>
<td>824.371</td>
<td>45313</td>
<td>973.315</td>
<td>48008</td>
<td>1752.085</td>
</tr>
<tr>
<td>August</td>
<td>793.44</td>
<td>45575</td>
<td>915.53</td>
<td>46241</td>
<td>1669.336</td>
</tr>
<tr>
<td>September</td>
<td>900.574</td>
<td>44205</td>
<td>1071.574</td>
<td>43078</td>
<td>1497.53</td>
</tr>
<tr>
<td>October</td>
<td>927.539</td>
<td>48218</td>
<td>1619.15</td>
<td>43812</td>
<td>1848.048</td>
</tr>
<tr>
<td>November</td>
<td>944.314</td>
<td>49040</td>
<td>1718.538</td>
<td>34831</td>
<td>2038.849</td>
</tr>
<tr>
<td>December</td>
<td>900.041</td>
<td>48148</td>
<td>1767.838</td>
<td>34457</td>
<td>2237.889</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1955.714</td>
<td>544061</td>
<td>13431.755</td>
<td>494422</td>
<td>20764.082</td>
</tr>
</tbody>
</table>

From data oil and gas above can be determined value $\alpha$ (\(\alpha\)) sebesar 0.2 , nilai $\beta$ (\(\beta\)) 0.1 and $\gamma$ (\(\gamma\)) 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

2.2.1 Flowchart System

![Picture 2.1 Flowchart system Forecasting for Oil and Gas](image-url)
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).

![Flowchart Application Forecasting Oil and Gas](image)

*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).

![Flowchart Diagram]

- Start
- Login
- Input Oil or gas data
- Determine alpha, beta and gamma
- Looking for a starting value
  \[ S_L = \frac{1}{L} (X_L + X_{L-1} + \ldots + X_1) \]
  \[ b_L = \frac{1}{L} \left( \frac{(X_L - X_1)}{L} + \frac{(X_{L-1} - X_2)}{L} + \ldots + \frac{(X_1 - X_L)}{L} \right) \]
  \[ l_L = X_L - S_L \]
- Calculate Smoothing whole
  \[ S_t = \alpha (X_t - l_{t-L}) + (1 - \alpha) (S_{t-1} + b_{t-1}) \]
- Calculate Smoothing Trend
  \[ b_t = \beta (S_{t-1} - S_t) + (1 - \beta) b_{t-1} \]
- Calculate Smoothing Seasonal
  \[ l_t = \gamma (X_t - S_t) + (1 - \gamma) l_{t-L} \]
- Calculate Forecasting
  \[ F_{t+m} = S_t + b_t m + l_{t-L+m} \]
- Determine MSE And SSE:
  \[ \text{MSE} = \frac{1}{n} \sum_{t=1}^{n} (e_t)^2 \]
  \[ \text{SSE} = \sum (e_t)^2 \]
- Forecasting Results
- Logout
- Finish
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

\[ S_L = \frac{1}{L} (X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12}) \]

\[ = \frac{1}{12} (53497 + 45012 + 45219 + 41810 + 41930 + 42154 + 43213 + 45575 + 44203 + 48238 + 45960 + 48168) \]

\[ = 45413.42 \]

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

\[ = \frac{1}{12} (37527 - 534.79 + 38295 - 45012 + 45219 + 41810 + 41930 + 42154 + 43213 + 45575 + 44203 + 48238 + 45960 + 48168) \]

\[ = 450,743 \]

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

\[ I_K = \frac{X_1}{S_L} \]

\[ I_t = \frac{\text{Data}}{\text{Seasonal}} \]

\[ = 1.18 \]

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.

\[ S_t = \alpha \frac{X_t}{S_{t-1}} + (1 - \alpha) (S_{t-1} + b_{t-1}) \]

\[ = 0.2 \frac{534.79}{1.18} + (1 - 0.2) (45413.42 + 540,743) \]

\[ = 45846.01 \]

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

2) Specifies the value for smoothing trend \( (b_t) \) period 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.

\[ I_t = \gamma \frac{X_t}{S_t} + (1 - \gamma) I_{t-1} \]
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\[
0.5 \times \frac{534.79}{4 \times 584.61} + (1 - 0.5) \times 1.18 = 1.17
\]

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

4) Examples calculation forecasting \( F_{t+m} \) Period 25 From data 2011 and 2012.

\[
F_{t+m} = (S_t + b_t)m \times l_{t-m+l}
\]

\[
= (45846.01 + 529.93) \times 1.17 = 54354.81
\]

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.

<table>
<thead>
<tr>
<th>Month</th>
<th>Oil Year 2013</th>
<th>Gas Year 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Data</td>
<td>Forecasting Results</td>
<td>e</td>
</tr>
<tr>
<td>January</td>
<td>36534</td>
<td>54354.81</td>
</tr>
<tr>
<td>February</td>
<td>34891</td>
<td>49152.45</td>
</tr>
<tr>
<td>March</td>
<td>33744</td>
<td>47106.48</td>
</tr>
<tr>
<td>April</td>
<td>37441</td>
<td>44127.18</td>
</tr>
<tr>
<td>May</td>
<td>38068</td>
<td>42960.41</td>
</tr>
<tr>
<td>June</td>
<td>32236</td>
<td>42610.95</td>
</tr>
<tr>
<td>July</td>
<td>40294</td>
<td>43119.43</td>
</tr>
<tr>
<td>August</td>
<td>38275</td>
<td>44793.56</td>
</tr>
<tr>
<td>September</td>
<td>33343</td>
<td>4627.20</td>
</tr>
<tr>
<td>October</td>
<td>35193</td>
<td>47062.16</td>
</tr>
<tr>
<td>November</td>
<td>36628</td>
<td>46644.98</td>
</tr>
<tr>
<td>December</td>
<td>40106</td>
<td>47836.93</td>
</tr>
</tbody>
</table>

| 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:

\[
MSE = \sum_{i=1}^{n} \frac{e^2}{n}
\]

Based on the above formula, the calculation of the value of MSE oil from the results of 2013 is:
\[
\text{MSE} = \sum_{t=1}^{n} \frac{e_t^2}{n}
\]
\[
\text{MSE} = \frac{1354596939.472415}{12} = 112883078.2872701
\]

\[\text{SSE} = \sum (e_t)^2\]

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

\[\text{SSE} = \sum (e_t)^2\]
\[\text{SSE} = 1354596939.4472415\]

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

1) How to Find the Initial Value \(S_1\) and \(B_1\) in Additive. Same as Multiplicative.

2) Example calculation to find the initial value \(I_1\) Period 25 is as follows:
\[
I_k = X_k - S_k.
\]
\[
I_1 = 53479 - 45413,42
\]
\[
I_1 = 8065,58
\]

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
\[
S_t = \alpha (X_t - I_{t-1}) + (1 - \alpha)(S_{t-1} + b_{t-1})
\]
\[
= 0.2 * (53479 - 8065,58) + (1 - 0.2)(45413,42 + 540,743)
\]
\[
= 45846,01
\]

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
\[
b_t = \beta (S_{t-1} - S_t) + (1 - \beta) b_{t-1}
\]
\[
= 0,1 (45413,42 - 45846,01) + (1 - 0,1) 540,743
\]
\[
= 443,41
\]

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

5) Determine value smoothing seasonal \((I_t)\) Period 25 for the year 2013
\[
I_t = \gamma (X_t - S_t) + (1 - \gamma) I_{t-L}
\]
\[
= 0,5 (53479 - 45846,01) + (1 - 0,5) * 8065,58
\]
\[
= 7849,29
\]

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.
\[
F_{t+m} = (S_t + b_t m) I_{t-m+l}
\]
\[
= (45846,01 + 443,41) + 7849,29
\]
\[
= 54138,71
\]
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.

<table>
<thead>
<tr>
<th>Month</th>
<th>Oil Year 2013</th>
<th>Gas Year 2013</th>
<th>Oil Year 2013</th>
<th>Gas Year 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual Data</td>
<td>Forecasting</td>
<td>Actual Data</td>
<td>Forecasting</td>
</tr>
<tr>
<td>January</td>
<td>36534</td>
<td>54138.71</td>
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</tr>
<tr>
<td>February</td>
<td>34891</td>
<td>49199.94</td>
<td>14308.944</td>
<td>1553.06</td>
</tr>
<tr>
<td>March</td>
<td>33744</td>
<td>47320.81</td>
<td>13576.05</td>
<td>1544.733</td>
</tr>
<tr>
<td>April</td>
<td>37441</td>
<td>44532.08</td>
<td>7091.089</td>
<td>1674.342</td>
</tr>
<tr>
<td>May</td>
<td>38068</td>
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<td>1735.626</td>
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<td>June</td>
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</tr>
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<td>November</td>
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<td>December</td>
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<td>Total error value</td>
<td>118834.83</td>
<td>Total error value</td>
<td>10269.19</td>
<td></td>
</tr>
</tbody>
</table>

3. RESULT AND DISCUSSION

From the data obtained can be concluded that use Holt-Winters Multiplikative seasonal method More accurate in predicting oil and gas production data year 2016 at PT.VICO Indonesia plan sambelah. This is a forecasting chart using Alfa = 1 beta = 1 gamma = 1:
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 multiplicative value MSE = 18066.640309, and Results SSE = 406999015.6245.

   b) For production data gas multiplication 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 Multiplicative seasonal method more accurate in predicting data of oil and gas production in 2016 in PT.VICO Indonesia in plan samberah.

REFERENCES


