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Application of Exponential Smoothing Method on Forecasting The Results of Bandeng Pounds in Cot Muda Itam Village-Peureulak District-Aceh Timur

Penerapan Metode *Exponential Smoothing* pada Peramalan Hasil Tambak Ikan Bandeng di Desa Cot Muda Itam-Kecamatan Peureulak-Aceh Timur

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ABSTRAK

Budidaya tambak hingga saat ini terhitung sebagai usaha yang dapat memberikan pendapatan yang luar biasa. Desa Cot Muda Itam merupakan salah satu Desa di Kabupaten Aceh Timur yang berbudidaya tambak dengan memproduksi ikan bandeng.Hasil panen ikan bandeng juga bervariasi terkadang mengalami kenaikan juga tak jarang mengalami penurunan hasil panen.. Oleh karena itu diperlukan adanya suatu kajian yang dapat meramalkan hasil produksi ikan bandeng pada panen selanjutnya. Peramalan (*forecasting*) merupakan suatu proses memprediksi nilai-nilai dari variabel berdasarkan nilai yang telah diketahui dari variabel yang berhubungan sebelumnya. Berdasarkan hasil pengolahan data dan analisis data menggunakan metode *smoothing eksponensial linier satu parameter brown*d dengan $\alpha = 0{,}2$ dan nilai MSE sebesar 16407,241875 didapatkan hasil peramalan bahwa pada bulan ke 11 dan 12 hasil panen menurun yaitu, 587 kg dan 580 kg.
Kata kunci: Tambak, Forecasting, Produksi, Cot Muda Itam

ABSTRACT

Pould cultivation until now is counted as a bussines that can provide extraordinary income. Cot Muda Itam Village is one of the villages in East Aceh Regency that cultivates ponds by producing milkfish. Milkfish yields also vary, sometimes increasing and not infrequently experience a dcrease in yields.. Therefore, it is necessary to have a study that can predict the production of milkfish un the next harvest. Forecasting is a process of predicting the values of variables based on known values of previously related variables. Based on the results of data processing and data analysis using the linear exponential smoothing method of one brown parameter with $\boldsymbol{\alpha = 0{,}2}$ *and MSE value of 16407,241875 it is obtained that the forecast results in the* 11^{th} *and* 12^{th} *months of the harvest decrease, namely 587 kg and 580 kg.*
***Keywords**: Pond, Forecasting, Production, Cot Muda Itam*

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PRELIMINARY

Pond cultivation until now is counted as a bussines that can provide extraordinary income. This evidenced by the production results in newly opened ponds, both at the level of mastery of cultivator technology which is still low to moderate. Pond is one type of habitat that is used as a place for brackish water cultivation located in coastal areas (Muin & Huznul, 2017). Saveral fishery commodities from ponds are very potential and have prospects to be developed as superior export commodities to provide contribution to improving people's living standards such as milkfish and tilapia.

Acording to Maulana (2008), milkifish is one of the fishery commodities commonly consumed by the public. The protein contente is quite high, the taste is savory and neutral, the price is relatively affordable, and the texture is not easily destroyed when cooked, maing milkfish much in demand. Milkfish has a fairly high protein content, which is about 20 grams (per 100 grams). Therefore, many cultivators and businessmen cultivate milkfish and commercialize it.

East Aceh is one of the districts in Aceh province and has an area of 6,060.60 km^2, administratively the East Aceh district consists of 24 sub-districts, 59 mukim, and 513 village with a population of 427,032 people (BPS, 2022). The agricultural sector in East Aceh is still a sector that has a major rolw in the economy of East Aceh. The sector itself consists of 6 sub-sectors, namely food crops, horticulture, plantations, livestock, agriculture, and fisheries.

Cot Muda Itam Village is one of the villages in the East Aceh sub-district with the most people who work as pond farmers and fishermen, which is more than 75%. The location of the village which is on the coast makes many people move in the fishery sector. Milkfish cultivation is one of the pond productions in the village, the community earns income from the cultivation of milkfish ponds, in addition to milkfish, the community also cultivates tilapia and vaname shrimp. The potential for milkfish which is more in demand, less capital and the ease of cultivating milkfish are the reasons for the community to cultivate milkfish more than tilapia and vaname shrimp. The people of Cot Muda Itam Village in cultivating milkfish still use natural ponds, where there is no modern technology that helps in the cultivation period. Milkfish yields also vary in each harvest period, ranging from 350 to 900 kg in harvest. Milkfish production can be caused by several factors such as the size of the pond, the number of seeds, labor, and the distance between the pond and the sea (Wahyuni, et al 2019). The diversity of milkfish production that goes up and down certainly affects the income of farmers (community). Therefore, it is

necessary to have a study that can predict the production of milkfish in the next harvest based on the data from the previous haevest.

Acording to Sinaga & Irawati (2018) Forecasting is the prediction of the values of a variable based on the known values of the variable. Forecasting comes from the word ramala, basically forecast is a guess or estimate regarding the occurrence of an event or event in the future. Forecasting is a very important tool in effective and efficient planning (Wardah & Iskandar, 2017). This forecast can be the basis for short, medium and long term planning. The usefulness of forecasting (forecasting) according to Syahputra, et al (2018) includes, among others, accurate forecasting will save company costs, companies/agencies can anticipate future conditions so that the risk of failure can be minimized, and Forecasting can be used for decision making because the results of forecasting contain information that starts at the level of management of the company/agency. In this study, the author uses a linear exponential smoothing method with one brown parameter to predict the milkfish harvest in the next two months.

METHOD

The research is a type of quantitative research where the data used is numerical data (numbers). The data used in this study is secondary data, according to Sugiarto (2017) Secondary data is data or information obtained not directly from the source but from a third party or document. And this data was obtained from one of the milkfish pond farmers in Cot Muda Itam Village, Peureulak, East Aceh from November to August 2021. In this study the authors applied the linear exponential smoothing method with one brown parameter in predicting the production of milkfish harvest. The next two months in Cot Muda Itam Village, Peureulak District, East Aceh.

The formula used in Brown's implementations is (Purwanti & Purwadi 2019) :

a. Calculating Single Smoothing Value (*Single Smoothing*)

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

Note :

S'_t : single exponential value mont t

α : score α

X_t : monthly pond yield t

b. Calculating Double Smoothing Value (*Double Smoothing*)

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

Note :

$S_t^{"}$: double exponential value month t

α : score α

S_t' : single exponential value month t

c. Determining the smoothing constant

$$a_t = S_t' + (S_t' - S_t^{"}) \quad (3)$$

Note:

a_t : value a month t

S_t' : single exponential value month t

$S_t^{"}$: double exponential value month t

d. Determine The Value Of The Trend Coeffecient

$$b_t = \frac{a}{1-a}(S_t' - S_t^{"}) \quad (4)$$

Note :

b_t : value b month t

a_t : value a month t

S_t' : single exponential value month t

$S_t^{"}$: double exponential value month t

e. Doing Forecasting

$$F_{t+m} = a_t + b_t m \quad (5)$$

Note :

F_{t+m} : forecast value

m : the number of future periods to be forecast

f. Finding Forecast Error Values With MSE

To find the forecast error value using MSE with the following formula :

$$MSE = \sum_{t=1}^{N} \frac{e_t^2}{N} \quad (6)$$

Note :

MSE : MSE value

N : amount of data

e : error value of month t

where to get the value must first obtain the value by using the equation formula :

$$e_t = X_t - F_t \quad (7)$$

Note :

e : error value of month t

X : lots of data year t

F : forecast value of month t

RESULT AND DISCUSSION

Based on the problem, to increase the yield of good ponds, it is necessary to process data that obtains the value of m for the next period as a comparison to the previous year's data. In this case, we will analyse the results of the ponds of one of the residents of Cot Muda Itam Village for the 11th mont of 2020 to the 8th month of 2021. The data on the results of the pond harvest can be seen in the following table:

Table 1. Pond Harvest Data

Month	Yields
1st Month	400 kg
2nd Month	600 kg
3rd Month	600 kg
4th Month	700 kg
5th Month	550 kg
6th Month	600 kg
7th Month	500 kg
8th Month	800 kg
9th Month	533 kg
10th Month	500 kg

From the data above, for the results of the ponds, it is necessary to analyse the data and predict the results of the ponds for the next 2 months with linear exponential smoothing method with one brown parameter, which can be seen in the following table using α = 0,1 to α = 0,9.

Table 2. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,1

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	420	402	439	-1,7			
ke3	600	438	405,6	471,4	-3,14	437,3	162,7	26471,29
ke4	700	464,2	411,46	517,94	-5,174	468,26	231,74	53703,43
ke5	550	472,78	417,592	528,968	-5,4188	512,766	37,234	1386,371
ke6	600	485,502	424,383	547,621	-6,0119	523,5492	76,4508	5844,725

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke7	500	486,9518	430,63988	544,2637	-5,5312	541,6091	-41,6091	1731,317
ke8	800	518,25662	439,401554	598,1117	-7,7855	538,7325	261,2675	68260,69
ke9	533	519,730958	447,434494	593,0274	-7,1296	590,3262	-57,3262	3286,291
ke10	500	517,757862	454,466831	582,0489	-6,2291	585,8978	-85,8978	7378,428

Note :
X_t : lots of Data
S_t' : equation 1
S_t'' : equation 2
a_t : : equation 3
b_t : : equation 4
F_{t+m} : equation 5
e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,1 using MSE (equation 6) is = 21007,81775.

Table 3. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,2

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	440	408	473	-6,2			
ke3	600	472	420,8	524,2	-10,04	466,8	133,2	17742,24
ke4	700	517,6	440,16	596,04	-15,288	514,16	185,84	34536,51
ke5	550	524,08	456,944	592,216	-13,227	580,752	-30,752	945,6855
ke6	600	539,264	473,408	606,12	-12,971	578,9888	21,0112	441,4705
ke7	500	531,4112	485,00864	578,8138	-9,0805	593,1488	-93,1488	8676,699
ke8	800	585,12896	505,032704	666,2252	-15,819	569,7332	230,2668	53022,78
ke9	533	574,703168	518,966797	631,4395	-10,947	650,406	-117,406	13784,16
ke10	500	559,762534	527,125944	593,3991	-6,3273	620,4923	-120,492	14518,39

Note :
X_t : lots of Data
S_t' : equation 1
S_t'' : equation 2
a_t : : equation 3
b_t : : equation 4
F_{t+m} : equation 5
e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,2 using MSE (equation 6) is = 16407,241875.

Table 4. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,3

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	460	418	503	-12,3			
ke3	600	502	443,2	561,8	-17,34	490,7	109,3	11946,49
ke4	700	561,4	478,66	645,14	-24,522	544,46	155,54	24192,69
ke5	550	557,98	502,456	614,504	-16,357	620,618	-70,618	4986,902
ke6	600	570,586	522,895	619,277	-14,007	598,1468	1,8532	3,43435
ke7	500	549,4102	530,84956	568,9708	-5,2682	605,2697	-105,27	11081,71
ke8	800	624,58714	558,970834	691,2034	-19,385	563,7026	236,2974	55836,44
ke9	533	597,110998	570,412883	624,8091	-7,7094	671,8186	-138,819	19270,59
ke10	500	567,977699	569,682328	567,2731	0,81139	617,0997	-117,1	13712,33

Note :

X_t : lots of Data

S_t' : equation 1

S_t'' : equation 2

a_t : : equation 3

b_t : : equation 4

F_{t+m} : equation 5

e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,3 using MSE (equation 6) is = 17628,823294.

Table 5. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,4

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	480	432	529	-18,8			
ke3	600	528	470,4	586,6	-22,64	510,2	89,8	8064,04
ke4	700	596,8	520,96	673,64	-29,936	563,96	136,04	18506,88
ke5	550	578,08	543,808	613,352	-13,309	643,704	-93,704	8780,44
ke6	600	586,848	561,024	613,672	-9,9296	600,0432	-0,0432	0,001866
ke7	500	552,1088	557,45792	547,7597	2,53965	603,7424	-103,742	10762,49
ke8	800	651,26528	594,980864	708,5497	-22,114	550,2993	249,7007	62350,43
ke9	533	603,959168	598,572186	610,3462	-1,7548	686,4359	-153,436	23542,58
ke10	500	562,375501	584,093512	541,6575	9,0872	608,5914	-108,591	11792,08

Note :

X_t : lots of Data

S_t' : equation 1

S_t'' : equation 2

a_t : : equation 3

b_t : : equation 4

F_{t+m} : equation 5

e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,4 using MSE (equation 6) is = 17970,367734.

Table 6. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,5

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	500	450	551	-24,5			
ke3	600	550	500	601	-24,5	526,5	73,5	5402,25
ke4	700	625	562,5	688,5	-30,75	576,5	123,5	15252,25
ke5	550	587,5	575	601	-5,75	657,75	-107,75	11610,06
ke6	600	593,75	584,375	604,125	-4,1875	595,25	4,75	22,5625
ke7	500	546,875	565,625	529,125	9,875	599,9375	-99,9375	9987,504
ke8	800	673,4375	619,53125	728,3438	-26,453	539	261	68121
ke9	533	603,21875	611,375	596,0625	4,57813	701,8906	-168,891	28524,04
ke10	500	551,609375	581,492188	522,7266	15,4414	600,6406	-100,641	10128,54

Note :

X_t : lots of Data

S_t' : equation 1

S_t'' : equation 2

a_t : : equation 3

b_t : : equation 4

F_{t+m} : equation 5

e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,5 using MSE (equation 6) is = 18631,025813.

Table 7. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,6

Month	X_t	S'_t	S''_t	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	520	472	569	-28,2			
ke3	600	568	529,6	607,4	-22,44	540,8	59,2	3504,64
ke4	700	647,2	600,16	695,24	-27,624	584,96	115,04	13234,2
ke5	550	588,88	593,392	585,368	3,3072	667,616	-117,616	13833,52
ke6	600	595,552	594,688	597,416	0,0816	588,6752	11,3248	128,2511
ke7	500	538,2208	560,80768	516,6339	14,1521	597,4976	-97,4976	9505,782
ke8	800	695,28832	641,496064	750,0806	-31,675	530,786	269,214	72476,15
ke9	533	597,915328	615,347622	581,483	11,0594	718,4052	-185,405	34375,1
ke10	500	539,166131	569,638728	509,6935	18,8836	592,5424	-92,5424	8564,098

Note :

X_t : lots of Data

S'_t : equation 1

S''_t : equation 2

a_t : : equation 3

b_t : : equation 4

F_{t+m} : equation 5

e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,6 using MSE (equation 6) is = 19452,717638.

Table 8. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,7

Month	X_t	S'_t	S''_t	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	540	498	583	-28,7			
ke3	600	582	556,8	608,2	-16,94	554,3	45,7	2088,49
ke4	700	664,6	632,26	697,94	-21,938	591,26	108,74	11824,39
ke5	550	584,38	598,744	571,016	10,7548	676,002	-126,002	15876,5
ke6	600	595,314	596,343	595,285	1,4203	581,7708	18,2292	332,3037
ke7	500	528,5942	548,91884	509,2696	14,9272	596,7053	-96,7053	9351,915
ke8	800	718,57826	667,680434	770,4761	-34,928	524,1968	275,8032	76067,4
ke9	533	588,673478	612,375565	565,9714	17,2915	735,5476	-202,548	41025,53
ke10	500	526,602043	552,3341	501,87	18,7124	583,2629	-83,2629	6932,703

Note :

X_t : lots of Data

S_t' : equation 1
S_t'' : equation 2
a_t : : equation 3
b_t : : equation 4
F_{t+m} : equation 5
e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,7 using MSE (equation 6) is = 20437,403963.

Table 9. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,8

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	560	528	593	-24,8			
ke3	600	592	579,2	605,8	-9,44	568,2	31,8	1011,24
ke4	700	678,4	658,56	699,24	-15,072	596,36	103,64	10741,25
ke5	550	575,68	592,256	560,104	14,0608	684,168	-134,168	18001,05
ke6	600	595,136	594,56	596,712	0,3392	574,1648	25,8352	667,4576
ke7	500	519,0272	534,13376	504,9206	12,8852	597,0512	-97,0512	9418,935
ke8	800	743,80544	701,871104	786,7398	-32,747	517,8059	282,1941	79633,52
ke9	533	575,161088	600,503091	550,8191	21,0736	753,9923	-220,992	48837,6
ke10	500	515,032218	532,126392	498,938	14,4753	571,8927	-71,8927	5168,558

Note :
X_t : lots of Data
S_t' : equation 1
S_t'' : equation 2
a_t : : equation 3
b_t : : equation 4
F_{t+m} : equation 5
e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,8 using MSE (equation 6) is = 21684,951325.

Table 10. Forecasting pond yield using one parameter linear exponential smoothing method brown with a = 0,9

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	580	562	599	-15,3			
ke3	600	598	594,4	602,6	-2,34	583,7	16,3	265,69
ke4	700	689,8	680,26	700,34	-7,686	600,26	99,74	9948,068

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke5	550	563,98	575,608	553,352	11,3652	692,654	-142,654	20350,16
ke6	600	596,398	594,319	599,477	-0,9711	564,7172	35,2828	1244,876
ke7	500	509,6398	518,10772	502,1719	8,52113	598,5059	-98,5059	9703,412
ke8	800	770,96398	745,678354	797,2496	-21,857	510,693	289,307	83698,54
ke9	533	556,796398	575,684594	538,9082	17,8994	775,3925	-242,393	58754,14
ke10	500	505,67964	512,680135	499,6791	7,20045	556,8076	-56,8076	3227,101

Note :

X_t : lots of Data

S_t' : equation 1

S_t'' : equation 2

a_t : : equation 3

b_t : : equation 4

F_{t+m} : equation 5

e_t : equation 7

Than the error value in the brown linear exponential smoothing method with a = 0,9 using MSE (equation 6) is = 23398,998375.

Furthermore, the value is compared to determine the value that gives the smallest//minimum MSE value. The comparison of the accuracy of the pond yield forecasting method sees the MSE as follows :

Table 11. Alpha values with MSE

Alfa	MSE
0,1	21007,81775
0,2	16407,241875
0,3	17628,823294
0,4	17970,367734
0,5	18631,025813
0,6	19452,717638
0,7	20437,403963
0,8	21684,951325
0,9	23398,998375

After knowing the error contained in the data above, forecasting the results of ponda I carried out. As already described, good forecasting is a method that provides forecasting results that are not much different from what actually happened. In other words, a good forecasting method is a method that produces the smallest possible error value. From the data obtained, it is found that α=0,2 is which gives the smallest error value.

Table 12. Forecasting pond yield using one parameter linear exponential smoothing method brown with α = 0,2

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}	e_t	e_t^2
ke1	400							
ke2	600	440	408	473	-6,2			
ke3	600	472	420,8	524,2	-10,04	466,8	133,2	17742,24
ke4	700	517,6	440,16	596,04	-15,288	514,16	185,84	34536,51
ke5	550	524,08	456,944	592,216	-13,227	580,752	-30,752	945,6855
ke6	600	539,264	473,408	606,12	-12,971	578,9888	21,0112	441,4705
ke7	500	531,4112	485,00864	578,8138	-9,0805	593,1488	-93,1488	8676,699
ke8	800	585,12896	505,032704	666,2252	-15,819	569,7332	230,2668	53022,78
ke9	533	574,703168	518,966797	631,4395	-10,947	650,406	-117,406	13784,16
ke10	500	559,762534	527,125944	593,3991	-6,3273	620,4923	-120,492	14518,39

The next stage is the forecasting stage for pond yields obtained with α=0,2 because the error value is the smallest of the overall values of α, using equation 5.

1. Forecast for the 11th month with α= 0,2 m=1

$F_{t+m}=a_t+b_tm$

$F_{10+1}=a_{10}+b_{10}(1)$

F_{11}=593,3991+(−6,3273)1

F_{11}=587,0718

2. Forecast for the 12th month with α= 0,2 m=2

$F_{t+m}=a_t+b_tm$

$F_{10+2}=a_{10}+b_{10}(2)$

F_{12}=593,3991+(−6,3273)2

F_{12}=580,7445

Table 13. Actual data forecasting pond yield

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}
ke1	400					
ke2	600	580	562	599	-15,3	
ke3	600	598	594,4	602,6	-2,34	583,7
ke4	700	689,8	680,26	700,34	-7,686	600,26
ke5	550	563,98	575,608	553,352	11,3652	692,654
ke6	600	596,398	594,319	599,477	-0,9711	564,7172
ke7	500	509,6398	518,10772	502,1719	8,52113	598,5059
ke8	800	770,96398	745,678354	797,2496	-21,857	510,693
ke9	533	556,796398	575,684594	538,9082	17,8994	775,3925

Month	X_t	S_t'	S_t''	a_t	b_t	F_{t+m}
ke10	500	505,67964	512,680135	499,6791	7,20045	556,8076
ke11						587,0718
ke12						580,7445

So forecast results for the next 2 month are :

Table 14. Forecasting pond yield for the next 2 months

Month	Kilogram(kg)
11th month	587
12th month	580

CONCLUSION

Based on the results of data processing and data analysis using the linear exponential smoothing method with $\alpha = 0{,}2$ one brown parameter and an MSE value of 16407,241875, it was obtained that the forecasting results in the 11th and 12th months of harvest decreased, namely, 587 kg and 580 kg. in this case, it is expected that the pond farmers of Cot Muda Itam Village will pay more attention to the factors that are suspected to be the cause of the decline in crop yields in the 11th and 12th months can increase (contrary to the results of forecasting).

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