Economic Affairs, Vol. 62, No. 2, pp. 297-301, June 2017
DOI: 10.5958/0976-4666.2017.00012.2

A Study on Dynamicity of Data on the Import of Fish to Tripura

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ABSTRACT

In the present study, an attempt has been made to study the dynamicity of the data (1998-99 to 2015-16) on imports of fishes from other states to Tripura. Some time series models such as moving average, exponential smoothing have been tried to capture the trend of imports over the years in order to smooth out short-term fluctuations and highlight longer-term trends or cycles. The appropriate time series model has been identified and it has been evaluated by the model accuracy parameters like bias, Mean Absolute Deviation (MAD), Mean Squared Error (MSE), Mean Absolute Percent Error (MAPE). It is revealed that the precision levels are much higher when the 2-interval simple moving average is used or the progressively lower values of smoothing constant is employed as it closely fits that actual data. The importance of such studies stems from the fact that the policy makers need the trend/pattern of imports of fishes/various items over the years in advance which helps to determine/regulate the trade policy of such items.

Keywords: Moving average, exponential smoothing, accuracy parameters, smoothing constant, Dynamics.

Fish is one of the major constituents of the diet of people of Tripura. It is not only an important source of protein in the diet of majority of people living in the state but also a vital source of livelihood to the people engaged in this sector directly or indirectly in order to promote their economic condition in rural areas and also to provide employment to the unemployed. The local production is not sufficient enough to provide the required quantity of fish to the populace of the State. During 2014-15, the fish production was estimated to be 66,564 Mt, whereas the reported requirement was of 65,163 Mt (GoT, 2015). This gap in supply and demand for fish attracted fish producers and fish traders from other states like Andhra Pradesh, and West Bengal and even from the neighboring country Bangladesh (Nandeesha, 2008). The Department of Fisheries (Government of Tripura) has also reported that requirement of fish is higher than the fish produced locally and the state procures fish from other states to meet its demand. The local fish producers have comparative advantage in terms of marketing and better prices for fresh fish. On the other hand, the inter-state fish producers have the advantage of higher productivity at low cost due to economies of scale (Upadhyay, 2008). During 2013-14, the Department has aimed at a target of raising the per capita availability to 17 kg from 16.33 Kg for expected populace by producing 61950 tons of fish, through utilizing 25333 ha of culture area i.e. the average productivity of culture ponds have to be brought up to 2700 kg/ha/annum and 3000 Kg/ha/Year by 2020. A crude estimation was made with the assumption that 95% of the expected population would require 13 kg fish/capita/year. Based on this estimation, the fish production of 43,280 Mt in 2010-2011was increased to 65,163 Mt by 2014-2015. This projection though based on nutritional requirement, is only a crude estimation, whereas the actual fish demand in Tripura is a matter of research.

It is, thus, expected that the set target of 61259 tons (6.6% growth over previous year), enabling per capita availability of 16.81 kg of locally produced fish for its fish eating populace, already been achieved during 2013-14 with expected increase in average productivity of culture resources to 2581 kg/ha/annum (against 2600 kg/ha/annum during 2013-14). Popularization and adoption of various schemes and projects by the Department of Fisheries, Government of Tripura, in an integrated way, plays a meaningful role in socio-economic development of this state. Fishery sector plays an important role in nutritional security, employment and development of rural and urban socio-economic status. The minimum requirement of fish in Tripura per year for an individual is 11 Kg. Most of the people take fish as a diet. Besides, a number of people consume dry-fish. But the present production of fish in the state is below than the minimum requirement may be due to the fact that the level of exploitation and utilization of the resources for aquaculture purpose is low. In this study, an attempt has been made to capture the dynamics of the import value of fish from different states/country by employing exponential smoothing and moving average methods and to identify the appropriate model in terms of the performance of different accuracy parameters.

Data Base and Methodology

In the present study, the data of imports of fish were collected from Department of Fisheries, Government of Tripura. In order to identify the data trends of import from 1998-2015 different time series modeling (Box *etal*.2008) techniques such as moving average, exponential smoothing for short series of data have been employed. A moving average is commonly used to smooth out short-term fluctuations and highlight longer-term trends or cycles. The threshold between short-term and long-term depends on the application, and the parameters of the moving average are to be set accordingly. The moving average is used to locate trends in macroeconomic time series which perform the following three functions, viz., Smoothing the data, which means to improve the fit of the data to a line, reducing the effect of temporary variation and random noise, highlighting outliers above or below the trend. Points in the exponential moving average also represent an average of a specified number of previous periods where as the exponential smoothing applies weighting factors to previous periods that decrease exponentially, never reaching zero. As a result, exponential smoothing takes into account all previous periods instead of a designated number of previous periods that the weighted moving average does.

Exponential smoothing is sometimes referred to as an EMA (Exponential Moving Average) or an EWMA (Exponential Weighted Moving Average). Exponential smoothing was first suggested by Robert Goodell Brown in 1956. Thus, exponential smoothing is referred to as "Brown's Simple Exponential Smoothing" is shown as follows:

$$S_0 = X_0$$

$$S_t = \alpha X_t + (1-\alpha)\, S_{t-1}$$

Where,

α = Smoothing constant $0 < \alpha < 1$

$S_t = Y_{t\text{-exp}}$ = Forecast Value at time = t

$X_t = X_{t\text{-act}}$ = Actual Value at time = t

This formula was used to perform exponential smoothing in this article. This exponential smoothing formula is convenient because it can be applied when as few as 2 time periods of data are available. The initial value of S_0 plays an important role in calculating every subsequent S_t. Several methods of initializing the value of S_0 have been evaluated. One possibility is to set S_0 to the target value of the process. Another method is to set S_0 to the average of the first four or five actual data values. The smaller the alpha, the greater is the importance of the proper value of S_0 because lower value of alpha cause greater smoothing of the forecast and therefore less resemblance to the original data observations. Alpha can be set to any value between 0 and 1. The closer alpha is to 0, the more smoothing will occur in the forecasted values. The closer alpha is to 1, the less smoothing will occur and consequently the forecasted values will more closely resemble the observed data values.

Analyzing Forecast Accuracy

Accuracy can be described as goodness of fit. The two components of forecast accuracy are, the (a) **Forecast Bias** – The tendency of a forecast to be consistently higher or lower than actual values of a time series. Forecast bias is the sum of all error

Table 1: Moving average of the 2, 4, 6 periods for each data point

Year	Import	Forecast 2 intervals	Forecast 4 intervals	Forecast 6 intervals
1	2124.00			
2	3190.00	2657.00		
3	2588.00	2889.00		
4	3444.10	3016.05	2836.53	
5	3300.00	3372.05	3130.53	
6	4211.25	3755.63	3385.84	3142.89
7	3613.16	3912.21	3642.13	3391.09
8	6043.09	4828.13	4291.88	3866.60
9	7902.70	6972.90	5442.55	4752.38
10	8660.01	8281.36	6554.74	5621.70
11	11504.37	10082.19	8527.54	6989.10
12	18241.17	14872.77	11577.06	9327.42
13	15189.67	16715.42	13398.81	11256.84
14	20305.40	17747.54	16310.15	13633.89
15	23660.69	21983.05	19349.23	16260.22
16	11885.74	17773.22	17760.38	16797.84
17	14977.66	13431.70	17707.37	17376.72
18	15289.84	15133.75	16453.48	16884.83

Table 2: Performance of the model accuracy parameters of moving average model

Accuracy parameters	2 interval	4 interval	6 interval
Bias	387.23	1190.71	2475.63
MAD	1338.44	2496.97	20930600.70
MSE	3851452.88	9931846.33	3845.81
MAPE	12.93	21.00	29.88

Table 3: Exponential smoothing of different values of smoothing constant for each data point

Year	Import	Smoothing Constant α=		
		0.2	0.5	0.7
1	2124.00			
2	3190.00	2124.00	2124.00	2124.00
3	2588.00	2976.8	2657	2443.8
4	3444.10	2665.76	2622.5	2487.06
5	3300.00	3288.432	3033.3	2774.172
6	4211.25	3297.686	3166.65	2931.92
7	3613.16	4028.537	3688.95	3315.719
8	6043.09	3696.235	3651.055	3404.951
9	7902.70	5573.719	4847.073	4196.393
10	8660.01	7436.904	6374.886	5308.285
11	11504.37	8415.389	7517.448	6313.803
12	18241.17	10886.57	9510.909	7870.973
13	15189.67	16770.25	13876.04	10982.03
14	20305.40	15505.79	14532.85	12244.32
15	23660.69	19345.48	17419.13	14662.65
16	11885.74	22797.65	20539.91	17362.06
17	14977.66	14068.12	16212.82	15719.16
18	15289.84	14795.75	15595.24	15496.71

divided by the number of periods. A positive bias indicates a tendency to under-forecast. A negative bias indicates a tendency to over-forecast. Bias does not measure accuracy because positive and negative errors cancel each other out. (b) **Forecast Error** – The difference between actual values of a time series and the predicted values of the forecast. The most common measures of forecast error are the following:

Sl. No.	Accuracy Parameters	Equations
1	Bias	∑Et/n = ∑(Yt-act – Yt-est)/n
2	MAD – Mean Absolute Deviation	∑ ǀEtǀ / n = ∑ ǀ(Yt-act – Yt-est) ǀ / n
3	MSE – Mean Squared Error	∑ Et2 / n = ∑ (Yt-act – Yt-est)2 / n
4	MAPE – Mean Absolute Percent Error	∑ (ǀEtǀ / Yt-act) * 100% / n = ∑ (ǀ(Yt-act – Yt-est)ǀ / Yt-act) * 100% / n

RESULTS AND DISCUSSION

It is interesting to note that the 2-interval simple moving average creates a smoother graph than the 4-interval simple moving average. In this case the 2-interval simple moving average might be the more desirable than the 4-interval moving average. As expected, the 6-interval simple moving average is significantly smoother than the 2 or 4-interval simple moving averages (Fig. 1). A smoother graph more closely fits a straight line. Bias, MAD, MSE, MAPE and RMSE are summarized for the 2-interval, 4-interval, and 6-interval simple moving averages as follows in the Table 2. The 2-interval simple moving average is the model that most closely fits that actual data in terms of the values of the accuracy parameters.

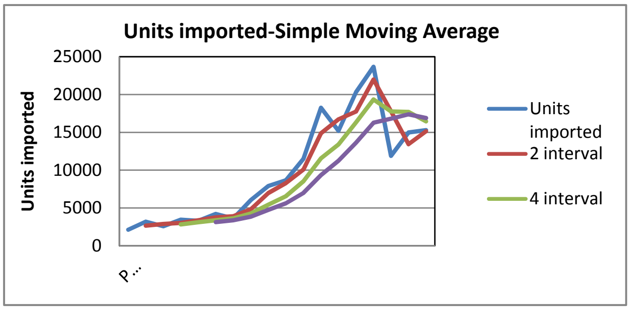

Fig. 1: Comparison of different series of moving average along with original data

In case of Exponential smoothing constant alpha is set to 0.2. For comparison, an exponential weighted moving average was calculated with alpha = 0.5, 0.7 and added to the chart (Fig. 2).

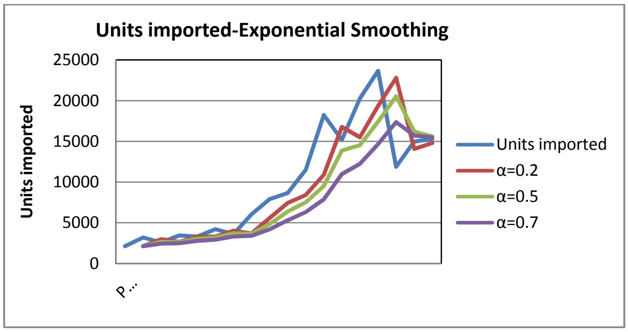

Fig 2: Comparison of different values of smoothing constant along with original data

Table 4: Performance of the model accuracy parameters of exponential smoothing model

Accuracy parameters	α=0.2	α=0.5	α=0.7
Bias	960.81	1566.89	2609.93
MAD	14309238.83	15640954.93	21454171.33
MSE	2525.12	2783.30	3365.78
MAPE	23.97	25.21	30.02

The progressively lower alpha caused forecasted values to be closer to actual data observations and less "smoothed."The alpha = 0.7 series weighted moving average is significantly smoother than the other two weighted moving averages that have alpha = 0.5 and alpha = 0.2. A smoother graph more closely fits a straight line. Bias, MAD, MSE, MAPE and RMSE are summarized for the alpha = 0.2, alpha = 0.5, and alpha = 0.7 exponential weighted moving averages as follows in the Table 4. The alpha = 0.2 exponential weighted moving average is the model that most closely fits that actual data, as would be expected.

CONCLUSION

It is revealed from the study that the precision levels are much higher when the 2-interval simple moving average is used and the progressively lower values of smoothing constant is employed in case of exponential smoothing which closely fit the actual data. Hence, the 2-interval simple moving average or the progressively lower values of smoothing constant in case of exponential smoothing would be taken as the appropriate model to study the dynamicity of the import data.

ACKNOWLEDGMENTS

The authors express their sincere acknowledgment to the authority of the College of Fisheries (Central Agricultural University), Lembucherra, Tripura for all sorts of assistance.

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