Time Series Modeling for Online Banking Transactions in India

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Abstract: In the present era of Globalization and to cope with the global scenario Indian banking system is forced to alter its face and is offering exceptionally technology oriented services. Technology has enabled banks to deliver effectively, momentously and most importantly in a secure manner. It has enhanced the overall growth of the Indian banking sector. As technology is the order of the day, Reserve Bank of India has implemented a new range of electronic products like RTGS, NEFT, IMPS, ECS, mobile banking, MICR, and CTS etc., that offers a wide range of services to the customers. In the present study, we build seasonal ARIMA model for RTGS and NEFT transactions and predicted the NEFT and RTGS transactions till 2020. We have taken the volume of RTGS and NEFT transactions for the last eight years (2010–2017) of the entire public sector banks, four seasonal ARIMA models are constructed on bank transactions of India. As the country is rapidly transforming to the digitalization because of the development of Internet facilities, the Digital India program is a flagship program of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy. "Faceless, Paperless, Cashless" is one of the professed roles of Digital India. As part of promoting cashless transactions and converting India into less–cash society, one of the digital payments is Internet Banking through NEFT and RTGS.

Index Terms **- NEFT, RTGS, Seasonal ARIMA, Prediction, Banking Transactions.**

I. INTRODUCTION

Banks play a crucial role in promoting online businesses. At present, banks have e–payment systems like Internet banking, electronic fund transfers (NEFT/RTGS), plastic money (credit card & debit card) and mobile banking. The current and recent trends in the banking sector are moving towards E–Banking or Virtual–Banking. People are using NEFT, RTGS facilities to transfer their funds through online–banking. These systems provide payment to online transactions like online purchases of products, mobile recharges, hotel booking, ticket booking, etc. by considering all types of security measures.

National Electronic Funds Transfer (NEFT) is a national wide payment system facilitating one-to-one funds transfer. Under this system, individuals, firms, and corporate offices can electronically transfer funds from any bank branch to any individual, firm or corporate having an account with any other bank branch in the country participating in the system.

Real-time gross settlement (RTGS) are specialist funds transfer systems where the transfer of money or securities takes place from one bank to another on a "real time" and on a "gross" basis. Settlement in "real time" means a payment transaction is not subjected to any waiting period, with transactions being settled as soon as they are processed. "Gross settlement" means the transaction is settled on a one-to-one basis without bundling or netting with any other transaction. "Settlement" means that once processed, payments are final and irrevocable.

II. OBJECTIVES OF THE STUDY

The main objectives of the present study are

1. To understand the limitations of traditional funds transfer.
2. To understand the various technologies used in an interbank funds transfer.
3. To analyze the NEFT and RTGS Transactional data and predictions till 2020.

III. METHODOLOGY OF THE STUDY

The principal objective of time series modeling and analysis is forecasting. This forecasting procedure was applied in forecasting number of transactions and value through NEFT and RTGS Transactions for the next three years. The original values and forecast values are presented. The data used for analysis were from secondary data of RBI official website. The area of study was confined to analyze the NEFT and RTGS transactions and predictions till 2020.

Methodology we adopt here is a Seasonal Autoregressive Integrated Moving Average (SARIMA) Seasonal ARIMA model can be written as

$$\Phi(B^s)\phi(B)\nabla_s^D\nabla^d y_t = \alpha + \Theta(B^s)\theta(B)\epsilon_t$$

and is denoted by

$$ARIMA(p,q,d)\times(P,D,Q)_s$$

where ϵ_t is the white noise process.

$\nabla_s^D y_t = (1-B^s)^D y_t$

$\Phi(B^s) = 1 - \Phi_1 B^s - \cdots - \Phi_P B^{P_s}$

$\phi(B) = 1 - \phi_1 B - \cdots - \phi_P B^P$

$\Theta(B^s) = 1 + \Theta_1 B^s + \cdots + \Theta_Q B^{QS}$

$\theta(B) = 1 + \theta_1 B + \cdots + \theta_q B_q$

IV. EMPIRICAL STUDY

4.1 RTGS number of Transactions Data

Table 4.1.1: Actual Data Month Wise RTGS No. of Transactions (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	3.26	3.36	4.36	3.73	3.93	4.09	4.15	4.19	4.1	4.71	4.01	3.9
2011	3.83	3.81	4.8	3.3	4.28	4.25	4.13	4.13	4.34	4.46	4.7	5.1
2012	5	5.02	6.34	4.93	5.56	5.5	5.48	5.13	5.1	5.83	5.55	6.03
2013	6.28	5.82	7.29	6.46	6.69	6.14	6.58	6.21	6.26	6.95	6.38	7.02
2014	7.12	6.65	8.64	7.27	7.8	7.47	7.55	6.97	7.72	7.21	7.33	8.19
2015	7.89	7.69	9.67	7.9	8.06	8.26	8.26	7.82	7.77	8.34	7.6	8.02
2016	8.22	8.22	9.86	8.33	8.7	8.83	8.25	8.56	8.47	9.01	7.87	8.84
2017	9.33	9.1	12.54	9.54	10.43	9.83						

Modelling: Model for RTGS number of Transactions using ARIMA(2,0,0)(2,1,1)[12] with drift Coefficients:

	ar1	ar2	sar1	sar2	sma1	drift
	0.3262	0.3712	−1.0309	−0.5628	0.7358	0.0704
s.e.	0.1096	0.1091	0.1929	0.1077	0.3100	0.0073

σ^2 estimated as 0.129: log likelihood = −33.31 AIC= 80.62 AICc= 82.22 BIC= 97.12

Table 4.1.2: Fitted Data Month Wise RTGS No. of Transactions (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	3.257	3.357	4.356	3.727	3.926	4.086	4.146	4.186	4.097	4.706	4.007	3.897
2011	4.012	4.007	4.947	4.125	4.229	4.301	4.519	4.450	4.353	4.952	4.387	4.472
2012	4.812	4.971	5.996	4.861	5.612	5.545	5.438	5.389	5.391	5.581	5.558	5.910
2013	5.847	6.042	7.189	5.992	6.677	6.689	6.442	6.192	6.262	6.843	6.500	6.725
2014	6.902	6.713	8.004	6.874	7.743	7.270	7.439	7.139	7.173	7.659	7.481	7.909
2015	8.078	7.735	9.473	8.347	8.572	8.076	8.252	7.816	8.204	8.208	7.915	8.595
2016	8.310	7.899	9.921	8.555	8.706	8.565	8.909	8.388	8.383	9.059	8.447	8.872
2017	8.874	9.084	11.065	9.903	10.489	10.225						

Figure 4.1.1: Actual Values Vs Fitted Values

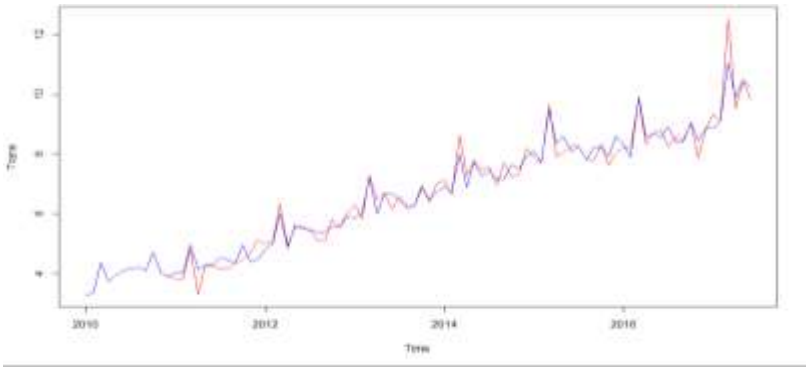
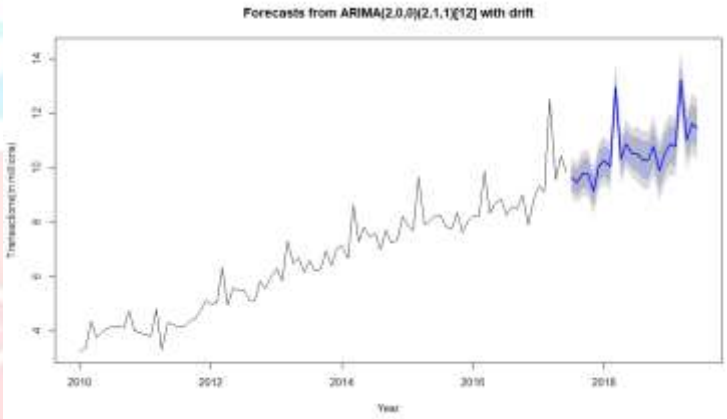


Table 4.1.3: Forecasted Values (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	——	——	——	——	——	——	9.647	9.444	9.803	9.779	9.139	10.062
2018	10.270	10.041	12.957	10.316	10.865	10.534	10.503	10.289	10.256	10.803	9.882	10.536
2019	10.873	10.770	13.213	11.028	11.635	11.437	11.026	11.112	11.230	11.505	10.592	11.550
2020	11.913	11.679	14.904	12.048	12.786	12.300	12.195	11.978	12.161	12.395	11.632	12.428

Figure 4.1.2: Forecasts from ARIMA



4.2 RTGS Transactions Value

Table 4.2.1: Actual Data Month Wise RTGS Transactions Value (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	31545.53	28846.73	48166.51	36415.94	32755.59	37333.74	36372	34587.05	41136.93	42604.95	41405.03	46025.75
2011	38238.55	38080.89	59915.93	38184.71	41900.85	47690.05	40563.9	38446.46	46838.68	38884.88	38709.96	51920.33
2012	45882.91	43110.35	67174.07	49945.36	50407.71	64583.56	54735.28	52366.54	57997.01	54458.83	46774.57	57277.9
2013	58002.05	52882.71	77409.55	61061.12	58723.11	62383.43	62422.87	55083.37	62835.22	58824.07	52505.26	63850.38
2014	61921.84	52867.91	81773.84	58109.41	58381.63	66242.97	57378.87	55570.27	71529.23	56828.89	54644.76	68744.01
2015	61648.02	57414.11	87421.48	65199.83	60051.45	74181.48	68891.04	64376.22	68791.35	63365.56	53896.03	68924.04
2016	66517.7	70341.9	100045.36	68411.27	76332.58	83834.94	74919.55	77588.32	86687.35	76473.29	78479.19	84096.48
2017	77486.07	74218.81	123375.83	88512.19	90170.52	92812.58						

Table 4.1.2: Fitted Data Month Wise RTGS Transactions Value (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	31514.61	28819.13	48120.21	36382.02	32725.95	37300.14	36339.99	34557.45	41101.4	42568.57	41370.48	45987.2
2011	38799.14	36339.56	56687.15	44436.67	39725.65	45239.91	44130.45	41066.41	47080.88	47191.48	43645.8	48360.31
2012	42820.24	42772.37	63944.91	47853.93	49018.95	55197.98	53555.06	51644.05	59028.12	54612.6	53278.07	60349.96
2013	53068.33	52751.01	74604.76	58908.53	59397.68	67765.97	59621.11	58435.2	63869.36	60523.12	56404.92	64387.83
2014	60490.62	58282.02	80076.75	62505.92	61619.19	67891.05	62756.28	56990.69	64389.73	62041.5	55924.66	67606.83
2015	65732.68	58734.98	84831.01	66476.59	66008.7	73207	67071.9	64638.57	75233.36	65154.09	59884.04	70491.23
2016	67379.04	61868.52	93140.96	75126.08	70151.63	81487.26	77933.49	72172.29	82598.43	76580.29	69863.15	86182.86
2017	81686.72	77438.37	105731	85089.52	87744.68	97363.31						

Figure 4.2.1: Actual Values Vs Fitted Values

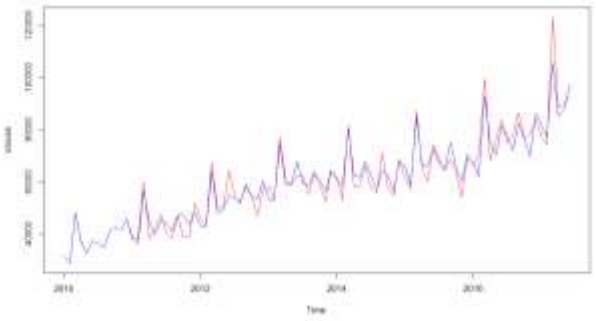


Table 4.2.3: Forecasted Values (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	—	—	—	—	—	—	87316.67	86232.16	96053.66	85228.66	82551.89	93147.72
2018	87187.16	85173.43	122656.66	92648.95	93440.43	101002.86	94521.56	93095.85	100770.49	91776.74	87903.74	98583.79
2019	93538.55	93058.13	130851.33	98958.89	102284.59	108483.12	101371.1	101342.61	109989.74	100059.62	98415.83	107329.61
2020	101479.89	99629.11	141115.39	108678.37	110759.08	116087.3	109652.41	108883.84	117650.22	107639.76	105054.18	114968.91

4.3 NEFT Number of Transactions Data

Table 4.3.1: Actual Data Month Wise NEFT Number of Transactions (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	6.18	6.4	8.28	7.47	7.74	8.42	9.46	9.8	9.83	11.63	11.75	13.46
2011	12.96	13.43	16.36	14.87	15.77	15.94	16.63	17.33	17.56	19.25	18.79	20.61
2012	20.63	21.63	27.11	23.77	27.23	27.19	29.25	29.28	29.43	34.84	33.71	35.54
2013	38.36	38.29	47.09	40.66	45.06	43.19	50.42	47.62	51.25	56.91	52.65	60.36
2014	65.91	64.15	82.83	70.62	69.11	67.86	71.67	66.98	88	73.29	69.12	83.49
2015	80.22	81.19	106	83.53	88.13	91.22	103.11	95.94	98.54	114.6	99.82	119.61
2016	118.97	110.17	129.24	111.84	117.5	118.29	113.48	118.56	120.15	133.21	123.05	166.31
2017	164.19	148.21	186.7	143.17	155.82	152.34						

Modeling: Model for NEFT Number of Transactions using ARIMA(2,1,0)(1,1,0)[12] with drift Coefficients:

ar1	ar2	sar1
–0.6093	–0.2327	–0.2821

s.e. 0.1102 0.1165 0.1395

σ^2 estimated as 46.42: log likelihood $= -256.17$ AIC $= 520.35$ AICc $= 520.9$ BIC $= 529.72$

Table 4.3.2: Fitted Data Month Wise NEFT Number of Transactions (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	6.176	6.398	8.277	7.469	7.739	8.418	9.458	9.798	9.828	11.626	11.747	13.459
2011	12.967	13.227	15.265	14.853	15.329	16.212	17.123	17.305	17.231	19.163	19.375	20.824
2012	20.268	20.769	23.822	23.938	25.074	26.351	27.557	29.156	29.504	31.298	32.301	35.148
2013	35.582	37.405	42.926	42.025	44.659	44.907	45.628	47.693	48.339	54.206	54.373	56.197
2014	59.578	62.628	72.408	71.144	76.291	72.744	74.882	70.839	71.723	83.020	78.007	80.379
2015	83.385	81.906	97.583	89.463	88.857	86.765	92.210	93.567	112.234	98.513	98.302	112.937
2016	116.844	117.385	138.702	114.203	114.324	117.163	127.908	116.047	122.674	128.623	119.406	138.998
2017	149.316	152.778	175.126	159.335	159.439	158.566						

Figure 4.3.1: Actual Values Vs Fitted Values of NEFT number of Transactions

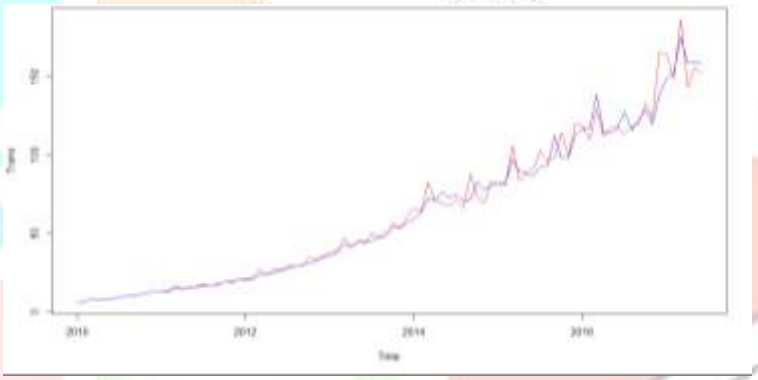
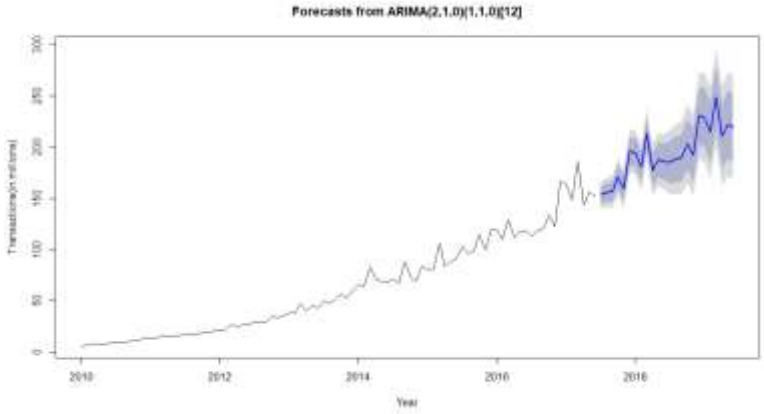


Table 4.3.3: Forecasted Values (Millions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	——	——	——	——	——	——	153.54	155.52	156.88	171.02	159.53	196.13
2018	194.46	180.49	213.50	177.35	188.02	185.75	185.25	188.11	189.53	203.36	192.25	230.73
2019	228.93	214.40	248.96	210.72	221.95	219.34	219.32	221.93	223.33	237.25	226.04	263.98
2020	262.22	247.85	281.97	244.32	255.40	252.88	252.73	255.40	256.81	270.71	259.52	297.62

Figure 4.3.2: Forecasts using ARIMA for NEFT number of Transactions



4.4 NEFT Transactions Value (Billions)

Table 4.4.1: Actual Data Month Wise NEFT Transactions Value (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	321.06	354.94	438.97	498.66	558.67	524.47	670.52	616.42	616.2	777.04	773.61	936.64
2011	938.88	905.88	1503.81	1302.94	1145.32	1319.95	1283.54	1225.68	1365.51	1420.33	1362.15	1603.45
2012	1705.7	1765.03	2403.89	1954.96	1994.77	2070.26	2109	2107.76	2272.94	2534.21	2301.55	2667.68
2013	2814.88	2560.35	3602.48	3247.96	3289.5	3253.07	3444.39	3150.58	3434.45	3860.19	3332.65	3929.28
2014	3871.54	3656.05	5312.25	4219.56	4307.38	4509.52	4577.84	4520.4	5393.36	4781.5	4616.75	5573.36
2015	5084.73	5046.41	7173.09	6043.75	5536.03	6324.58	6289.37	6153.38	6860.21	6906.88	6370.16	8197.21
2016	7086.75	7278.6	10226.36	8324.52	7732.54	8815.31	8145.39	8764.14	9880.17	9504.5	8807.89	11537.63
2017	11355.08	10877.91	16294.5	12156.17	12410.81	12694.2						

Modeling: Model for NEFT Transactions Value using ARIMA(1,1,0)(1,1,2)[12] with drift Coefficients:

	ar1	sar1	sma1	sma2
	–0.6791	0.6856	–0.4388	0.2913
s.e.	0.0930	0.2978	0.3496	0.2562

σ^2 estimated as 160978: log likelihood = – 572.55 AIC = 1155.11 AICc = 1155.95 BIC = 1166.83

Table 4.4.2: Fitted Data Month Wise NEFT Transactions Value (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	320.87	354.83	438.83	498.50	558.49	524.35	670.28	616.26	616.06	776.76	773.36	936.48
2011	938.65	946.32	1116.44	1229.51	1472.15	1268.84	1318.09	1329.97	1253.53	1426.95	1471.08	1562.18
2012	1587.44	1615.82	2495.98	2192.16	1811.27	2061.64	2086.90	1955.95	2272.19	2319.65	2289.96	2667.24
2013	2772.29	2876.56	3618.30	2856.71	3082.80	3395.49	3355.03	3318.89	3582.77	3672.68	3457.29	3916.80
2014	4011.71	3740.88	4787.14	4554.85	4763.14	4230.00	4558.25	4353.26	4659.40	5556.16	4892.07	4981.80
2015	5315.68	5041.67	6788.36	5800.60	6102.29	6164.78	6039.15	6285.12	7229.92	6317.12	6145.32	7740.83
2016	7050.49	7364.20	9637.27	8529.29	8032.71	8713.90	8677.98	8444.80	9183.15	9539.53	9127.38	11138.33
2017	9710.26	10824.18	14803.83	12729.12	12632.57	13083.02						

Figure 4.4.1: Actual Values Vs Fitted Values of NEFT Transactions Value

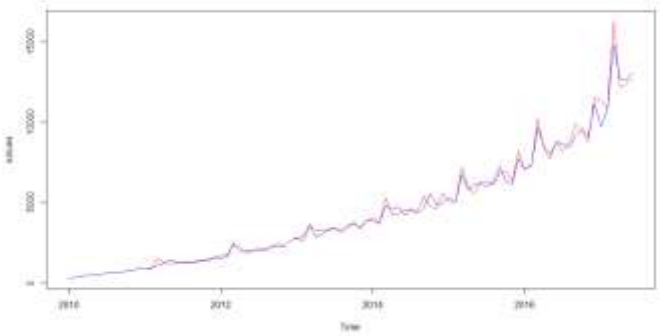
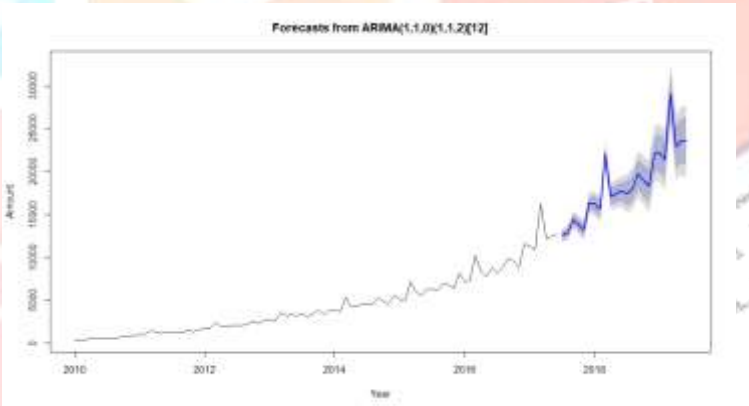


Table 4.3.3: Forecasted Values (Billions)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	—	—	—	—	—	—	12575.43	12863.39	14422.72	13833.87	13181.31	16383.14
2018	16225.44	15656.29	22034.09	17050.88	17428.25	17674.56	17431.51	17926.72	19698.23	19015.33	18264.52	21993.56
2019	22193.76	21345.7	28963.29	22839.51	23617.65	23510.25	23404.94	23890.83	25910.64	25093.42	24322.68	28380.99
2020	28848.43	27794.3	36272	29359.37	30416.93	30063.86	30055.14	30533.18	32724.22	31814.25	31030.3	35314.03

Figure 4.3.2: Forecasts using ARIMA for NEFT Transactions Value



V. RESULTS AND DISCUSSION

An in depth study of online banking transactions data is concluded that there a seasonality presents in both the RTGS and NEFT transactions. It also seems to be a good fit for forecasting till 2020.

Estimated model for a number of transactions of RTGS data are Seasonal ARIMA (2,0,0)×(2,1,1)[12] with log likelihood= –33.31 and observed that on an average there is a steady increase in transactions ranging from 8% – 12%.

Estimated model for the value of transactions of RTGS data are Seasonal ARIMA (1,0,1)×(2,1,0)[12] with log likelihood = –767.99 and observed that on an average there is a steady increase in transactions ranging from 14% – 18%.

Estimated model for a number of transactions of NEFT data are Seasonal ARIMA (2,1,0)×(1,1,0)[12] with log likelihood = –256.17 and observed that on an average there is a steady increase in transactions ranging from 27% – 32%.

Estimated model for the value of transactions of NEFT data are Seasonal ARIMA (1,1,0)×(1,1,2)[12] with log likelihood = – 572.55 and observed that on an average there is a steady increase in transactions ranging from 35% – 40%.

REFERENCES

[1] Bank wise volumes in ECS/NEFT/RTGS/Mobile transactions. (2010–2017). Reserve Bank of India. Available at: https://rbi.org.in/Scripts/NEFTUserView.aspx?Id=32.

[2] Rao N K,(2005). "Indian Banking system: The Forward March", Indian Banking 2005

[3] Buckman Akuffo and Enock Mintah Ampaw (2013). "An Autoregressive Integrated Moving Average (ARIMA) Model For Ghana's Inflation (1985 – 2011)", Mathematical Theory and Modeling.

[4] Laxman, R., Deena, S. and Badiger, S. (2008). "Changing Dimensions Of Banking Sector In India", Paradigm Shift In Indian Banking, pp. 70–80.
[5] Sultan, S. and Sahila, C. (2011). "E–Banking Scenario And Its Impact On Customers' Satisfaction In India", International Journal Of Research In Commerce & Management, 2 (4), pp. 29–34.
[6] Khan, Shri H. R. (2011). "Banking, electronic payments, and road ahead, Reserve Bank of India at the FICCI–IBA conference on Global Banking. Retrieved from": https://www.rbi.org.in/scripts/bs_speechesview.aspx?id=594.
[7] Nadia Sha and Shariq Mohammad (2017). "Virtual banking and online business". Banks and Bank Systems, 12(1), 75–81. doi:10.21511/bbs.12(1).2017.09