FORECASTING FOR BOOK CLASSIFIED ON A LIBRARY BY USING SINGLE EXPONENTIAL SMOOTHING (CASE STUDY : LIBRARY OF BHAYANGKARA SURABAYA UNIVERSITY)

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ABSTRACT

To facilitate the addition of library collections of UBHARA libraries, in this study will provide a solution to field manuals based on forecasting using MSE single exponential smoothing formula errors and RMSE errors. Data is forecast from 2012 to 2016, with the value of each field of economics, law, socio-political, and engineering. The data will be processed through the pre-processing process before preparing the data to be forecast. In the calculation example, the program uses data in 2012 and 2015, alpha value = 0.1 and is calculated from month 1 to month to 3 months so it is estimated to 4. The result of the data obtained is borrowed book which has the highest data is Economy. Because in every data the number of loan books looks more dominant economic data. In 2015 the calculation shows the value of MSE error and RMSE error. The error value to determine whether the error forecasting results is better or not. For 2015 forecast data to be displayed at the value of the error.

Keywords: Libraries, *single exponential smoothing*, alpha, preprocessing, MSE error, and error RMSE.

1. INTRODUCTION

1.1. Background

The library is where the media to seek knowledge through reading books that students can acquire additional knowledge of reading apart from the knowledge gained from lecturers, by reading books in the library can also improve the reading power of other students to visit the library in addition to reading, students can borrow books in library, but borrow books in the library of Bhayangkara University Surabaya still use manuals so librarians difficult to determine the number of books to be added and difficult to determine the title or field that they added in the library.

Therefore, in this thesis conducted a study entitled "**System forecasting field of library books using single exponential smoothing (Case Study Library Bhayangkara University Surabaya)**". In this research will be carried out pre-processing in advance of any borrowing of books that will be used as a feature to get a field book that will be added. Expected by this research could yield forecasting system for the field of books in the library.

1.2. Formulation of the problem

Some of the main issues related to the research are as follows:

1. How does the data classifying borrowing books which will be processed using the method of pre-processing?
2. How to create a forecasting system field book lending seen from the amount of data by using a single smoothing?

1.3. Scope of problem

Limitation of problem in this research are as follows:

1. The data used is data in the library book lending Bhayangkara University, Surabaya in 2012-2015.
2. The data is used only on the classification of books without classifying fields to the sub-field of books.

1.4. Research purposes

The purpose of this study is devise a system to predict the data fields of the book, making it easier for librarians to add to the list of reference books available in the library of the University of Surabaya based on data Bhayangkara borrowing.

2. THEORETICAL
Theoretical basis contains theories that support the creation of research and system.

2.1. Data Mining
Tan (2006) defines data mining as a process to obtain useful information from large data base warehouse. Data mining can also be interpreted as extracting new information drawn from a large chunk of data that help in decision making. The term is sometimes also called data mining knowledge discovery. Some techniques that are often mentioned in the literature in its application of data mining include: clustering, classification, association rule mining, neual networks, genetic algorithms and others. What distinguishes perceptions of data mining is the development of data mining techniques for database applications on a large scale. Before the popularity of data mining, these techniques can only be used for small-scale data.

2.2. Single Eksponensial Smoothing
Exponential smoothing method of order one is actually a development of the method of moving average (moving average) is simple. This method is widely influenced in forecasting (forecasting) for simple, efficient in the calculation and forecast changes, easily adapted to changes in the data, and the accuracy of this method is huge. Single Exponential Smoothing method but this method is not good enough applied if the data is not stationary, because the equations used in the method of procedure there is no single exponential smoothing effect resulting trend becomes stationary data remain stationary, but this method is the basis for metode- other exponential smoothing method.

Here is the equation used in the calculation of Single Exponential Smoothing:

$$F_{t+1} = \alpha D_t + (1 - \alpha)F_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where :

F_{t-1} = Smoothing the old value or average up period t-1
F_{t+1} = Value forecast for the next period
α = Smoothing parameters are determined subjectively
D_t = Actual demand or sales for the period to t-1

2.3. MSE
The Mean Squared Error (MSE) is another method to evaluate forecasting methods. Each error or residual squared. Then totaled and added to the total number of observations. This Endekatan organize large forecasting error because the error is squared. The method produces errors while the chances are better for small mistakes, but sometimes makes a large difference. Objective statistical optimization often to choose a model that minimum MSE, but this measure has two drawbacks First, this measure shows matching a model against historical data. Polinomi of order matching by using a high or a Fourier transformation right. A model that is too match the series of data which equates to incorporate random elements as part of the process angkitan. It is as bad as not recognizing the success of non-random patterns in the data.

MSE (Mean Squared Error) is the average squared difference between the predicted and observed (actual value). Here's the formula MSE.

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(Y_1 - Y_t^\wedge)^2$$

Y_1 = the value of the original data
$Y_1^\wedge$ = forecasting data values

3. ANALYSIS AND DESIGN
3.1. System analysis
In this system will be pre-proceing prior to borrowing the amount of data that will get monthly total in each field. This research is expected to be able to produce a system for forecasting the addition of a data field of books based on the data in order to facilitate borrowing books librarians more easily add a collection of books in the library field.

This book lending data is data taken from the library user records UNKRIS form excel format are used as guidelines in the study and treated for forecasting systems. Author book data received remains to be processed in advance to suit the application. Last result is what will be used as a feature in the grouping process. The following will be given an example of a process for processing until the forecasting process. An example is given of data borrow a book from 3 months in 2012, in January, February, and March. Furthermore, for months to 4 will be made forecasting data is adding a book that will be added with a view of the highest field dai forecasting results.

3.2. System planning

Diagram context that aims to facilitate the modeling and development functions within the system as well as providing an overview of the system built. Diagram context / level 0 diagram is shown in Figure 1.
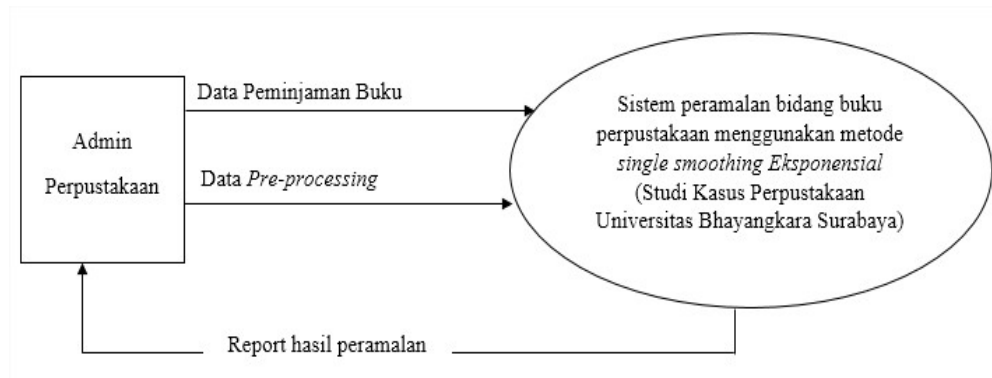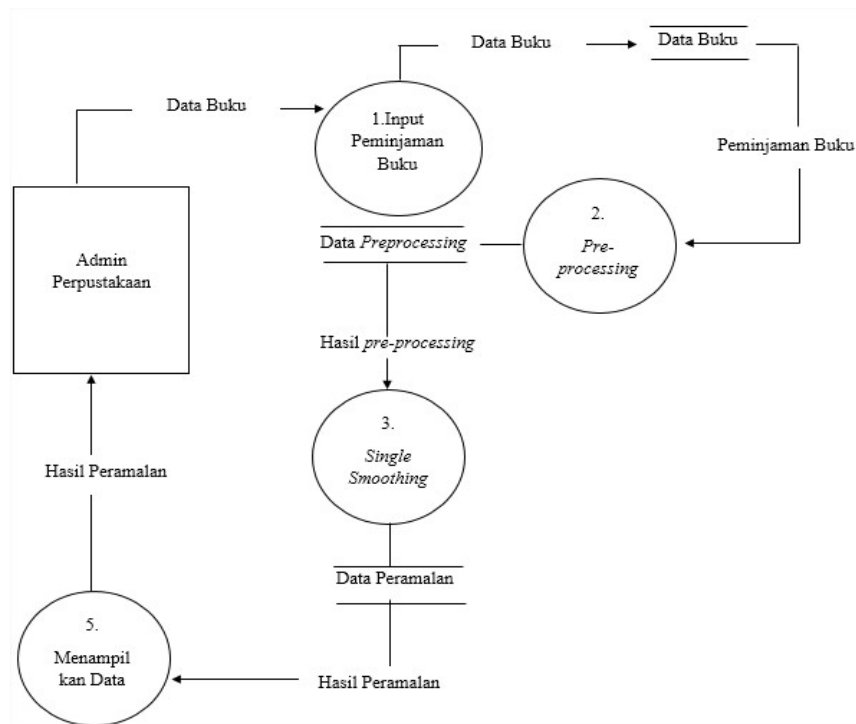

Picture 1 Display DFD Level 0

Explanation pictures DFD level 0 is as follows:
1. Admin input data and process data book pre-processing.
2. Then on the next process run by the system in the field of library books forecasting applications using Single Exponential Smoothing.
3. Ends with forecasting the results of the book to the Admin.

### a. Designing Data Flow Diagram Level 1

Picture 2 Display DFD Level 1

Explanation pictures DFD level 1 are as follows:
1. Admin input data book lending in libraries.
2. Data book later in the pre-processing.
3. Then the results of the pre-processing will be performed as a single process smoothing calculation.
4. Print the results of forecasting with a single method of smoothing.

b. Designing Data Flow Diagram Level 2 Single Smoothing
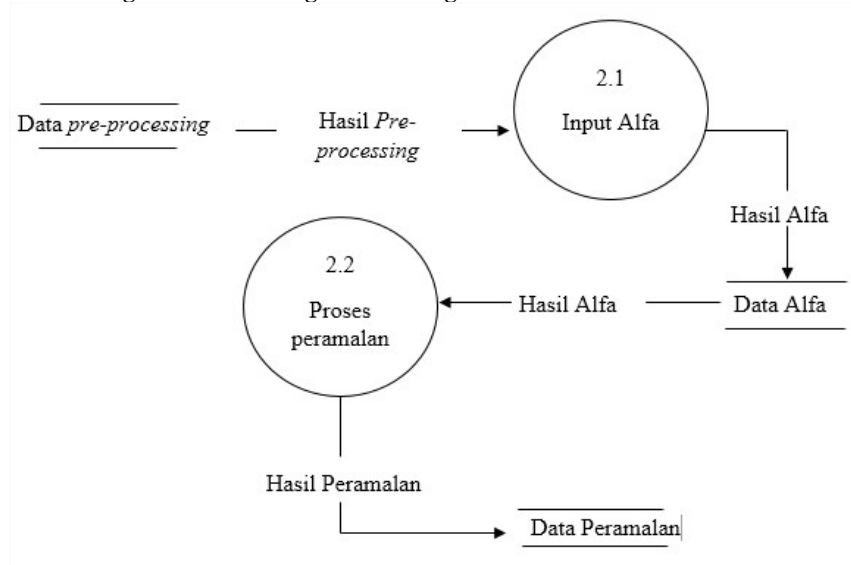
Picture 3 Display DFD Level 2 Single Smoothing

Penjelasan gambar DFD level 2 *Single Smoothing* berikut pemrosesannya :
1. Proses *pre-processing*, mengambil data peminjaman.
2. Inputkan nilai Alfa.
3. Menghitung data dengan menggunakan metode *single smoothing*.

4. **RESULTS & DISCUSSION**
   In Experiment Singer findings will be made forecasting data matching books WITH Timeframe The data in each field OR faculty borrowing. The experiments were performed 4 times as many Tests That being recorded in 2012, 2013, 2014, And 2015 WITH alpha value of 0.1. To review the abstract hearts Singer Trial displayed Only 2015 Only.
   In each trial will be conducted as many as three months AT setaip year. BEFORE forecasting data to be processed Election Data Become month And Year To how Yang would be a forecasting and Process ITU-called pre-processing. The taxable income dipre Data-processing Furthermore, SIAP conducted forecasting data book. From the data that's been in those four fields OR faculty Being every Namely Data books: Economics, Law, STIR, Engineering.

4.1. Results of experiments in 2015
   Testing is done by giving the number of alpha of 0.1, the process is done 1 time. In 2015 it displayed an error value and error-MSE-RMSE. And following the results of his experiments :
   Yield data at 1 month ahead forecast 2015 economics, law, socio-political, the technique is as follows.

- **Forecasting Process (SSE) Economics**

Picture 4 Economic Forecasting 2015

The results of calculation of the value of smoothing for months to 4 using = 0.1 economics is as follows:

Economic Months to 1:
$$F_{t+1} \quad = 155$$

Economic Months to 2:
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,155\,) + (\,1 - 0{,}1\,)\,(155\text{-}1)$$
$$= 0{,}1\,(\,155\,) + (\,0{,}9\,)\,154$$
$$= 15{,}5 + 138{,}6$$

$$= \mathbf{154{,}1}$$

Economic Months to 3:
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,279\,) + (\,1 - 0{,}1\,)\,(154{,}1\text{-}1)$$
$$= 0{,}1\,(\,279\,) + (\,0{,}9\,)\,153{,}1$$
$$= 27{,}9 + 137{,}79$$
$$= \mathbf{165{,}69}$$

Economic Months to 4:
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,424\,) + (\,1 - 0{,}1\,)\,(165{,}69\text{-}1)$$
$$= 0{,}1\,(\,424\,) + (\,0{,}9\,)\,164{,}69$$
$$= 42{,}4 + 148{,}221$$

$$= \mathbf{190{,}621}$$

- **Forecasting Process (SSE) Legal Affairs**
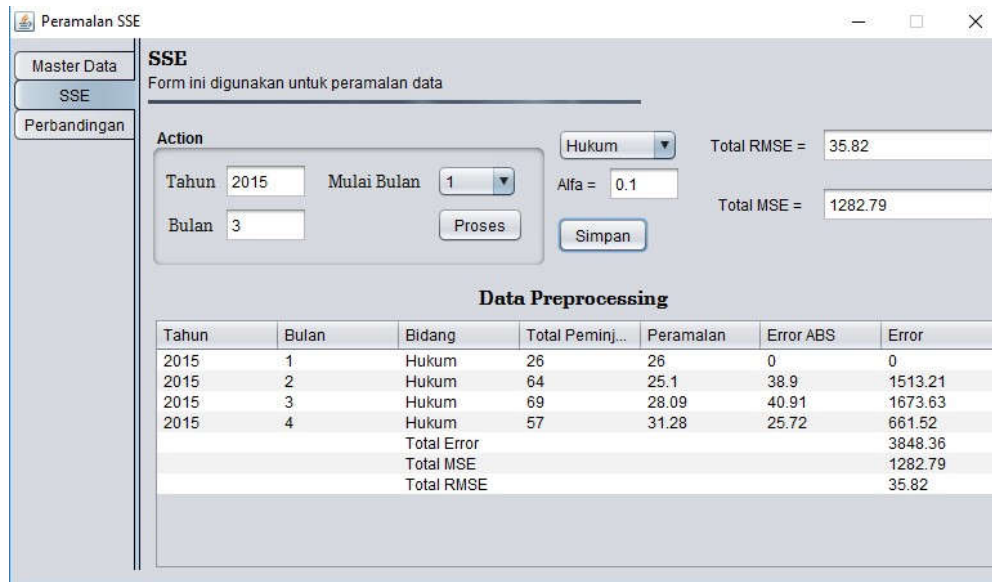
Picture 5 Law Forecasting 2015

The results of calculation of the value of smoothing for months to 4 using = 0.1 legal field are as follows:

Law Month 1 :
$$F_{t+1} \quad = \mathbf{26}$$

Law Month 2 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\,(\,26\,) + (\,1 - 0,1\,)\,(26\text{-}1)$$
$$= 0,1\,(\,26\,) + (\,0,9\,)\,25$$
$$= 2,6 + 22,5$$
$$= \mathbf{25,1}$$

Law Month 3 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\,(\,64\,) + (\,1 - 0,1\,)\,(25,1\text{-}1)$$
$$= 0,1\,(\,64\,) + (\,0,9\,)\,24,1$$
$$= 6,4 + 21,69$$
$$= \mathbf{28,09}$$

Law Month 4 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\,(\,69\,) + (\,1 - 0,1\,)\,(28,09\text{-}1)$$
$$= 0,1\,(\,69\,) + (\,0,9\,)\,27,09$$
$$= 6,9 + 24,381$$
$$= \mathbf{31,281}$$

- **Forecasting Process (SSE) Field Sospol**
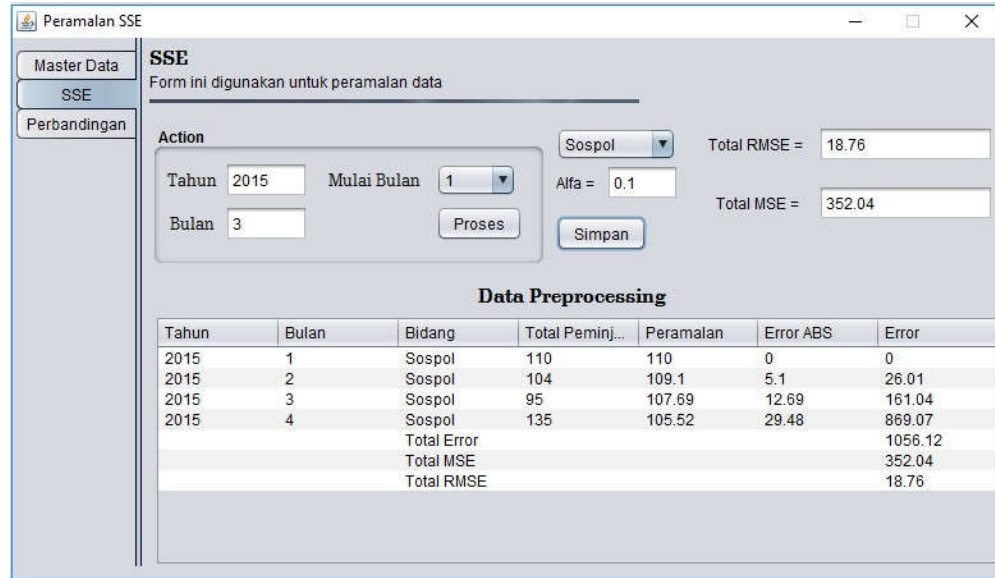
Picture 6 Sospol Forecasting 2015

The results of calculation of the value of smoothing for months to 4 using = 0.1 sospol field is as follows:

Sospol Months to 1 :
$$F_{t+1} = \textbf{110}$$

Sospol Months to 2 :
$$F_{t+1} = \alpha\, D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,110\,) + (\,1 - 0{,}1\,)\,(110\text{-}1)$$
$$= 0{,}1\,(\,110\,) + (\,0{,}9\,)\,109$$
$$= 11 + 98{,}1$$
$$= 1\textbf{09,1}$$

Sospol Months to 3 :
$$F_{t+1} = \alpha\, D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,104\,) + (\,1 - 0{,}1\,)\,(109{,}1\text{-}1)$$
$$= 0{,}1\,(\,104\,) + (\,0{,}9\,)\,108{,}1$$
$$= 10{,}4 + 97{,}29$$
$$= \textbf{107,69}$$

Sospol Months to 4 :
$$F_{t+1} = \alpha\, D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0{,}1\,(\,95\,) + (\,1 - 0{,}1\,)\,(107{,}69\text{-}1)$$
$$= 0{,}1\,(\,95\,) + (\,0{,}9\,)\,106{,}69$$
$$= 9{,}5 + 96{,}021$$
$$= \textbf{105,521}$$

-        **Forecasting Process (SSE) Engineering**
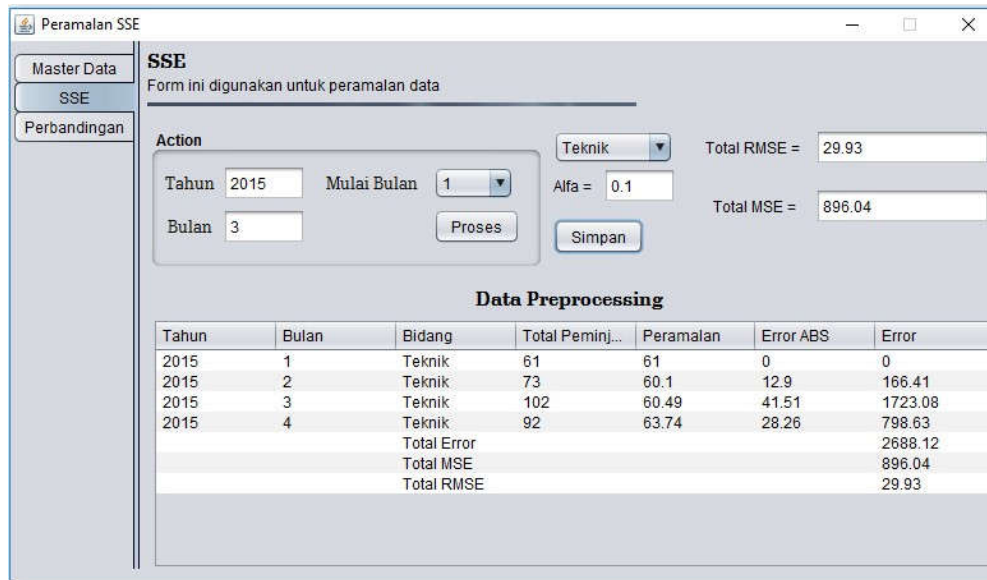
Picture 7 Technique Forecasting 2015

The results of calculation of the value of smoothing for months to 4 using = 0.1 technical field are as follows:

Mechanical Month 1 :
$$F_{t+1} \quad = \mathbf{61}$$

Teknik Bulan ke 2 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\ (\,61\,) + (\,1 - 0,1\,)\,(61\text{-}1)$$
$$= 0,1\ (\,61\,) + (\,0,9\,)\,60$$
$$= 6,1 + 54$$

$$= \mathbf{60,1}$$

Mechanical Month 3 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\ (\,73) + (\,1 - 0,1\,)\,(60,1\text{-}1)$$
$$= 0,1\ (\,73\,) + (\,0,9\,)\,59,1$$
$$= 7,3 + 53,19$$
$$= \mathbf{60,49}$$

Mechanical Month 4 :
$$F_{t+1} \quad = \alpha\,D_t + (\,1 - \alpha\,)(F_t\text{-}1)$$
$$= 0,1\ (\,102\,) + (\,1 - 0,1\,)\,(60,49\text{-}1)$$
$$= 0,1\ (\,102\,) + (\,0,9\,)\,59,49$$
$$= 10,2 + 53,541$$
$$= \mathbf{63,741}$$

- Results Comparison & Charts
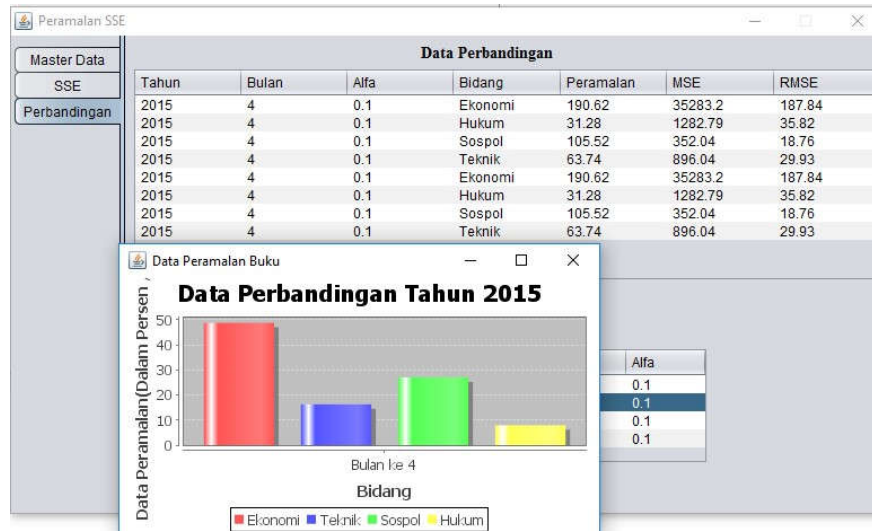
Picture 8 comparisons and charts in 2015

In figure 8 comparisons and graph 2015 shown results of forecasting the data in the form of data tables and graphs comparison. Here appears most is the amount of economic data. Data already dikonfersi into percentages.

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