

# Information System of Forecasting the Price of Beef Using Exponential Smoothing Method (Case Study: Dinas Perindustrian Dan Perdagangan Provinsi Sumatera Selatan)

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## ABSTRACT

Dinas Perindustrian dan Perdagangan Provinsi Sumatera Selatan is one of element in Indonesia government that having responsibility in trade areas, one of the areas is beef trading. The price of beef was having unstable fluctuation in every month hence it was difficult to predict the price of beef for next month. Therefore, it is necessary to have forecasting the price of beef in Dinas Perindustrian dan Perdagangan Provinsi Sumatera Selatan. It is important to be done for the improvement of accuracy and monitor the price in Dinas Perindustrian dan Perdagangan Provinsi Sumatera Selatan as consideration of regulation to anticipate the late response of the rise the price of beef. Exponential Smoothing method is the one of method to anticipate the problem, particularly in the area of improvement the accuracy of predict the price of beef. The study described about the prediction system the price of beef by implementing Exponential Smoothing method. As the result, this system can predict the price of beef for the next month in South Sumatra Province.

**Keywords:** forecasting, Exponential Smoothing, beef price

## Introduction

Forecasting is a process which is systematically estimating what will happen in the future based on historical and present data for accuracy of the value. Forecasting does not give the exact answer of the future prediction, but try to find the approach to predict what will happen in the future to give the best decision for the contribution [1].

Exponential Smoothing method is one of the quantitative forecasting methods in time series model that is used to predict or forecast the value using computer that cover moving average technique that gives the weighted exponentially on the latest data, so that it getting large and large weighted. Dinas Perindustrian dan Perdagangan Provinsi Sumatera Selatan is one of government's element in Trading Field, one is Beef Trading.

Based on news online media which is Kabar24.com on 7<sup>th</sup> July, 2015 the chief of Industry and Trade of South Sumatra Province (Disperindag) said that the price of beef in South Sumatra is very expensive compare to other provinces in Sumatra Island [2]. Due to the matter, it is good for government considering the effort to control the The Price of Beef to keep stability of make sense commodity price and making whole of citizen can fulfil their necessary easily.

## Literature review

Forecasting is estimating the future event based on analysis on historical event. In social life, everything is unpredictable and difficult to estimating precisely therefore it is needed forecasting. Forecasting that has developed is tried to minimize the problem of unpredictable thing [3].

Exponential Smoothing is one of procedure to improve moving average method the historical value from time series data exponentially continuously [4].

## Research methodology

### Exponential Smoothing Method

The following equation is general form of Single Exponential Smoothing but this method is not good enough applied if the data is stationary, because the equation that can be used in Single Exponential Smoothing does not have exponential procedure for trend pattern that causes the data is not stationary to be not stationary, but this method is the basic of other exponential methods [5].

$$F_{t+1} = F_t + \alpha (X_t - F_t) \quad (1)$$

In which,

$F_{t+1}$  = Forecasting result for periode t-1

$\alpha$  = unknown smoothing constant

$X_t$  = Observation data

$F_t$  = Last actual data

The basic understanding both of Single Exponential Smoothing and Double Exponential Smoothing is that the smoothing value be found on last time of actual value if there is trend component. Therefore, for single exponential values should be added by double smoothing value to match the trend. Double Exponential Smoothing method that is suitable for linier trend is Brown method. The basic understanding of Brown method is similar with moving average method, because both of methods require linier trend. The difference between single and double exponential smoothing is that for double should be added by smoothing value and suitbale for linier trend [5]. Brown method mathematically can be written in the following equation:

$$S'_t = \alpha X_t + (1 - \alpha) S'_{t-1} \quad (2)$$

$$S''_t = \alpha S'_t + (1 - \alpha) S''_{t-1} \quad (3)$$

$$\alpha_t = S'_t + (S'_t - S''_t) = 2S'_t - S''_t \quad (4)$$

$$bt = \frac{\alpha (S'_t - S''_t)}{1 - \alpha} \quad (5)$$

$$F_{t+m} = a_t + b_t m \quad (6)$$

In which,

$X_t$  = Observation data for t-th periode

$S'_t$  = Smoothing value I for t periode

$S''_t$  = Smoothing value for II periode

$S'_{t-1}$  = First last smoothing value( $t-1$ )

$S''_{t-1}$  = Second last smoothing value ( $t-1$ )

$\alpha$  = unknown smoothing constant

$a_t$  = Interception on period t

$b_t$  = Trend value on period t

$F_{t+1}$  = Forecasting value on period  $t+1$

$m$  = Number of period ahead to be forecast

Alpha ( $\alpha$ ) is the parameter to control relative weight on new observation. If alpha value is 1 then only new observation can be used exclusively. Oppositely, if alpha is 0 then past observation can be estimated by new same proportional weight. Alpha can be used for whole model.

## RESULTS AND FINDING

This research is based on data price of beef in South Sumatra Province that produced by Disperindag shows in Figure 1

Period	Demand
January 2015	Rp109.500
February 2015	Rp110.969
March 2015	Rp111.250
April 2015	Rp109.513
May 2015	Rp110.000
June 2015	Rp112.333
July 2015	Rp121.667
August 2015	Rp127.250
September 2015	Rp119.333
October 2015	Rp119.667
November 2015	Rp119.000
December 2015	Rp117.333
January 2016	Rp123.912
February 2016	Rp126.210
March 2016	Rp120.000
April 2016	Rp120.000
May 2016	Rp121.500
June 2016	Rp126.667
July 2016	Rp134.583
August 2016	Rp132.000
September 2016	Rp134.000

Figure 1. Demand Data of Beef Price

From those data, this study use equation (1) until (6), with three samples different constant ( $\alpha$ ). The samples are 0,1 (the smallest), 0,5 (middle), 0,9(the highest). The First sample is 0,1, calculation of forecasting with constant 0,1 shows in figure 2.

Alpha	0,1					
Data	Error Analysis					
Period	Demand	Forecast	Error	Absolute	Squared	[% Error]
January 2015	109500	109500				
February 2015	110969	109500	1469	1469	2157961	1,324%
March 2015	111250	109646,9	1603,1	1603,1	2569929,61	1,441%
April 2015	109513	109807,2	-294,21	294,21	86559,5241	0,269%
May 2015	110000	109777,8	222,211	222,211	49377,72852	0,202%
June 2015	112333	109800	2532,99	2532,99	6416037,834	2,255%
July 2015	121667	110053,3	11613,69	11613,69	134877816,6	9,545%
August 2015	127250	111214,7	16035,32	16035,32	257131545,8	12,601%
September 2015	119333	112818,2	6514,79	6514,79	42442484,02	5,459%
October 2015	119667	113469,7	6197,311	6197,311	38406659,58	5,179%
November 2015	119000	114089,4	4910,58	4910,58	24113792,07	4,127%
December 2015	117333	114580,5	2752,522	2752,522	7576375,409	2,346%
January 2016	123912	114855,7	9056,269	9056,269	82016016,91	7,309%
February 2016	126210	115761,4	10448,64	10448,64	109174130,8	8,279%
March 2016	120000	116806,2	3193,778	3193,778	10200219,7	2,661%
April 2016	120000	117125,6	2874,4	2874,4	8262177,956	2,395%
May 2016	121500	117413	4086,96	4086,96	16703245,36	3,364%
June 2016	126667	117821,7	8845,264	8845,264	78238701,7	6,983%
July 2016	134583	118706,3	15876,74	15876,74	252070807,3	11,797%
August 2016	132000	120293,9	11706,06	11706,06	137031937,6	8,868%
September 2016	134000	121464,5	12535,46	12535,46	157137700,3	9,355%
		Total	132180,9	132769,3	1366663477	105,76%
		Average	6609,044	6638,465	68333173,84	5,29%
		Bias		MAD	MSE	MAPE
		SE			8713,538243	
Next period	122718,088					

Figure 2. calculation with constant 0,1

The calculation with constant 0,1 produce Average Bias (mean error) 6609,044, Average Mean Absolute Deviation 6638, 465, Average Mean Square Error 68333173,85, Average Mean Absolute Percentage Error 5,29%, and Standard Error 8713, 538243. From the calculation figure 3 shows the comparation between demand and forecast price of beef.

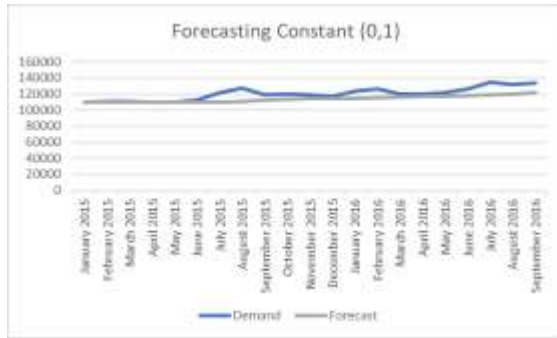


Figure 3. Table Comparison with Constant 0,1

The Second sample is 0,5. The reason for using 0,5 as second sample is middle value of constant. Based on the equation with constant 0,5 the result shows in figure 4.

Alpha	0,5					
Data						
Period	Demand	Forecast	Error	Absolute	Squared	% Error
January 2015	109500	109500				
February 2015	110969	109500	1469	1469	2157961	1,324%
March 2015	111250	110234,5	1015,5	1015,5	1031240,25	0,913%
April 2015	109513	110742,3	-1229,25	1229,25	1511055,563	1,122%
May 2015	110000	110127,6	-127,625	127,625	16288,14063	0,116%
June 2015	112333	110063,8	2269,188	2269,188	5149211,91	2,020%
July 2015	121667	111198,4	10468,59	10468,59	109591455,1	8,604%
August 2015	127250	116432,7	10817,3	10817,3	117013911,7	8,501%
September 2015	119333	121841,4	-2508,35	2508,352	6291827,561	2,102%
October 2015	119667	120587,2	-920,176	920,1758	846723,4684	0,769%
November 2015	119000	120127,1	-1127,09	1127,088	1270327,113	0,947%
December 2015	117333	119563,5	-2230,54	2230,544	4975326,292	1,901%
January 2016	123912	118448,3	5463,728	5463,728	29852323,96	4,409%
February 2016	126210	121180,1	5029,864	5029,864	25299532	3,985%
March 2016	120000	123695,1	-3695,07	3695,068	13653527,47	3,079%
April 2016	120000	121847,5	-1847,53	1847,534	3413381,869	1,540%
May 2016	121500	120923,8	576,233	576,233	332044,4723	0,474%
June 2016	126667	121211,9	5455,117	5455,117	29758296,04	4,307%
July 2016	134583	123939,4	10643,56	10643,56	113285332,2	7,909%
August 2016	132000	129261,2	2738,779	2738,779	7500911,097	2,075%
September 2016	134000	130630,6	3369,39	3369,39	11352786,02	2,514%
		Total	45630,61	73001,88	484303463,2	58,61%
		Average	2281,531	3650,094	24215173,16	2,93%
		Bias		MAD	MSE	MAPE
				SE	5187,075087	
Next period		132315,3052				

Figure 4. Calculation with constant 0,5

The calculation with constant 0,5 produce Average Bias (mean error) 2281,531, Average Mean Absolute Deviation 3650,094, Average Mean Square Error 24215173,16, Average Mean Absolute Percentage Error 2,93%, and Standard Error 5187,075087. From the calculation, figure 5 shows the comparison between demand and forecast price of beef.

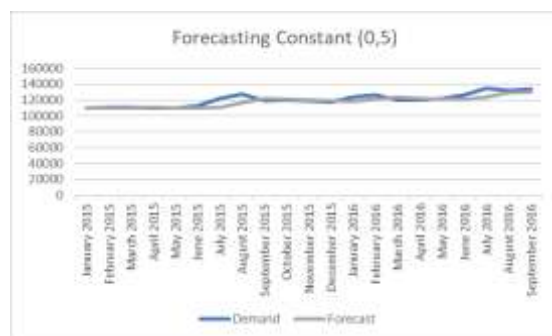


Figure 5. Table comparison with constant 0,5

The third sample is 0,9. The reason for using 0,9 as the third sample is the highest value of constant. Based on the equation with constant 0,9 the result shows in figure 6.

Alpha	0,9					
Data						
Period	Demand	Forecast	Error	Absolute	Squared	% Error
January 2015	109500	109500				
February 2015	110969	109500	1469	1469	2157961	1,324%
March 2015	111250	110822,1	427,9	427,9	183098,41	0,385%
April 2015	109513	111207,2	-1694,21	1694,21	2870347,524	1,547%
May 2015	110000	109682,4	317,579	317,579	100856,4212	0,289%
June 2015	112333	109968,2	2364,758	2364,758	5592079,926	2,105%
July 2015	121667	112096,5	9570,476	9570,476	91594006,85	7,866%
August 2015	127250	120710	6540,048	6540,048	42772222,34	5,140%
September 2015	119333	126596	-7263	7262,995	52751099,89	6,086%
October 2015	119667	120059,3	-392,3	392,2995	153898,9167	0,328%
November 2015	119000	119706,2	-706,23	706,23	498760,7457	0,593%
December 2015	117333	119070,6	-1737,62	1737,623	3019333,674	1,481%
January 2016	123912	117506,8	6405,238	6405,238	41027070	5,169%
February 2016	126210	123271,5	2938,524	2938,524	8634921,947	2,328%
March 2016	120000	125916,1	-5916,15	5916,148	35000802,7	4,930%
April 2016	120000	120591,6	-591,615	591,6148	350008,027	0,493%
May 2016	121500	120059,2	1440,839	1440,839	2076015,652	1,186%
June 2016	126667	121355,9	5311,084	5311,084	28207611,69	4,193%
July 2016	134583	126135,9	8447,108	8447,108	71353640,07	6,277%
August 2016	132000	133738,3	-1738,29	1738,289	3021649,209	1,317%
September 2016	134000	132173,8	1826,171	1826,171	3334900,827	1,363%
		Total	27019,31	67098,13	394700285,8	54,40%
		Average	1350,966	3354,907	19735014,29	2,72%
		Bias		MAD	MSE	MAPE
				SE	4682,712212	
Next period		133817,3829				

Figure 6. Calculation with constant 0,5

The calculation with constant 0,9 produce Average Bias (mean error) 1350,966, Average Mean Absolute Deviation 3354,907, Average Mean Square Error 19735014,29, Average Mean Absolute Percentage Error 2,72%, and Standard Error 4682,712212. From the calculation, figure 7 shows the comparison between demand and forecast price of beef.

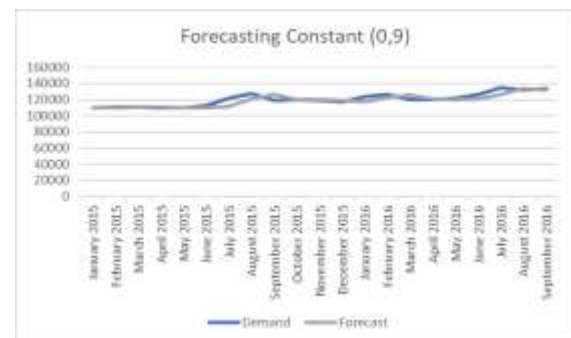


Figure 7. Table comparison with constant 0,9

From the result of calculation with three different constants, this study compare Bias Error, MAD, MSE, MAPE, and SE. It shows in table 1 below.

Table 1. Comparison of exponential smoothing with three different constants

	$\alpha = 0.1$	$\alpha = 0.5$	$\alpha = 0.9$
Bias Error	6609,044	2281,531	1350,966
MAD	6638,465	3650,094	3354,907
MSE	68333173,85	24215173,16	19735014,29
MAP E	5,29%	2,93%	2,72%
SE	8713,538243	5187,075087	4682,712212

## CONCLUSION

Based on the result, can be concluded as follow :  
Based on analysis on growth of The Price of Beef can be known that The Price of Beef has increased or decreased, so that it can be used to see growth of The Price of Beef for the next period, if the price before show the increasing then Department of Industry and Trading of South Sumatra Province needs to do market operation and can anticipate of increasing of The Price of Beef.

The Price of Beef forecasting that use exponential smoothing method will manage data that are related to The Price of Beef, recapitulation and to know the Price of Beef forecasting value.

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