Forecasting the number of airplane passengers uses the double and the triple exponential smoothing method

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Abstract. Forecasting is needed to increase capacity and infrastructure, and also to improve the quality and quantity of the airport, especially at Aji PangeranTumenggung Pranoto Samarinda's airport. The forecasting method is very diverse. It is difficult to forecast the number of passengers in each period. This is very important to compare the accuracy of the forecasting number of passengers and how to find out the best method to produce the forecasting value. This research uses the mean square error to measure the accuracy of double exponential smoothing and the triple exponential smoothing. The results of this research found the accuracy level between double exponential smoothing and triple exponential smoothing that produced the best forecasting value. MSE error calculation uses alpha constant values 0.1, 0.3, 0.5, 0.7 and 0.9. The best result is the double exponential smoothing method of alpha value 0.9 with an error value of 20522138,748.

1. Introduction

Air transport users always experience changes in the number of airplane passengers each year, data from 2010 to 2018 show changes in passenger volume in 2010 with 80,435 passengers, in 2011 there were 96,431 passengers, 98,022 in 2012 126,054, in 2014 there were 116,569 passengers, in 2015 there were 96,172 passengers, in 2016 there were 82,602 passengers, in 2017 there were 48,313 passengers, and in 2018 as many as 100,646 passengers. Data from 2010 to 2013 showed an increase in passenger volume, but from 2014 to 2017 passenger volumes tended to decline then increased again in the year. Changes in passenger increases this make it difficult for managers to make policy decisions, to increase the service and the airport facilities [1-3].

The number of aircraft passengers in the coming year can be predicted using the double exponential smoothing and triple exponential smoothing methods; this method is used the historical data on the number of passengers in the previous period. Forecasting is an important thing that is done by the manager, by knowing the prediction of the number of passengers that will come; the manager can make a comprehensive decision and can do it optimally [1-3].

2. Research method

2.1 Forecasting

Forecasting is knowledge and art to predict what will happen in the future at the present time. In doing forecasting, there must be passed data and information. Past data and information are behaviors that occurred in the past with various conditions at that time [3-4]. The exponential smoothing method is a procedure with repeated calculations that constantly uses the latest observational data. Every data used in this method is given a weight which is symbolized by alpha [4].

2.2 Double exponential smoothing

The Double Exponential Smoothing method is a linear model proposed by Brown. This method performs two smoothing processes; the rationale for the linear exponential smoothing method of Brown is similar to the linear moving average because both smoothing values must be updated from the actual data if there is a trend element [5]. The trend is a smoothed estimate of the average growth at the end of each period. The double exponential smoothing formula, namely [6]:

1) Calculate the value of the first exponential smoothing given the symbol (S't) with the equation :
$$St = \alpha.Xt + (1 - \alpha)\ t\text{-}1 \quad (1)$$
2) Calculating the second exponential smoothing value given symbol (S"t) with the equation :
$$S\ "t = \alpha.S't + (1 - \alpha)\ S"\ t\text{-}1 \quad (2)$$
3) Calculates the value of a constant and is given a symbol (αt) with the equation:
$$\alpha t = 2S' - S"t \quad (3)$$
4) Determine the number of slopes with the expression:
$$bt = \alpha/1\text{-}\alpha(S't - S"t) \quad (4)$$
5) Calculate the amount of predictive value with the equation :
$$F_{t+m} = \alpha t + bt \quad (5)$$

where:

No = First exponential smoothing value
S "t = Value of second exponential smoothing
S't-1 = Exponential smoothing value before
αt = The amount of period constant t
bt = Slope or trend value from the appropriate data
Ft + m = Predicted value for the future period
m = prediction period
Xt = Actual value of the period to t
α = Exponential smoothing parameter of magnitude $0 < \alpha < 1$

2.3 Triple exponential smoothing

Exponential Triple Technique Quadratic smoothing of one brown parameter is based on quadratic function. The technique is an extension of the Double Linear exponential technique of two Holt Parameters over the season by including a third smoothing to adjust the season component [7]. Forecasting using the Triple Linear Method of Expansion One Brown parameter is required in the following steps [8]:

1) Calculates the value of the first exponential smoothing
$$St = \alpha.Xt + (1 - \alpha)\ No\text{-}1 \quad (6)$$
2) Calculating the value of the second exponential smoothing
$$S\ "t = \alpha.S't + (1 - \alpha)\ S"\ t\text{-}1 \quad (7)$$
3) Calculating the third exponential smoothing value
$$S\ "'t = \alpha.S"\ t + (1 - \alpha)\ S\ "'\ t\text{-}1 \quad (8)$$
4) Calculate the amount of constants αt
$$\alpha t = 3S't - 3S\ "t + S'\ "t \quad (9)$$
5) Calculate the value of the bt slope
$$bt = \alpha / 2\ (1\text{-}\alpha)\ (6\text{-}5.\alpha)\ S't - (10\text{-}8.\alpha)\ S\ "t + (4\text{-}3.\alpha)\ S\ "\ 't \quad (10)$$
6) Calculate the value of ct

$$ct = \alpha 2 / 2 (1-\alpha) 2 (S't - 2S "t + S " 't) \quad (11)$$

7) Determine the amount of forecasting value, using the following formula:

$$Ft + m '= at + bt (m) + 0.5ct (m) \quad (12)$$

Where :

St ’= First smoothing period t = Smoothing constant (0 <<1)
Yt = real value of period t or actual data
St "= The smoothing of both periods t
St "’ = Smoothing all three periods t
αt = The value of the constant αt
bt = Value of bt slope
ct = Value of ct
Ft + m ’= Basic forecasting value

2.4. Forecasting accuracy value

Forecasting is said to be good also the result of the forecast has a small error so that the forecasting data made will be close to the actual request. One way that can be done is to compare errors in the forecast by looking at several factors such as the method used or alpha used [9].

Forecasting requires a method to determine the error rate of forecasting results that have been calculated using the forecasting method. There are many methods for knowing forecasting errors, methods to determine the level of accuracy. Mean Square Error (MSE), The Mean Square Error (MSE) uses the square value for each difference in the calculation that occurs. The MSE value is obtained from the equation [10-11]:

$$MSE = \Sigma(yt - \hat{y}t)^2 /n \quad (13)$$

where :

y_t = actual data in period t
ŷ_t = forecasting data in period t
n = amount of data

3. Results and discussion

3.1 Description of the system

Forecasting the number of aircraft passengers in Samarinda using the double exponential smoothing and triple exponential smoothing methods as a smoothing method to predict the number of passengers based on the data of the last 5 years. The existing data is first calculated using the double exponential smoothing and triple exponential smoothing methods, the calculation results of each method will be searched for error values using the mean square error to determine which method is the best.

3.2 Manual calculation of the double exponential smoothing method

The calculation that will be done is a manual calculation using the smoothing method twice, with alpha values 0.1, 0.3, 0.5, 0.7, and 0.9. Examples of data used are 2014 data for February and March.

Calculation of alpha = 0.1 February 2014 forecasting:

$S'_1 = (\alpha \times X_1) + (1 - \alpha) \times S'_0$
$= (0{,}1 \times 10579) + (1 - 0{,}1) \times 10579 = 10579.000$
$S''_1 = (\alpha \times S'_1) + (1 - \alpha) \times S''_0$
$= (0{,}1 \times 10579.000) + (1 - 0{,}1) \times 10579 = 10579.000$
$\alpha_1 = (2 \times S'_1) - S''_1$
$= (2 \times 10579.000) - 10579.000 = 10579.000$
$b_1 = \alpha/1-\alpha \times (S'_1 - S''_1)$
$= 0{,}1/1-0{,}1 \times (10579.000 - 10579.000) = 0$
$F_2 = \alpha_1 + b_1 = 10579.000 + 0 = 10579.000$

Calculation of alpha = 0.5 February 2014 forecasting:

S'_1 $= (\alpha \times X_1) + (1 - \alpha) \times S'_0$
$= (0,5 \times 10579) + (1 - 0,5) \times 10579 = 10579.000$
S''_1 $= (\alpha \times S'_1) + (1 - \alpha) \times S''_0$
$= (0,5 \times 10579.000) + (1 - 0,5) \times 10579 = 10579.000$
α_1 $= (2 \times S'_1) - S''_1$
$= (2 \times 10579.000) - 10579.000 = 10579.000$
b_1 $= \alpha/1-\alpha \times (S'_1 - S''_1)$
$= 0,5/1-0,5 \times (10579.000 - 10579.000) = 0$
F_2 $= A_1 + B_1 = 10579.000 + 0 = 10579.000$

Calculation of alpha = 0.9 February 2014 forecasting:
S'_1 $= (\alpha \times X_1) + (1 - \alpha) \times S'_0$
$= (0,9 \times 10579) + (1 - 0,9) \times 10579 = 10579.000$
S''_1 $= (\alpha \times S'_1) + (1 - \alpha) \times S''_0$
$= (0,9 \times 10579.000) + (1 - 0,9) \times 10579 = 10579.000$
α_1 $= (2 \times S'_1) - S''_1$
$= (2 \times 10579.000) - 10579.000 = 10579.000$
b_1 $= \alpha/1-\alpha \times (S'_1 - S''_1)$
$= 0,9/1-0,9 \times (10579.000 - 10579.000) = 0$
F_2 $= \alpha_1 + b_1 = 10579.000 + 0 = 10579.000$

Calculation of alpha = 0.9 forecasting in March 2014:
S'_2 $= (\alpha \times X_1) + (1 - \alpha) \times S'_1$
$= (0,9 \times 9236) + (1 - 0,9) \times 10579.000 = 9370.300$
S''_2 $= (\alpha \times S'_2) + (1 - \alpha) \times S''_1$
$= (0,9 \times 9370.300) + (1 - 0,9) \times 10579.000 = 9491.170$
α_2 $= (2 \times S'_2) - S''_2$
$= (2 \times 9370.300) - 9491.170 = 9249.430$
b_2 $= \alpha/1-\alpha \times (S'_2 - S''_2)$
$= 0,9/1-0,9 \times (9370.300 - 9491.170) = -1087.83$
F_3 $= \alpha_2 + b_2 = 9249.430 + (-1087.83) = 8161.6000$

Calculations with constant α = 0.1, 0.3. 0.5, 0.7, and 0.9 are continued until January 2019. The result of the calculation and testing the accuracy of forecasting are presented in the following table:

Table 1. Double exponential smoothing forecasting results

Month	Forecasting results DES				
	α = 0,1	*α = 0,3*	*α = 0,5*	*α = 0,7*	*α = 0,9*
02/14	10579	10579	10579	10579	10579
03/14	10310.4	9773.2	9236	8698.8	8161.599
04/14	10352.29	10140.61	10251.25	10684.21	11439.49
05/14	10115.37	9541.216	9223	8902.864	8322.952
06/14	9835.718	8982.293	8571.437	8346.8295	8310.005
07/14	9939.713	9716.245	10175.437	10916.269	11794.041
08/14	9950.453	9910.919	10268.078	10402.447	10090.408
09/14	10239.38	10861.50	11649.468	12172.974	12613.471
10/14	10091.07	10201.40	9987.699	9248.414	8200.240
11/14	9602.107	8729.029	7645.582	6588.691	5978.003
12/14	9228.752	8042.038	7288.657	7199.337	7749.118
01/15	9467.836	9359.339	10134.011	11497.530	12910.234
02/15	9324.727	9078.866	9243.597	9054.568	8037.665
03/15	8893.411	7995.786	7392.344	6608.213	5933.880
04/15	8242.970	6553.395	5501.945	4775.557	4529.459
05/15	8229.634	7403.169	7828.609	8951.745	10512.103

Month	Forecasting results DES				
	α = 0,1	*α = 0,3*	*α = 0,5*	*α = 0,7*	*α = 0,9*
06/15	8427.695	8546.113	9640.122	10614.887	10909.886
07/15	8269.438	8214.515	8446.720	7987.585	6936.046
08/15	8681.185	9661.996	10754.439	11565.281	12658.34
09/15	8645.839	9299.632	9379.509	8754.6360	7653.058
10/15	7785.029	6575.227	4719.899	2682.826	1019.908
11/15	6930.124	4686.298	2900.022	2203.578	2735.651
12/15	7204.849	6687.855	7700.547	10011.992	12738.231
01/16	7723.057	8708.282	10608.791	12151.643	12290.419
02/16	7656.806	8310.016	8712.405	7880.976	6113.131
03/16	7290.785	7127.653	6441.457	5260.828	4594.332
04/16	7062.919	6705.287	6217.355	6055.288	6618.455
05/16	6642.599	5797.172	5106.991	4787.618	4563.827
06/16	6776.623	6781.440	7351.402	8411.785	9653.890
07/16	6691.437	6749.581	7025.155	7053.165	6440.759
08/16	6895.492	7559.038	8262.554	8742.968	9202.783
09/16	6969.751	7703.129	8042.515	7914.366	7505.279
10/16	6930.114	7452.842	7368.626	6989.742	6690.137
11/16	6731.857	6799.395	6308.748	5817.102	5557.324
12/16	6262.069	5521.541	4523.591	3827.464	3426.683
01/17	6392.581	6407.793	6775.904	7807.079	9253.023
02/17	6354.310	6471.216	6731.506	6901.635	6448.277
03/17	5743.787	4771.663	3790.030	2624.524	1349.945
04/17	5316.116	4107.243	3478.403	3398.177	4023.396
05/17	5064.371	4106.495	4106.646	4594.369	5133.409
06/17	4717.544	3742.514	3718.295	3784.355	3549.377
07/17	4723.598	4470.777	5165.633	5882.960	6557.501
08/17	4810.126	5140.996	5977.559	6395.324	6385.666
09/17	4975.273	5787.553	6573.151	6769.368	6716.318
10/17	4929.279	5570.197	5684.511	5213.151	4630.196
11/17	3976.881	2683.724	774.973	-1310.002	-3106.973
12/17	3154.670	1038.017	-557.154	-1029.784	-248.296
01/18	2491.822	280.010	-451.647	7.039	746.500
02/18	1804.307	-447.424	-786.609	-459.105	-424.306
03/18	1300.817	-543.039	-295.697	267.662	625.513
04/18	1352.542	904.022	2354.955	3701.357	4710.705
05/18	1556.274	2225.561	3864.879	4598.564	4527.246
06/18	2075.663	3994.584	5832.390	6499.386	6731.472
07/18	2735.473	5593.833	7206.670	7491.301	7388.081
08/18	3525.613	7097.870	8412.823	8514.085	8454.151
09/18	3830.251	6736.560	6580.155	5419.554	4206.429
10/18	4149.505	6614.427	6126.949	5562.664	5699.544
11/18	4363.006	6294.084	5615.910	5243.839	5212.644
12/18	5864.052	10013.108	12033.673	14538.523	17258.073
01/19	13978.458	32528.250	47823.695	62008.368	74683.088

3.3. Manual calculation of triple exponential smoothing forecasting

The calculation that will be done is a manual calculation using the smoothing method three times, with alpha values 0.1, 0.3, 0.5, 0.7, and 0.9. Examples of data used are 2014 data for February.

Forecasting in February 2014 $\alpha = 0.1$

S'_1 = $\alpha \times X_1 + (1 - \alpha)\, S'_0$
= 0,1 × 10579 + (1-0,1) 10579 = 10579,000
S''_1 = $\alpha \times S'_1 + (1 - \alpha)\, S''_0$
= 0,1 × 10579,000 + (1-0,1) 1057 = 10579,000
S'''_1 = $\alpha \times S''_1 + (1 - \alpha)\, S'''_0$
= 0,1 × 10579,000 + (1-0,1) 10579 = 10579,000
α_1 = $3S'_1 - 3S''_1 + S'''_1$
= 3 × 10579,000 – 3 × 10579,000 + 10579,000 = 10579,000
b_1 = $\alpha/2(1-\alpha) \times (6-5 \times \alpha)S'_1 - (10-8 \times \alpha)S''_1 + (4-3 \times \alpha)S'''_1$
= 0,1/2(1-0,1) × (6-5 × 0,1) 10579,000-(10-8 × 0,1) 10579,000 +(4-3 × 0,1) 10579,000 = 0
c_1 = $\alpha \times 2/2(1-\alpha)2\, (S'_1 - 2S''_1 + S'''_1)$
= 0,1 × 2/2(1-0,1)2 × (10579,000 – 2 × 10579,000 + 10579,000) = *0*
F_2 = $\alpha_1 + b_1 + 0{,}5c_1$
= 10579,000 + 0 + 0,5 × 0 = 10579,000

Forecasting in February 2014 α = 0.7

S'_1 = $\alpha \times X_1 + (1 - \alpha)\, S'_0$
= 0,7×10579 + (1-0,7)10579 = 10579,000
S''_1 = $\alpha \times S'_1 + (1 - \alpha)\, S''_0$
= 0,7×10579,000 + (1-0,7)10579 = 10579,000
S'''_1 = $\alpha . S''_1 + (1 - \alpha)\, S'''_0$
= 0,7×10579,000 + (1-0,7)10579 = 10579,000
α_1 = $3S'_1 - 3S''_1 + S'''_1$
= 3×10579,000 – 3×10579,000 + 10579,000 = 10579,000
b_1 = $\alpha/2 \times (1-\alpha) \times (6-5 \times \alpha)S'_1 - (10-8 \times \alpha)S''_1 + (4-3 \times \alpha)S'''_1$
= 0,7/2(1-0,7) × (6-5×0,7) 10579,000-(10-8×0,7) 10579,000 + (4-3×0,7) 10579,000 = 0
c_1 = $\alpha \times 2/2 \times (1-\alpha)2 \times (S'_1 - 2S''_1 + S'''_1)$
= 0,7×2/2×(1-0,7)2×(10579,000 – 2×10579,000 + 10579,000) = 0
F_2 = $\alpha_1 + b_1 + 0{,}5c_1$
= 10579,000 + 0 + 0,5×0 = 10579,000

Forecasting in February 2014 α = 0.9

S'_1 = $\alpha \times X_1 + (1 - \alpha)\, S'_0$
= 0,9×10579 + (1-0,9)10579 = 10579,000
S''_1 = $\alpha \times S'_1 + (1 - \alpha)\, S''_0$
= 0,9×10579,000 + (1-0,9)10579 = 10579,000
S'''_1 = $\alpha \times S''_1 + (1 - \alpha)\, S'''_0$
= 0,9×10579,000 + (1-0,9)10579 = 10579,000
α_1 = $3S'_1 - 3S''_1 + S'''_1$
= 3×10579,000 – 3×10579,000 + 10579,000 = 10579,000
b_1 = $\alpha/2 \times (1-\alpha) \times (6-5 \times \alpha)S'_1 - (10-8 \times \alpha)S''_1 + (4-3 \times \alpha)S'''_1$
= 0,9/2(1-0,9) × (6-5×0,9) 10579,000-(10-8×0,9) 10579,000 + (4-3×0,9) 10579,000 = 0
c_1 = $\alpha \times 2/2 \times (1-\alpha)2\, (S'_1 - 2S''_1 + S'''_1)$
= 0,9×2/2×(1-0,9)2×(10579,000 – 2×10579,000 + 10579,000) = 0
F_2 = $\alpha_1 + b_1 + 0{,}5c_1$
= 10579,000 + 0 + 0,5.0 = 10579,000

Calculations with constant α = 0.1, 0.3. 0.5, 0.7 and 0.9 are continued until January 2019. The result of the calculation and testing the accuracy of forecasting are presented in the following table:

Table 2. Triple exponential smoothing forecasting result

Month	Forecasting results TES				
	α = 0,1	*α = 0,3*	*α = 0,5*	*α = 0,7*	*α = 0,9*
02/14	10579	10579	10579	10579	10579
03/14	10176.1	9370.3	8564.5	7758.7	6952.9

Month	Forecasting results TES				
	α = 0,1	*α = 0,3*	*α = 0,5*	*α = 0,7*	*α = 0,9*
04/14	10259.08	10102.72	10591	11723.92	13501.48
05/14	9918.35	9238.81	8877.75	8190.53	6532.51
06/14	9529.565	8556.345	8200.813	8080.025	8584.605
07/14	9733.604	9882.393	10969.406	12364.448	13819.497
08/14	9784.283	10152.249	10643.844	10288.612	8798.016
09/14	10247.279	11514.652	12465.813	12924.610	13775.365
10/14	10029.137	10264.855	9345.637	7637.123	5558.405
11/14	9310.467	8032.633	6196.701	5043.814	5292.404
12/14	8799.965	7317.551	6710.926	7681.091	9445.455
01/15	9230.154	9652.886	11556.317	14100.220	15745.561
02/15	9060.528	9166.047	9370.244	8062.604	4770.488
03/15	8463.759	7554.953	6536.869	5156.626	5038.664
04/15	7564.443	5638.578	4365.535	3896.832	4476.945
05/15	7660.263	7393.578	8837.432	11404.438	14220.738
06/15	8060.198	9222.148	11069.729	11859.773	10530.957
07/15	7898.221	8530.806	8352.963	6546.730	4299.956
08/15	8593.646	10639.545	11851.701	13056.215	15813.789
09/15	8577.735	9721.717	8944.920	7257.819	4485.296
10/15	7321.152	5466.797	2122.850	-660.464	-2026.619
11/15	6133.131	3134.829	1236.548	2115.613	5104.081
12/15	6691.843	6887.838	9905.299	14724.198	18588.688
01/16	7577.168	9950.813	13042.394	13811.010	10737.757
02/16	7533.299	8907.603	8525.310	5333.336	1917.388
03/16	7037.148	6922.56	5107.707	3342.252	4281.739
04/16	6768.368	6411.826	5643.752	6436.737	8417.497
05/16	6218.311	5221.463	4447.012	4493.051	3711.022
06/16	6520.704	7009.892	8418.917	10503.482	12572.966
07/17	6471.148	6938.166	7321.711	6606.325	4233.465
08/16	6851.388	8136.073	9014.755	9434.801	10595.069
09/16	7011.608	8152.642	8142.838	7399.538	6301.903
10/16	6988.31	7609.062	6985.031	6317.738	6272.549
11/16	6724.422	6572.497	5598.637	5155.081	5193.242
12/16	6062.792	4764.693	3417.162	2921.087	2714.083
01/17	6330.425	6451.738	7677.894	10059.741	12788.348
02/17	6325.311	6578.239	7125.549	6775.878	4469.889
03/17	5457.157	4029.915	2495.799	379.952	-1277.244
04/17	4902.07	3411.419	3027.773	3815.739	6310.427
05/17	4631.418	3801.146	4498.629	5640.013	5982.756
06/17	4223.049	3501.621	3868.963	3693.190	2628.644
07/17	4355.399	4825.198	6124.820	7046.762	8208.388
08/17	4591.987	5804.657	6802.336	6725.592	5919.404
09/17	4925.835	6593.518	7136.259	6787.022	6573.692
10/17	4918.758	5992.606	5336.989	4200.390	3354.748
11/17	3546.484	1524.352	-1881.043	-4759.036	-6753.696
12/17	2432.524	-389.961	-1958.149	-707.194	2749.408
01/18	1603.524	-799.680	-488.068	1364.366	1963.638
02/18	766.057	-1256.011	-526.996	15.9645	-880.844
03/18	231.561	-838.023	455.414	1050.758	1372.136
04/18	539.729	1699.247	4276.359	5706.122	6738.806

Month	Forecasting results TES				
	α = 0,1	*α = 0,3*	*α = 0,5*	*α = 0,7*	*α = 0,9*
05/18	1042.788	3570.911	5414.604	5082.144	3670.121
06/18	1978.499	5830.461	7277.813	7069.665	7256.638
07/18	3064.959	7554.072	8135.687	7484.314	7002.774
08/18	4283.404	8996.287	8947.996	8411.679	8379.547
09/18	4707.701	7580.091	5381.330	3264.972	1522.233
10/18	5132.185	6911.931	5117.459	5154.602	6829.338
11/18	5377.867	6154.208	4774.691	5045.355	5104.634
12/18	7545.126	11638.97	14825.108	19236.291	23391.892

The process of calculating error values on alpha values using the mean square error method is done by means of actual data minus the forecasting results and squared and then summed up with data errors which are then divided by the amount of data, 59 data. Here is an example of MSE error calculation for forecasting using alpha value 0.9 can be seen in Table 3.

Table 3. Calculation of MSE data forecasting DES on $\alpha = 0,9$

Years	Month	X_i (Actual data)	F_i (Forecasting results)	$\Sigma(X_i - F_i)^2/n$
2014	Feb	9236	10579	1,803,649.000
2014	Mar	10587	8161.599	5,882,565.160
2014	Apr	9221	11439.49	4,921,697.880
2014	May	8827	8322.952	254,064.386
2014	Jun	10530	8310.0055	4,928,375.580
2014	Jul	10133	11794.041	2,759,059.130
2014	Aug	11525	10090.408	2,058,053.458
2014	Sep	9549	12613.471	9,390,983.959
2014	Oct	7732	8200.240	219,248.852
2014	Nov	7939	5978.003	3,845,507.977
2014	Dec	10711	7749.118	8,772,743.427
2015	Jan	8965	12910.234	15,564,868.311
2015	Feb	7406	8037.665	399,001.356
2015	Mar	5975	5933.880	1,690.791
2015	Apr	8656	4529.459	17,028,336.506
2015	May	9679	10512.103	694,060.762
2015	Jun	8023	10909.886	8,334,110.912
2015	Jul	10735	6936.046	14,432,050.174
2015	Aug	8788	12658.34	14,979,534.615
2015	Sep	4620	7653.058	9,199,438.485
2015	Oct	3990	1019.908	8,821,445.782
2015	Nov	8973	2735.651	38,904,521.953
2015	Dec	10363	12738.231	5,641,722.913
2016	Jan	7801	12290.419	20,154,889.379
2016	Feb	6232	6113.131	14,129.689
2016	Mar	6628	4594.332	4,135,805.009
2016	Apr	5471	6618.455	1,316,653.228
2016	May	7902	4563.827	11,143,394.300
2016	Jun	6877	9653.890	7,711,123.565
2016	Jul	8233	6440.759	3,212,124.501
2016	Aug	7711	9202.783	2,225,416.741
2016	Sep	7175	7505.279	109,084.228
2016	Oct	6332	6690.137	128,262.807
2016	Nov	4806	5557.324	564,488.962
2016	Dec	7434	3426.683	16,058,584.881

Years	Month	X_i (Actual data)	F_i (Forecasting results)	$\Sigma(X_i - F_i)^2/n$
2017	Jan	6662	9253.023	6,713,402.613
2017	Feb	3749	6448.277	7,286,100.954
2017	Mar	4183	1349.945	8,026,198.724
2017	Apr	4713	4023.396	475,553.279
2017	May	4016	5133.409	1,248,604.671
2017	Jun	5486	3549.377	3,750,504.779
2017	Jul	5856	6557.501	492,104.357
2017	Aug	6279	6385.666	11,377.747
2017	Sep	5315	6716.318	1,963,692.947
2017	Oct	720	4630.196	15,289,640.521
2017	Nov	629	-3106.973	13,957,500.117
2017	Dec	771	-248.296	1,038,965.817
2018	Jan	104	746.500	412,806.754
2018	Feb	456	-424.306	774,940.334
2018	Mar	2796	625.513	4,711,011.190
2018	Apr	3533	4710.705	1,386,990.929
2018	May	5206	4527.246	460,706.963
2018	Jun	6245	6731.472	236,655.149
2018	Jul	7348	7388.081	1,606.564
2018	Aug	5480	8454.151	8,845,578.170
2018	Sep	5760	4206.429	2,413,581.253
2018	Oct	5454	5699.544	60,292.046
2018	Nov	12040	5212.644	46,612,782.002
2018	Dec	46224	17258.073	839,024,899.593
		Sigma amount		1210806186.1319
		MSE		20522138.748

The MSE value for $\alpha = 0.9$ is done by dividing the number of sigma results in table 4.7 with the amount of data that is 59. The process of calculating the MSE value for alpha $\alpha = 0.9$ is:

$$MSE = \Sigma(x_i - F_i)^2/n = 1210806186.1319 /59$$
$$= 20522138.748$$

The result of calculating the MSE error value for alpha $\alpha = 0.9$ is 20522138.7480 then the calculation in Table 3 is repeated for other alpha values.

3.4. Implementation

Before entering into the home menu the user must enter a username and password on the login page [12-13]. The data page is a page that displays data on the number of aircraft feeders stored in the database can be seen in Figure 1 and Figure 2.

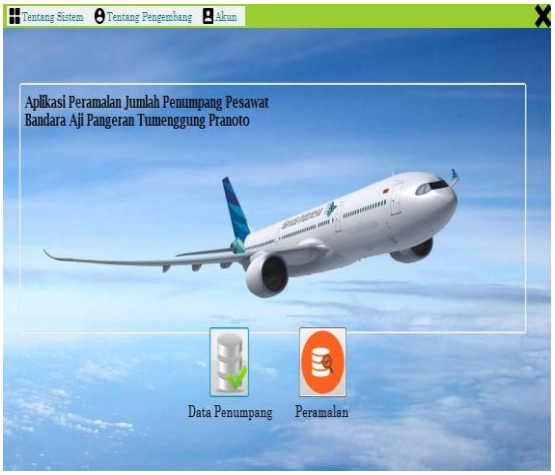

Figure 1. Home page

Figure 2. Data page

The forecasting page is a page that displays data from the calculation of the triple exponential smoothing method, double exponential smoothing, and the results of error calculations. The display of data pages can be seen in Figure 3.

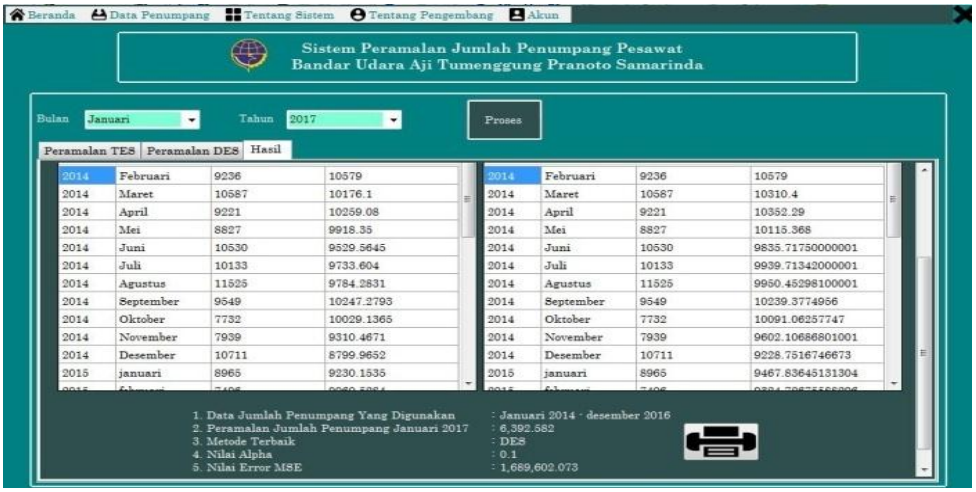

Figure 3. Forecasting page

4. Conclusions

In conclusion, the results of the study have been produced forecasting the number of airplane passengers using a comparison of the double exponential smoothing and triple exponential smoothing methods in Samarinda. The forecasting system is measured using the mean square error method as an error calculation method. It uses α constant values, which results in 5 different forecastings between the double exponential smoothing and triple exponential smoothing methods. Double exponential smoothing method with an error value of 20522138,748 obtained from an alpha value of 0.9. Triple exponential smoothing method with an error value of 21137573,741 obtained from an alpha value of 0.7. This system produces the best forecasting method, namely the double exponential smoothing method of alpha α = 0.9 resulting in an error value 20522138.748

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