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Forecasting Foreign Exchange Rates Based on Artificial Neural Networks of Different Countries Currency Based on India Rupee

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ABSTRACT: This Research paper investigates the behavior of daily exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR. This Research paper attempts to examine the performance of ANN model in forecasting the currencies traded in Indian foreign exchange markets. The accuracy of the forecast is compared with Mean Error (ME), Mean Absolute Error (MAE), Mean Percentage error (MPE), Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE), Mean Absolute Square Error. Study the performance indicators of model by using AIC and BIC values. This research paper attempts to examine the performance of ANN model in forecasting the currencies traded in Indian foreign exchange markets. Study the Forecasting value of next 5 years exchange rates USD American dollar, GBP British Pound, CHF Swiss Franc and JPY Japanese JPY currencies with INR Indian data from that investigates the behavior of daily exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR.

Comparison of daily exchange rates of USD American dollar, GBP British Pound, CHF Swiss Franc and JPY Japanese JPY currencies with INR Indian currency data taken from 15th May 2011-13th May 2021 analyzed is collected from the official website (<http://www.rbi.org.in>) of Reserve Bank of India (RBI).

KEYWORDS: Forecasting, ANN, ME, MAE, MPE, MAPE, RMSE, AIC and BIC

I. INTRODUCTION

Sunitha et al (2018) proposed the Forecasting GDP using ARIMA and Artificial Neural Networks Models under Indian Environment. Artificial neural networks (ANNs) are one of the most accurate and widely used forecasting models that have enjoyed fruitful applications in forecasting social, economic, engineering, foreign exchange, stock problems, etc. In fact, real world systems are often nonlinear (Zhang, Patuwo, & Hu, 1998). Meanwhile, in recent years neural networks have shown the dramatical power in a wide spectrum of domains, e.g., natural language processing, computer vision, speech recognition, time series analysis, etc [Wang et al., 2016b; Sutskever et al., 2014; Yang et al., 2015; Lipton et al., 2015; Guo et al., 2016]. For timeseries data, two mainstream architectures, convolutional neural network (CNN) and recurrent neural network (RNN), have been exploited in different tasks, e.g., RNN in time series classification [Lipton et al., 2015] and CNN in activity recognition and snippet learning [Liu et al., 2015; Yang et al., 2015]. RNN is powerful in discovering the dependency in sequence data [Chung et al., 2014] and particularly the Long Short-Term Memory (LSTM) RNN works well on sequence data with long-term dependencies [Chung et al., 2014; Hochreiter and Schmidhuber, 1997] due to the internal memory mechanism.

Table 1.1 below pertains a fair simple information of relevant studies more recently:

Author	Methodology	Main Findings
Nwankwo (2014)	ARIMA	AR (1) model (i.e ARIMA (1, 0, 0)) was the best.
Pedram and Ebrahim (2014)	ARIMA, ANN	ANNs are far much better than ARIMA models
Erdogan and Goksu (2014)	ANN	ANNs can closely forecast the future EUR/TRY exchange rates
Babu and Reddy (2015)	ARIMA, ANN, Fuzzy Neuron	ARIMA model performs better than complex non-linear models

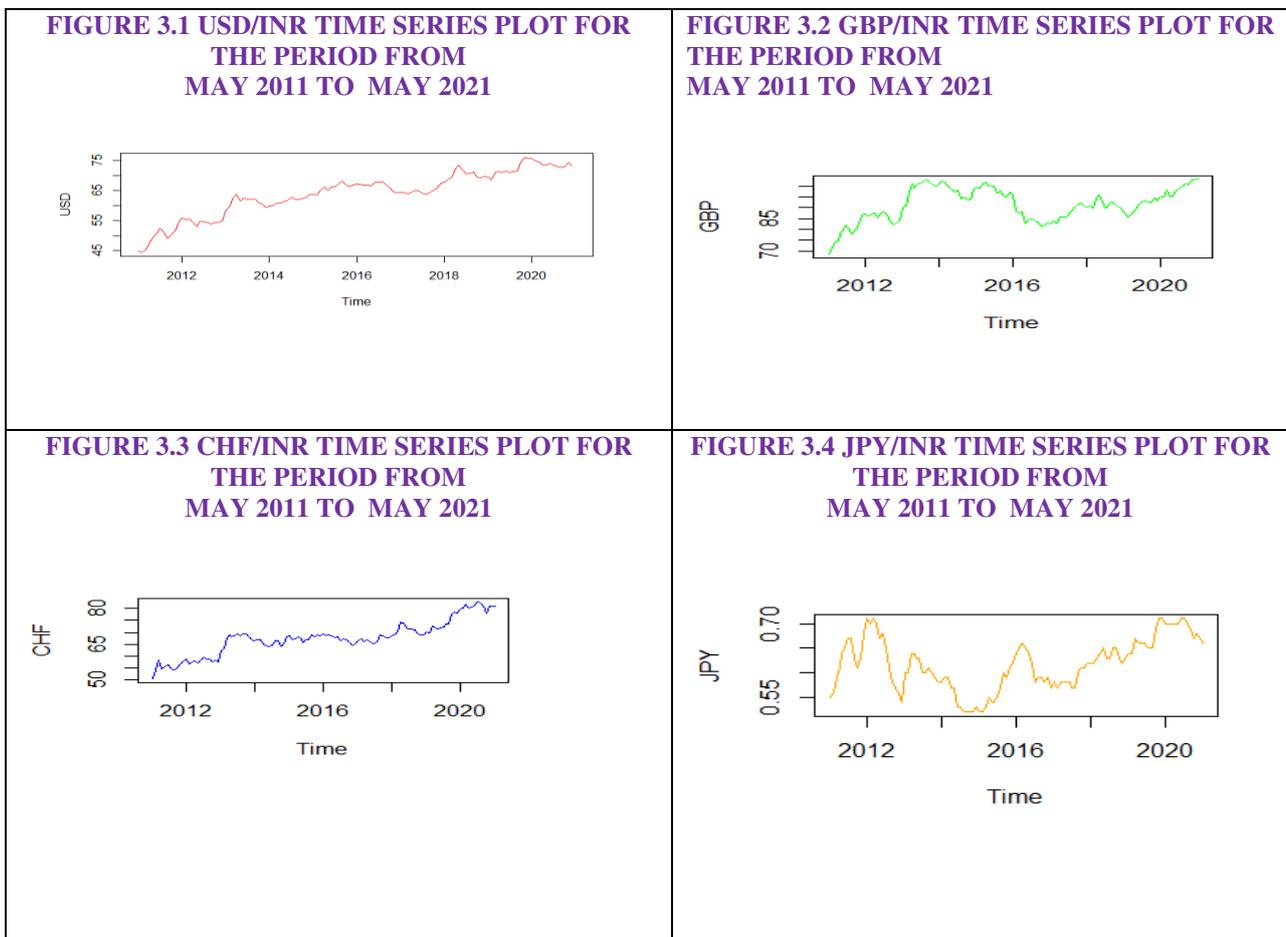


Gupta and Kashyap (2015)	ARIMA	The following models were found to be performing very well: ARIMA (0, 1, 1), ARIMA (2, 1, 1) and ARIMA (2, 1, 2)
Mia et al. (2017)	ARIMA, ESM, ANN	ANNs perform better than ARIMA models
Nyoni (2018l)	ARIMA	ARIMA (1, 1, 1) is the optimal model

This Research paper investigates the behavior of daily exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR. This Research paper attempts to examine the performance of ANN model in forecasting the currencies traded in Indian foreign exchange markets. The accuracy of the forecast is compared with Mean Error (ME), Mean Absolute Error (MAE), Mean Percentage error (MPE), Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE), Mean Absolute Square Error. Study the performance indicators of model by using AIC and BIC values. This research paper attempts to examine the performance of ANN model in forecasting the currencies traded in Indian foreign exchange markets. Study the Forecasting value of next 5 years exchange rates USD American dollar, GBP British Pound, CHF Swiss Franc and JPY Japanese JPY currencies with INR Indian data from that investigates the behavior of daily exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR.

Comparison of daily exchange rates of USD American dollar, GBP British Pound, CHF Swiss Franc and JPY Japanese JPY currencies with INR Indian currency data taken from 15th May 2011-13th May 2021 analyzed is collected from the official website (<http://www.rbi.org.in>) of Reserve Bank of India (RBI).

The exchange rate series USD/INR, GBP/INR, CHF/INR and JPY/INR for the period from May 15th, 2011 to May 13th, 2021 is exhibited in Figure 2.1,2.2,2.3 and 2.4.



When we observe the Figures 2.1, 2.2, 2.3 and 2.4, the variable is not stationary because it has got a trend and it's a stochastic trend hence it can be made stationary by differencing it. Hence, lag differencing technique is used to convert



these non-stationary series to stationary series. General information about the daily exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR.

2.1 PARAMETER ESTIMATION AND ITS STANDARD ERRORS OF ANN MODEL

TABLE 3.1 PERFORMANCE INDICATOR BASED ON DAILY EXCHANGE RATES BETWEEN USD/INR, GBP/INR, CHF/INR AND JPY/INR

	USD/INR	GBP/INR	CHF/INR	JPY/INR
σ^2	0.01762	0.04469	0.03122	0.000434

PERFORMANCE MEASUREMENTS

Let S_t be the actual value, f_t is forecasted value, $e_t = S_t - f_t$ is the forecast error and 'n' is the sample size of the foreign exchange test set. Also,

$$\text{Test mean} = \bar{S} = \frac{\sum_{t=1}^n S_t}{n} \quad \dots (2.1)$$

$$\text{Test Variance} = \sigma^2 = \frac{\sum_{t=1}^n (S_t - \bar{S})^2}{n} \quad \dots (2.2)$$

$$\text{ME} = \frac{\sum_{t=1}^n e_t}{n} \quad \dots (2.3)$$

$$\text{RMSE} = \sqrt{\frac{\sum_{t=1}^n e_t^2}{n}} \quad \dots (2.4)$$

$$\text{MAE} = \frac{\sum_{t=1}^n |e_t|}{n} \quad \dots (2.5)$$

$$\text{MPE} = \frac{\sum_{t=1}^n (e_t / S_t)}{n} \times 100 \quad \dots (2.6)$$

$$\text{MAPE} = \frac{\sum_{t=1}^n |e_t / S_t|}{n} \times 100 \quad \dots (2.7)$$

$$\text{MASE} = \frac{\sum_{t=1}^n e_t}{\frac{1}{n} \sum_{t=2}^n |S_t - S_{t-1}|} \quad \dots (2.8)$$

TABLE 2.2 ME, RMSE, MAE, MPE, MAPE AND MASE BASED ON DAILY EXCHANGE RATES BETWEEN USD/INR, GBP/INR, CHF/INR AND JPY/INR

	ME	RMSE	MAE	MPE	MAPE	MASE
USD/INR	0.0062	1.0441	0.7923	-0.0196246	1.2722	0.9457
GBP/INR	0.0112	2.018	1.5103	-0.03694	1.6581	0.9329
CHF/INR	0.0078	1.4381	1.0767	-0.0356	1.6124	0.9598
JPY/INR	0.0001	0.0163	0.0124	-0.0525	2.0321	1.0052

II. FORECASTING BASED ON DAILY EXCHANGE RATES BETWEEN USD/INR, GBP/INR, CHF/INR AND JPY/INR

After performing behavior of the monthly exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR of analytical checking, the job is to forecast. Forecasts are presented in Table 3.1. The post sample period



forecasting indicates that the monthly exchange rates between USD/INR, EUR/INR and AUD/INR will be rising as evident from monthly observations. Forecasting based on monthly exchange rates between USD/INR, GBP/INR, CHF/INR and JPY/INR for 2022 to 2027 years. Figure 3.1,3.2,3.3 and Figure 3.4 below illustrate the design for 5 years' forecast.

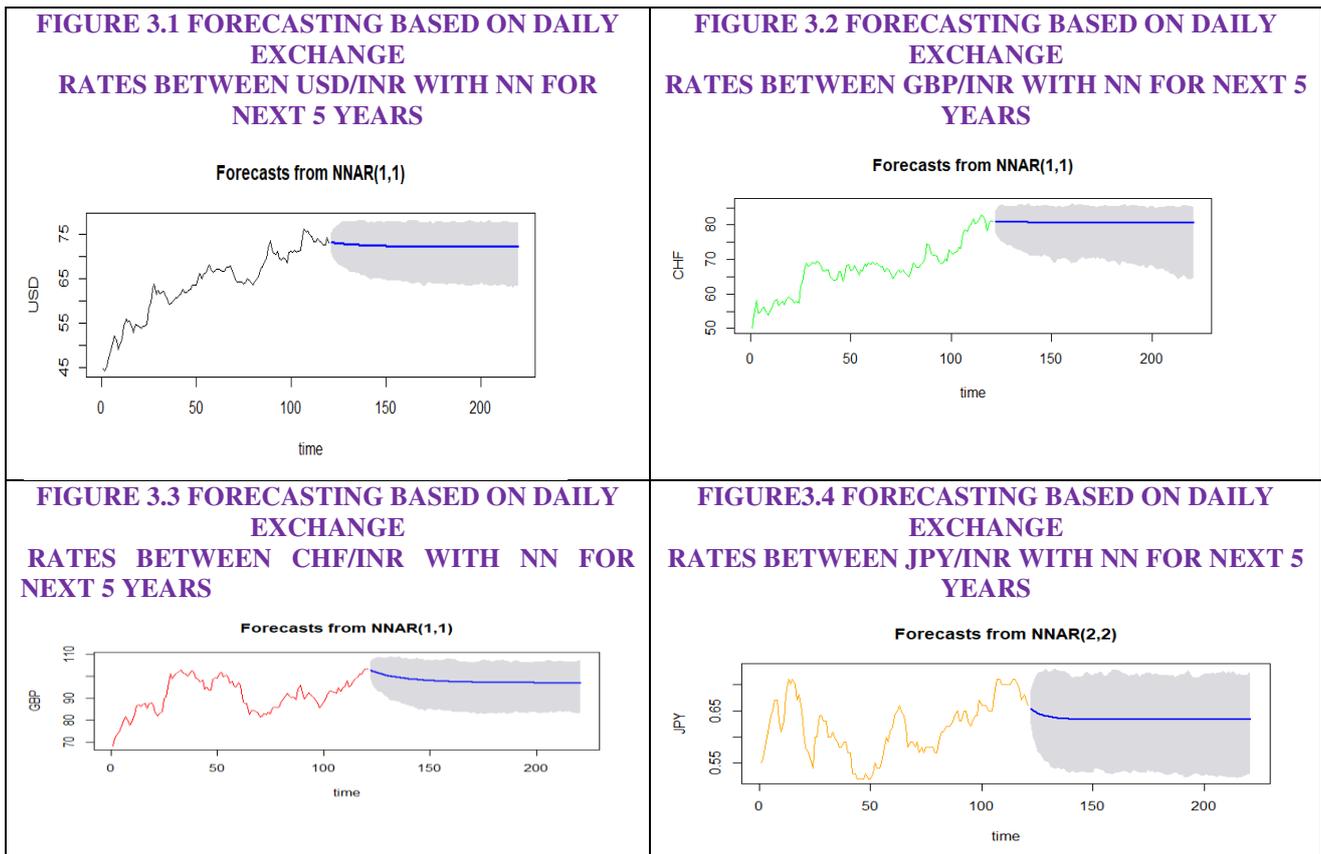


TABLE 3.1 SAMPLE OF FORECASTED OBSERVATIONS BASED ON MONTHLY EXCHANGE RATES BETWEEN USD/INR, GBP/INR, CHF/INR AND JPY/INR

Date	USD/INR			GBP/INR			CHF/INR			JPY/INR		
	Foreca st	Lo 95	Hi 95	Fore cast	Lo 95	Hi 95	Fore cast	Lo 95	Hi 95	Forec ast	Lo 95	Hi 95
31/5/2011	73.23	70.99	75.49	102.75	98.66	106.87	81.03	77.83	84.15	0.65	0.62	0.69
30/6/2021	73.17	70.21	76.15	102.33	96.29	107.76	80.98	76.84	84.98	0.65	0.6	0.7
31/7/2021	73.11	69.6	76.61	101.95	94.57	108.29	80.94	75.88	85.52	0.65	0.59	0.71
31/8/2021	73.06	68.99	77.15	101.6	93.72	108.4	80.9	75.2	85.77	0.65	0.57	0.72
30/9/2021	73.01	68.74	77.36	101.29	92.86	108.5	80.87	75.01	85.79	0.64	0.57	0.72
31/10/2021	72.96	68.2	77.39	101	92.79	108.77	80.85	74.46	85.27	0.64	0.56	0.72
30/11/2021	72.92	67.81	77.69	100.74	91.93	108.32	80.83	73.98	85.5	0.64	0.56	0.73
31/12/2021	72.8	67.6	77.4	100.5	90.95	108.14	80.81	73.95	85.51	0.64	0.55	0.73



	8	1	7									
31/1/2022	72.8 4	67.3 5	77.6 8	100.27	90.48	108.39	80.79	74.06	85.52	0.64	0.55	0.72
28/2/2022	72.8	67.2 2	77.5 8	100.07	89.23	108.44	80.78	73.65	85.45	0.64	0.54	0.73
31/3/2022	72.7 7	66.7 6	77.5 3	99.88	89.13	109.08	80.77	73.24	85.39	0.64	0.54	0.73
30/4/2022	72.7 3	66.7 4	77.5	99.7	88.84	108.49	80.76	72.69	85.63	0.64	0.54	0.73
31/5/2022	72.7	66.5 7	77.7 9	99.53	88.86	108.6	80.75	72.88	86.07	0.64	0.54	0.73
30/6/2022	72.6 7	66.5	77.8 7	99.38	88.63	108.83	80.75	72.55	85.9	0.64	0.54	0.73
31/7/2022	72.6 5	66.3 3	77.9 4	99.24	88.24	108.65	80.74	72.38	85.91	0.63	0.54	0.72
31/8/2022	72.6 2	66.2 2	77.5	99.1	87.44	108.04	80.74	71.94	85.73	0.63	0.54	0.73
30/9/2022	72.6	66.3 1	77.9 8	98.98	87.65	108.06	80.73	71.89	86.03	0.63	0.53	0.72
31/10/2022	72.5 8	66.0 4	78.2 3	98.86	87.08	108.44	80.73	71.19	86.11	0.63	0.53	0.72
30/11/2022	72.5 5	65.9 9	78.3 7	98.75	86.68	107.84	80.73	71.15	85.51	0.63	0.53	0.72
31/12/2022	72.5 3	65.5 3	78.4 3	98.65	86.39	107.72	80.72	71.02	85.43	0.63	0.54	0.71
31/1/2023	72.5 2	65.5 4	78.5 6	98.55	86.43	107.54	80.72	70.98	85.48	0.63	0.53	0.71
28/2/2023	72.5	65.1 1	78.5 3	98.46	85.7	107.81	80.72	71.24	85.81	0.63	0.53	0.72
31/3/2023	72.4 8	65.2 5	78.2 4	98.37	85.53	108.63	80.72	70.93	85.4	0.63	0.53	0.71
30/4/2023	72.4 7	65.2 9	77.9 3	98.29	84.9	107.62	80.72	70.85	85.62	0.63	0.53	0.71
31/5/2023	72.4 5	65.6	77.9 4	98.21	84.89	107.78	80.72	71.3	85.67	0.63	0.53	0.72
30/6/2023	72.4 4	65.1	78.2 8	98.14	84.93	107.68	80.71	71.38	85.73	0.63	0.53	0.72
31/7/2023	72.4 2	64.9 5	78.5 5	98.08	84.3	107.01	80.71	71.01	85.81	0.63	0.53	0.72
31/8/2023	72.4 1	64.7 5	78.3 7	98.01	85.21	107.22	80.71	70.88	85.5	0.63	0.53	0.72
30/9/2023	72.4	64.4 8	78.2 7	97.95	85.17	107.4	80.71	70.02	85.32	0.63	0.53	0.72
31/10/2023	72.3 9	64.7 1	77.9 3	97.89	85.15	107.2	80.71	69.27	85.54	0.63	0.54	0.72
30/11/2023	72.3 8	64.8 6	78.0 8	97.84	84.43	107.3	80.71	69.03	85.23	0.63	0.54	0.72
31/12/2023	72.3 7	64.4 8	77.9 4	97.79	84.6	107.6	80.71	70.15	85.43	0.63	0.54	0.72
31/1/2023	72.3 6	64.3 4	78.3 3	97.74	85.03	107.21	80.71	69.93	85.46	0.63	0.54	0.72
28/2/2023	72.3 5	64.5 2	78.0 7	97.7	84.74	107.14	80.71	70.2	85.28	0.63	0.54	0.72

III. CONCLUSION

- Given the analysis and forecasts of this study, our recommendation is that policy makers in India ought to devalue the Rupee in order to restore and maintain exchange rate stability. Once devaluation is implemented in India, the local manufacturing sector will grow phenomenally and this is likely to be accompanied by inflows of the much awaited foreign capital.



2. MAPE and MASE based on daily exchange rates between USD/INR are least compare to GBP/INR, CHF/INR and JPY/INR. Therefore USD/INR is better fit than compare to GBP/INR, CHF/INR and JPY/INR
3. ME, RMSE, MAE and MPE based on daily exchange rates between JPY/INR are least compare to USD/INR, GBP/INR and CHF/INR. Therefore JPY/INR is better fit than compare to USD/INR, GBP/INR and CHF/INR
4. σ^2 based on daily exchange rates between JPY/INR values are less compare to USD/INR, GBP/INR and CHF/INR. Therefore JPY/INR is better fit than compare to USD/INR, GBP/INR and CHF/INR.
5. In this research paper we observe that, the table 5.4.1 Forecasted values for JPY/INR currency rate is most probably constant for next 5 years. Remaining USD, GBP and CHF countries currency rates are increased based on the INR currency.

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