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Determination of Optimal Smoothing Constants for Foreign Remittances in Bangladesh

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Abstract: Remittance is the tie that is sent to the country by earning money from abroad. In present Bangladesh, remittance is playing an important role in increasing reserves and revenue. For about two decades remittance has been contributing a huge portion of export earnings. Remittances have a significant impact on the budget of Bangladesh and also the budget depends a lot on remittances. So it is very crucial to know the future remittance to make an annual budget for upcoming year. This paper concentrates on choosing the appropriate smoothing constants for foreign remittances forecasting by Holt's method. This method is very popular quantitative skilled in forecasting. The forecasting of this deftness depends on optimal smoothing constants. So, choosing an optimal smoothing constant is very important to minimize the error of forecasting. We have demonstrated the techniques by presenting actual remittances and also presented graphical comparisons between actual and forecasting remittances for the optimal smoothing constants.

Index Terms: Foreign Remittance, Holt's Method, and Smoothing Constants

1. Introduction

Forecasting means predict about something basis on some past experience about that event. This is a process that has not yet been observed. With a good example something can be expected to change at certain times in the future. Guessing is an important issue, considering its general existence. Holt's method is simple and can give precise forecasting results comparable to the results of more complex techniques. This method is prevalent, simple to utilize and generally works well in practical applications. In this method, two smoothing constants have been used to evaluate the forecast value and these constants smooth the forecast value. So finding the optimal value of smoothing constants is very essential to make better forecast.

In Bangladesh, remittance is one of the most important economic variables in recent times as it helps in balancing balance of payments, increasing foreign exchange reserves, enhancing national savings and increasing velocity of money. The importance of foreign remittances in the economy of Bangladesh is widely recognized and requires little reiteration. Revenues from remittances now exceed various types of foreign exchange inflows, particularly official development assistance and net earnings from exports. Moreover, it is greater than foreign aid and thus helps in lessening dependence on foreign aid remittance gets momentum in recent time in Bangladesh. It also occupies an important part to make our national budget. So it is very important to know the forecast remittance to make an annual budget for next year. The aim of our project is to make a forecast for foreign remittance by using Holt's method for optimal smoothing constants.

A comprehensive procedures was used to evaluate optimal value of smoothing constants for Exponential smoothing method, Holt's method and Holt-Winter's seasonal multiplicative method[4, 5]. An appropriate forecasting technique is obtained for the newly launched biscuit company in Bangladesh [2]. For a given problem MAD & MSE are calculated with different values of smoothing constants and the optimal smoothing constants is determined by selecting the minimum values of MAD & MSE. Solver is used to determine the optimal value of smoothing constant for Exponential smoothing method [6, 7].Single smoothing forecasting techniques are attempted to evaluate the forecasts for solar irradiance and load demand [8]. Non-linear programming software is used to improve the demand forecast accuracy [11]. An appropriate quantitative forecasting method for demand forecasting of private car in Dhaka city is examined for optimal smoothing constants [13].

2. Holt's Method

Holt's Method is a popular smoothing method for forecasting data with trend. Holt's method uses two parameters, one for the overall smoothing and the other for the trend smoothing equation. In that case, many techniques have been developed to resolve the complexities of forecasting errors and are generally referred to as the "Holt's method".

It should be noted that Holt's method performs well where only trend but no seasonality exists.

The time series exhibits a trend here; the trend (slope) has to be calculated in addition to the level variable. The forecast for t+k period at the end of time t, is provided by

$$F_{t+k} = L_t + k * T_t$$

Here, L_t is the estimate of level made at the end of period t and is given by

$$L_t = \alpha A_t + (1-\alpha)F_t$$

T_t is the estimate of trend at the end of period t and is given by

$$T_t = \beta(L_t - L_{t-1}) + (1-\beta)T_{t-1}$$

β is also a smoothing constant between 0 and 1 and plays a role similar to that of α

Again, small values of α and β suggest that consecutive level and trend variable estimates do not vary much from each other. In the sense of the new demand, any revision is minimal. This method requires estimation of the initial level component L_t and the initial trend component T_t to start off the series of forecasts.

Initialization:

The initial estimated base label L_0 is assumed from the last period observation and initial trend T_0 is the average monthly or weekly change.

$L_0 =$ Last period's observation

$T_0 =$ Average monthly or weekly increase

3. Foreign Remittance Investigation

Foreign remittances data are given for some previous years. We have to forecast remittances for next ten years [The daily New Age].

Table 1. Foreign remittance of Bangladesh in different years

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Remittances (in billion USD)	10.71	11.0	12.17	14.17	13.83	14.94	15.31	12.46	13.53	15.53	18.42	19.8

Table-1 describes the foreign remittance of Bangladesh in different year. To evaluate the forecast value by Holt's method, first of all we have to initialize the estimated base label and trend.

Initialization:

Let the initial estimated base be L_0

And the initial estimated trend be T_0

$L_0 =$ Last year's observation $= 19.8$

$T_0 =$ Average yearly increase

$$\frac{(11-10.71)+(12.17-11)+(14.17-12.17)+\cdots+(19.8-18.42)}{11} = 0.826363636$$

Now, firstly we fixed a particular value of α then calculate MAD, MSE & MAPE for the different values of β. After that, we fixed another value of α then for different values of β, we compute MAD, MSE & MAPE. Continuing this process by fixing a particular value of α and changing the values of β, we get MAD, MSE & MAPE and find out whether MAD, MSE & MAPE give minimum value.

The process is shown by the following Table 2:

Table 2. MAD, MSE & MAPE for different values of α & β

constant (α)	constant (β)	MAD	MSE	MAPE
0.1	0.2	4.7113	32.3937	36.2483
	0.5	4.4696	32.2468	32.6697
	0.7	4.7486	34.9262	33.8883
0.2	0.1	3.8734	24.3194	29.7765
	0.5	3.8915	26.7945	28.0940
0.3	0.1	3.2104	20.3071	24.5128
	0.4	3.6471	22.3495	26.7073
0.4	0.1	2.9872	18.3882	22.5526
	0.3	3.44408	19.8661	25.2613
0.5	0.1	2.9252	17.3803	21.8667
	0.4	3.4969	19.8054	25.7287
0.6	0.1	2.8136	16.9089	20.8751
	0.4	3.3418	19.5871	24.6136
	0.8	3.4078	23.3995	25.0248
0.7	0.1	2.7213	16.8054	20.1266
	0.3	3.0796	18.7551	22.6463
0.8	0.1	2.7205	16.7995	20.0316
	0.3	2.9817	19.2148	21.8170
	0.7	3.6126	24.4224	27.0118
0.9	0.1	2.7291	17.4618	19.9891
	0.2	2.8877	18.7218	21.1030
	0.7	3.8007	26.6012	28.6235

Table-2 shows that, MAD gives minimum value for smoothing constants $\alpha = 0.8$ & $\beta = 0.1$, MSE gives minimum value for smoothing constants $\alpha = 0.8$ & $\beta = 0.1$ and MAPE gives minimum value for smoothing constants $\alpha = 0.8$ & $\beta = 0.1$

Now, this time we fixed a particular value of β then calculate MAD, MSE & MAPE for the different values of α. After that we fixed another value of β then for different values of α, we compute MAD, MSE & MAPE. Continuing this process by fixing a particular value of β and changing the values of α, we get MAD, MSE & MAPE and find out whether MAD, MSE & MAPE give minimum value. The process is shown by the following table:

Table 3. MAD, MSE & MAPE for different values of β & α

Smoothing constant (β)	Smoothing constant (α)	MAD	MSE	MAPE
0.1	0.2	3.8734	24.3194	29.7765
	0.4	2.9872	18.3882	22.5526
	0.8	2.7205	16.7995	20.0316
0.2	0.1	4.7113	32.3937	36.2483
	0.4	3.2635	19.1692	24.0921
	0.7	2.9783	17.7714	21.8778
0.3	0.2	3.7987	25.3740	27.8241
	0.6	3.2495	18.6572	23.8784
	0.9	3.0789	20.0548	22.7328
0.4	0.3	3.6471	22.3495	26.7073
	0.7	3.1056	19.7918	22.8684
0.5	0.1	4.4696	32.2468	32.6697
	0.4	3.6816	21.3836	27.1022
	0.7	3.1191	20.8670	22.9373
	0.6	3.3658	20.5595	24.8299
0.6	02	3.9479	27.0218	28.5895
	0.4	3.8133	22.3046	28.1864
	0.7	3.2490	21.9615	23.9831
0.7	0.1	4.7486	34.9262	33.8883
	0.5	3.6822	22.5968	27.2055
0.8	0.2	3.9892	27.6051	29.2658
	0.6	3.4078	23.3995	25.0248
	0.7	3.6314	24.2311	26.9104
0.9	0.1	4.9112	36.4444	34.7122
	0.3	4.1733	26.4499	30.9463
	0.4	4.0029	25.1278	29.6662

Table-3 shows that, MAD gives minimum value for smoothing constants $\beta = 0.1$ & $\alpha = 0.8$, MSE gives minimum value for smoothing constants $\beta = 0.1$ & $\alpha = 0.8$ and MAPE gives minimum value for smoothing constants $\beta = 0.1$ & $\alpha = 0.8$

Lower values of MAD, MSE & MAPE and corresponding value of smoothing constants are shown in the following Table 4:

Table 4. Optimal values of smoothing constants α & β

Criteria	Minimum value	value of α	value of β
Mean Absolute Deviation (MAD)	2.7205	0.8	0.1
Mean Squared Error (MSE)	16.7995	0.8	0.1
Mean Absolute Per. Error (MAPE)	20.0316	0.8	0.1

From Table-4, we see that, MAD & MAPE both give the minimum value for the value of smoothing constants $\alpha = 0.8$ & $\beta = 0.1$; therefore, $\alpha = 0.8$ & $\beta = 0.1$ are the optimal value of smoothing constants.

Now, we calculate forecast values for the optimal smoothing constants.

The forecast of next ten years foreign remittances are in below:

Table 5. Forecast values for optimal smoothing constants $\alpha = 0.8$ & $\beta = 0.1$

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Remittances (in billion)	20.00397	20.51936	21.0347	21.5501	22.0655	22.5808	23.0962	23.6116	24.1270	24.6424

From Table-5, we get the forecast value for the next ten years. Using Holt's method the forecast value for the optimal smoothing constants $\alpha = 0.8$ & $\beta = 0.1$ at the 2030th year is 24.6424

The following Figure represents the comparison between actual remittances and corresponding forecast values for optimal smoothing constants.

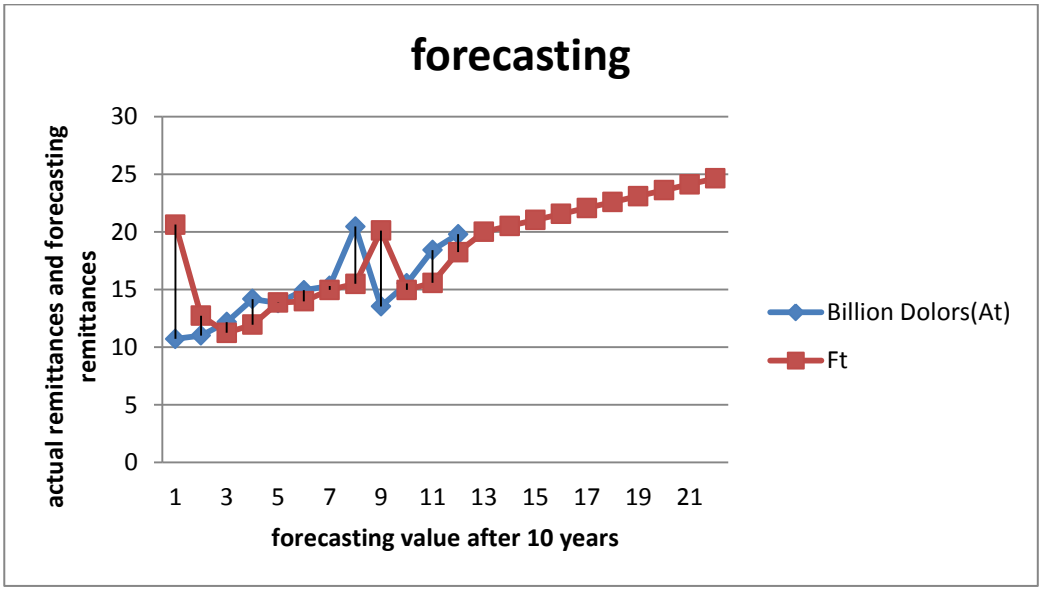

Fig.1. Comparison of actual remittances and forecast value (Holt's Method)

Figure-1 compares the actual remittances and forecast remittances and also describes the forecast remittances for the next ten years. From this figure we also conclude that the next ten years remittances will increase continuously.

To solve the given problem, we use Holt's method and we get the optimal smoothing constants $\alpha = 0.8$ & $\beta = 0.1$ and the corresponding forecast value for the 2030th year is 24.6424

4. Conclusion

Bangladesh's remittances have contributed to employment, poverty alleviation and foreign exchange reserves. As a result, a country is developed as a country with potential for the future. The resolution of the lesson shows that in recent year's remittance growth increased though migration decreased slowly. The role of remittances in the economies of labour sending countries such as Bangladesh is assuming increasing importance. The better a country forecasts is more ready to utilize potential prospects and decrease prospective risks. Thus, forecasts accuracy should be very crucial to maintain their information sources. Holt's Method is widely used to forecast the future events and it has two smoothing constants. The aim of this project was to determine the optimal smoothing constants to calculate the forecast value for foreign remittances in Bangladesh. Mean Absolute deviation (MAD), Mean Square Error (MSE) and Mean Absolute Percentage Error (MAPE) are applied to get optimal values of the smoothing constants. We have also computed corresponding forecast values for the next ten years foreign remittances.

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