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ANALYTICAL STUDY OF EVALUATING FORECASTING METHODS IN NIGERIAN AIRPORT

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ABSTRACT

Various studies have been carried out to evaluate forecasting methods most especially with a focus on moving average and exponential smoothing. The common approach for evaluating the accuracy of moving average and exponential smoothing were Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Root Mean Square Error (RMSE). This paper, therefore, examines single moving average and exponential smoothing and adopts the coefficient of description (correlation coefficient), coefficient of explanation (regression), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Root Mean Square Error (RMSE) to evaluate the accuracy of single moving averages and exponential smoothing with different smoothing constants. For single moving average: n=2, n=3, n=4, n=5, n=6, n=7, n=8, n=9, n=10; and for simple exponential smoothing: α=0.1, α=0.2, α=0.3, α=0.4, α=0.5, α=0.6, α=0.7, α=0.8, α=0.9. The study relies on secondary data of revenue passenger demand in Murtala Muhammed International Airport (MMIA) and Mallam Aminu Kano International Airport (MAKIA) from the period of 1995 to 2017. The behaviors of data obtained on different airports were observed, as there seems to be consistency in the MMIA demand than that of MAKIA demand. The implication of the consistency is that the result that emanates for forecast evaluation will be reliable. The study reveals that simple exponential smoothing generates a reliable forecast than the single moving average.

Keywords: Forecasting, Accuracy, Quantitative Techniques, Air Transport, MMIA, MAKIA.

INTRODUCTION

Forecasts serve a crucial need in making rational decisions and planning activities more precisely by handling uncertainty about the future. Efficient prediction is considered an important prerequisite for efficient administration and organization in different areas of application related application areas.

During planning, taking a decision on the most accurate forecasting technique to employ is quite challenging, it that requires a comprehensive analysis of empirical results. Recent findings reveal that the performance evaluation of forecasting models depend on the accuracy measures adopted (Nijat et al., 2016).

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Evaluating the performance of the forecasting method is very crucial. In the last three decades, various accuracy measures have been adopted by many scholars as an evaluation criterion. A number of different forecast accuracy measures for both regression and classification problems have been proposed by earlier researchers together with the comments and recommendations on the use of the relevant measures (Mahmou, 1984; Makridakis, 1991; Hyndman & Koehler, 2006; Sokolova & Lapalme, 2009; Power, 2011; Nijat et al., 2016; Adeniran & Ben, 2017; Adeniran & Kanyio, 2018). Such accuracy measures provide necessary and decisive feedback to decision makers for calibrating and refining the model in an effort to improve the preciseness of outcomes (Armstrong & Collopy, 1992). However, research findings suggest that there is no best overall accuracy measure which can be used as a universally accepted single metric for choosing the appropriate forecasting method (Mahmou, 1984). Forecasting approaches can realize extremely different performances depending on the chosen metric. Empirical evaluations reveal that some approaches are superior when error based measures are adopted, while others perform better for the same dataset when different metrics are utilized (Armstrong & Collopy, 1992).

It is pertinent to note that decision makers may be unwilling to generalize forecast from prior research, believing that their situation is different. Also, previous research may have revealed a number of relevant forecasting methods and one would like to narrow the field, which is systematic. Most principles for testing forecasting methods are based on commonly accepted methodological procedures, such as to pre-specify criteria or to obtain a large sample of forecast errors. However, forecasters often violate such principles, even in academic studies. Some principles might be surprising, such as R-square, Mean Square Error, and other models to select the most accurate forecasting model (Armstrong, 2001).

Ryu & Sanchez (2003) evaluated the forecasting method for institutional food service facility. They identified the most appropriate forecasting method of forecasting meal count for an institutional food service facility. The forecasting method analyzed included: naïve model 1, 2 and 3; moving average method, double moving method, exponential smoothing method, double exponential method, Holt’s method, Winter method, linear regression and multiple regression method. The accuracy of forecasting methods was measured using mean absolute deviation, mean squared error, mean percentage error, mean absolute percentage error method, root mean squared error and Theil’s U-statistic. Their result showed that multiple regressions were the most accurate forecasting method, but naïve method 2 was selected as the most appropriate forecasting method because of its simplicity and high level of accuracy.

Pradeep & Rajesh (2014) studied the evaluation of forecasting methods and their application for sales forecasting of sterilized flavored milk in Chhattisgarh. They applied weekly data spreading from October 2011 to October 2012, on the sales of sterilized flavored milk in a liter. The forecasting method analyzed included: naïve model, moving average, double moving average, simple exponential smoothing; and semi-average method. The accuracy of the forecasting method was measured using mean Forecast Error (MFE), Mean Absolute Deviation (MAD), Mean Square Error (MSE), root mean square Error (RMSE).

Adeniran, Kanyio & Owoeye (2018) study forecasting methods for domestic air passenger demand in Nigeria using two years single moving average and simple exponential smoothing with smoothing constant of 0.9 to forecast the 2018 demand. The two methods of forecasting earlier identified were evaluated and compared with their Mean Squared Deviations (MSD) to determine which method gives the lowest deviation as it will produce the best forecast for the year 2018 domestic air passenger demand in Nigeria using the domestic airport passenger demand from the period of the year 2010 to 2017. It was revealed that the MSD of two yearly single moving averages gave the best the year 2018 forecast as it has a lower MSD when compared to the MSD of simple exponential smoothing with the smoothing constant of 0.9. Similarly, Adeniran & Stephens (2018) study the dynamics for evaluating different forecasting methods for international air passenger demand in Nigeria. They used two single moving averages, four single moving averages and six single moving average, simple exponential smoothing, with smoothing constants of 0.7, 0.8 and 0.9, respectively with the data between the periods of the year 2001 to the year 2017. Single moving average and simple exponential smoothing were compared using Mean Squared Deviation (MSD). It was revealed that simple exponential smoothing with constant 0.8 will give a better forecast.

Evaluation of different forecasting methods for international air passenger demand in Murtala Muhammed International Airport (MMIA) and Mallam Aminu Kano International Airport (MAKIA), Nigeria was carried out in this study. The forecasting methods analyzed include: single moving average (n=2, n=3, n=4, n=5, n=6, n=7, n=8, n=9, n=10) and simple exponential smoothing method (α=0.1, α=0.2, α=0.3, α=0.4, α=0.5, α=0.6, α=0.7, α=0.8, α=0.9). The accuracy measures of forecasting method were the coefficient of description (correlation coefficient), the coefficient of explanation (regression), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Root Mean Square Error (RMSE).

METHODOLOGY

This study examines single moving average and exponential smoothing, and adopts the coefficient of description (correlation coefficient), coefficient of explanation (regression), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Root Mean Square Error (RMSE) to evaluate the accuracy of single moving averages and exponential smoothing with different smoothing constants. For single moving average: n=2, n=3, n=4, n=5, n=6, n=7, n=8, n=9, n=10; and for simple exponential smoothing: α=0.1, α=0.2, α=0.3, α=0.4, α=0.5, α=0.6, α=0.7, α=0.8, α=0.9. The study relies on secondary data of revenue passenger demand in MMIA and MAKIA from the period of 1995 to 2017.

RESULTS AND DISCUSSION

From Table 1 and Figure 1, the revenue passenger demand in MMIA is more than the revenue passenger in MAKIA by over 1000%. This signifies that the MMIA terminal is more utilized and there is a need for government attention on its infrastructures than other international airports, also there is need for government to come up with strategies that will drive international passengers to a less patronized airport like MAKIA. An example of such a strategy is the development of tourism in the airport location. Also, from Figure 1, the behaviors of data obtained on the different airports were observed; there seems to be consistency and predictability of revenue passenger demand in MMIA than the revenue passenger demand in MAKIA. The implication of this consistency is that the result that emanates from forecast evaluation will be reliable and suitable for the forecast.

Table 1. Demand for revenue passengers in MMIA and MAKIA from 1995 to 2017.

Years	Revenue passenger demand in MMIA	Revenue passenger demand in MAKIA
Yr 1995	1,664,485	123,464
Yr 1996	1,693,567	82,958
Yr 1997	1,158,792	141,820
Yr 1998	1,000,414	153,545
Yr 1999	1,205,487	208,103
Yr 2000	1,421,909	154,082
Yr 2001	1,791,485	225,632
Yr 2002	1,906,385	216,854
Yr 2003	1,840,037	222,228
Yr 2004	1,943,686	216,537
Yr 2005	2,102,601	240,702
Yr 2006	2,152,315	246,444
Yr 2007	2,430,224	219,666
Yr 2008	2,688,595	217,235
Yr 2009	2,324,469	134,760
Yr 2010	2,409,087	146,854
Yr 2011	2,619,190	975,881
Yr 2012	3,232,462	155183
Yr 2013	3,877,840	122,146
Yr 2014	2,582,288	175,336
Yr 2015	3,024,078	162,486
Yr 2016	2,945,914	202,589
Yr 2017	2,832,418	182,543

Source: Nigerian Civil Aviation Authority, 2018

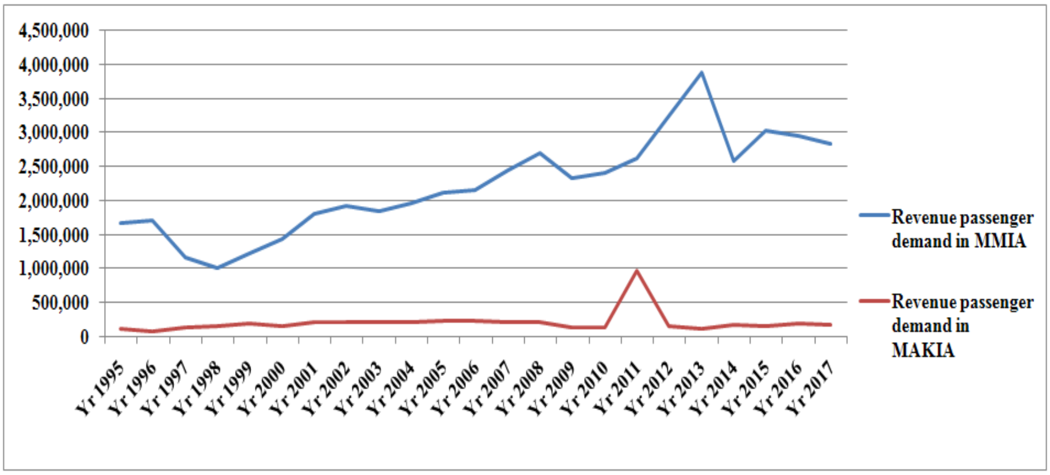

Figure 1. Line graph showing revenue passenger demand in MMIA and MAKIA.

Forecast Evaluation Using the Single Moving Average

From Tables 2 and 3, forecasts were obtained from two, three, four, five, six, seven, eight, nine and ten yearly single moving averages with twenty-three years data of revenue passenger demand in MMIA and MAKIA. From Figures 2 and 3, it was revealed that the lines of forecast and demand have similar trend from 1995 to 2017 which might be easily predictable without any critical analysis, but there seems to be a situation of rising and falling which might not be easily predictable without critical analysis. Hence, there is a need to evaluate the accurate forecasting technique that will produce a reliable 2018 forecast.

Table 2. Computation of forecast using single moving average for revenue passenger demand in MMIA.

Years	Demand	n=2	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
Yr 1995	1,664,485									
Yr 1996	1,693,567									
Yr 1997	1,158,792	1679026								
Yr 1998	1,000,414	1426180	1505615							
Yr 1999	1,205,487	1079603	1284258	1379315						
Yr 2000	1,421,909	1102951	1121564	1264565	1344549					
Yr 2001	1,791,485	1313698	1209270	1196651	1296034	1357442				
Yr 2002	1,906,385	1606697	1472960	1354824	1315617	1378609	1419448			
Yr 2003	1,840,037	1848935	1706593	1581317	1465136	1414079	1454006	1480316		

Yr 2013	Yr 2012	Yr 2011	Yr 2010	Yr 2009	Yr 2008	Yr 2007	Yr 2006	Yr 2005	Yr 2004
3,877,840	3,232,462	2,619,190	2,409,087	2,324,469	2,688,595	2,430,224	2,152,315	2,102,601	1,943,686
2925826	2514139	2366778	2506532	2559410	2291270	2127458	2023144	1891862	1873211
2753580	2450915	2474050	2481096	2423711	2228380	2066201	1962108	1896703	1845969
2646302	2510335	2463094	2398901	2343434	2157207	2009660	1948177	1870398	1739954
2654761	2494313	2400938	2339641	2263484	2093773	1989005	1916839	1780700	1633061
2617338	2437313	2351215	2273648	2192910	2062541	1956085	1834351	1684832	1527620
2550906	2389497	2292997	2211704	2151978	2023819	1879774	1744513	1587058	1474930
2494868	2333771	2236377	2173539	2106916	1948580	1795488	1651501	1533524	1502260
2433625	2278912	2199711	2131089	2030804	1866014	1707147	1596755	1551307	1520285
2374267	2241659	2158888	2060171	1948272	1779454	1652311	1606436	1562625	

Yr 2014	2,582,288	3555151	3243164	3034645	2892610	2858607	2797410	2716773	2648531	2578047
Yr 2015	3,024,078	3230064	3230863	3077945	2944173	2840889	2819133	2770519	2701830	2641907
Yr 2016	2,945,914	2803183	3161402	3179167	3067172	2957491	2867059	2844751	2798693	2734055
Yr 2017	2,832,418	2984996	2850760	3107530	3132516	3046962	2955837	2876916	2855991	2813415

Source: Authors' work

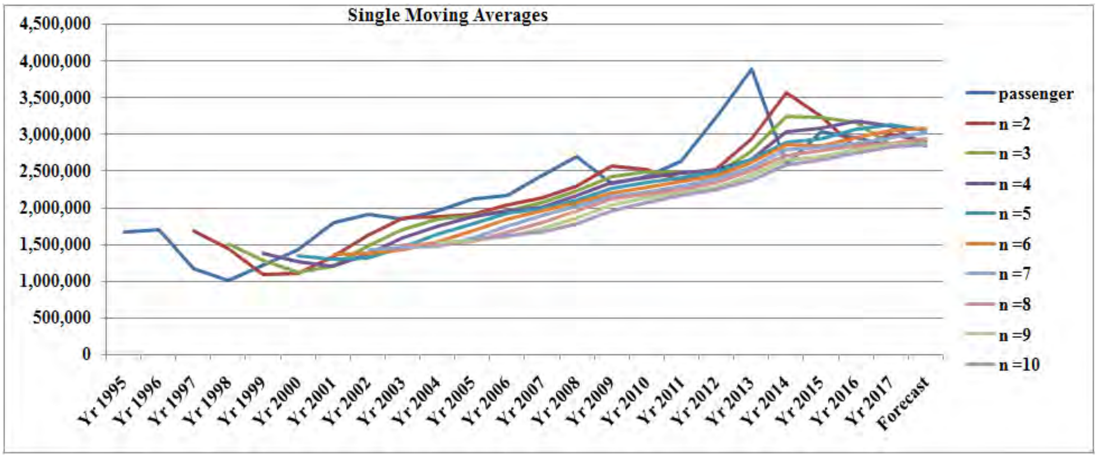

Figure 2. Line graph showing the comparison of revenue passenger demand in MMIA and forecasts from single moving averages.

Table 3. Computation of forecast using a single moving average for revenue passenger demand in MAKIA.

Years	Demand	n=2	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
Yr 1995	123464									
Yr 1996	82958									

Yr 2007	Yr 2006	Yr 2005	Yr 2004	Yr 2003	Yr 2002	Yr 2001	Yr 2000	Yr 1999	Yr 1998	Yr 1997
219666	246444	240702	216537	222228	216854	225632	154082	208103	153545	141820
243573	228620	219383	219541	221243	189857	181093	180824	147683	112389	103211
234561	226489	218540	221571	198856	195939	171910	167823	126108	116081	
231478	224080	220313	204699	201168	185341	164388	146607	125447		
228553	224391	207067	205380	191643	176636	148102	141978			
228066	212673	207239	196741	183339	161023	143995				
217497	212020	199569	188895	168999	155658					
216323	204710	192350	175653	163307						
209347	197723	180195	169854							
202595	186246	174522								

Yr 2017	Yr 2016	Yr 2015	Yr 2014	Yr 2013	Yr 2012	Yr 2011	Yr 2010	Yr 2009	Yr 2008
182543	202589	162486	175336	122146	155183	975881	146854	134760	217235
182538	168911	148741	138665	565532	561368	140807	175998	218451	233055
180137	153323	150888	417737	425973	419165	166283	190554	227782	235604
165639	153788	357137	350016	353170	368683	179629	204526	231012	230837
163548	318206	315080	306965	325983	338879	192992	211761	228117	229115
298937	289648	285027	292010	308263	323473	200944	212557	227135	227072
277211	267521	275342	281675	299432	311649	203171	213939	225667	226866
259404	261235	268383	277271	292091	299760	205553	214303	225662	217768
254719	256616	265945	273208	283696	291145	206809	215562	217709	216694
251214	255599	263421	267541	277549	283716	208691	209414	216748	210379

Source: Authors' work

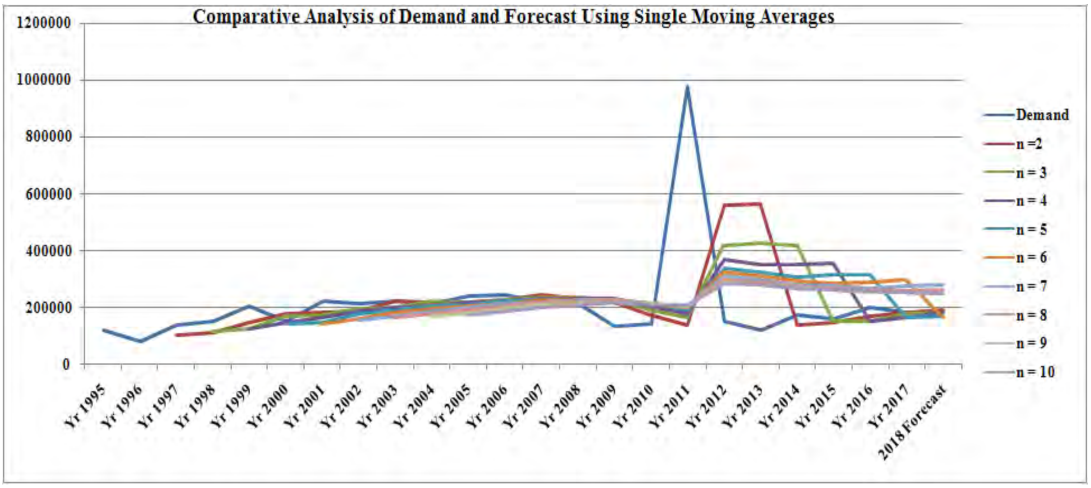

Figure 3. Line graph showing the comparison of revenue passenger demand in MAKIA and forecasts from single moving averages.

Forecast Evaluation Using the Simple Exponential Smoothing

From Tables 4 and 5, forecasts were obtained from simple exponential smoothing with smoothing constants of α=0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9. From Figures 4 and 5, it was revealed that the lines of forecast and demand have a similar trend from 1995 to 2017. It was also revealed that all forecasts follow a similar pattern. The suitability of forecasts produced by simple exponential smoothing is quite better and easily understandable than the forecasts produced by a single moving average. Although a mere examination of the line graph does not mean that the forecast of simple exponential smoothing will be more reliable than single moving average. Hence, there is a need to evaluate the accurate forecasting technique that will enhance a robust and reliable 2018 forecast.

Table 4. Computation of forecast using simple exponential smoothing for revenue passenger demand in MMIA.

Years	Deman d	α=0.1	α=0.2	α=0.3	α=0.4	α=0.5	α=0.6	α=0.7	α=0.8	α=0.9
Yr 1995	1664485									
Yr 1996	1693567	1664485	1664485	1664485	1664485	1664485	1664485	1664485	1664485	1664485
Yr 1997	1158792	1667393	1670301	1673210	1676118	1679026	1681934	1684842	1687751	1690659

Yr 2008	Yr 2007	Yr 2006	Yr 2005	Yr 2004	Yr 2003	Yr 2002	Yr 2001	Yr 2000	Yr 1999	Yr 1998
2688595	2430224	2152315	2102601	1943686	1840037	1906385	1791485	1421909	1205487	1000414
1799548	1729473	1682490	1635811	1601603	1575111	1538302	1510171	1519978	1554921	1616533
1963486	1846801	1770423	1687378	1623301	1569117	1484800	1408128	1404683	1454482	1568000
2093025	1948511	1861166	1757694	1677983	1608531	1480880	1347763	1315986	1363343	1518884
2184408	2020531	1932676	1819392	1736530	1667525	1508285	1319485	1251202	1281678	1469187
2249052	2067880	1983445	1864290	1784893	1729749	1553113	1314742	1207574	1209662	1418909
2297728	2098985	2018990	1893574	1818405	1785957	1605314	1326057	1182279	1147468	1368049
2337227	2120234	2045379	1911861	1837601	1831917	1658158	1347063	1172422	1095272	1316607
2371225	2135229	2066885	1924021	1845359	1866647	1707695	1372535	1175039	1053248	1264584
2401767	2145656	2085724	1933830	1845130	1890964	1752179	1398428	1187095	1021570	1211979

Yr 2017	Yr 2016	Yr 2015	Yr 2014	Yr 2013	Yr 2012	Yr 2011	Yr 2010	Yr 2009
2832418	2945914	3024078	2582288	3877840	3232462	2619190	2409087	2324469
2477485	2425437	2358922	2334103	2162577	2043701	1979758	1932054	1888453
2814663	2781850	2721294	2756045	2475596	2286380	2203177	2151700	2108507
2935769	2931421	2891711	3024320	2658526	2412554	2323996	2287528	2271696
2971142	2987960	2963882	3218278	2778569	2475974	2380497	2361437	2386083
2973612	3001309	2978540	3374793	2871745	2511028	2402867	2396646	2468824
2965744	2995489	2952605	3508080	2953440	2534908	2408484	2407581	2532248
2957709	2985232	2894592	3623303	3029382	2555529	2406986	2402084	2583185
2952997	2981329	2810333	3722514	3101208	2576190	2404189	2384599	2625121
2950537	2992146	2704755	3806954	3168983	2597669	2403980	2358013	2659912

Source: Authors' work

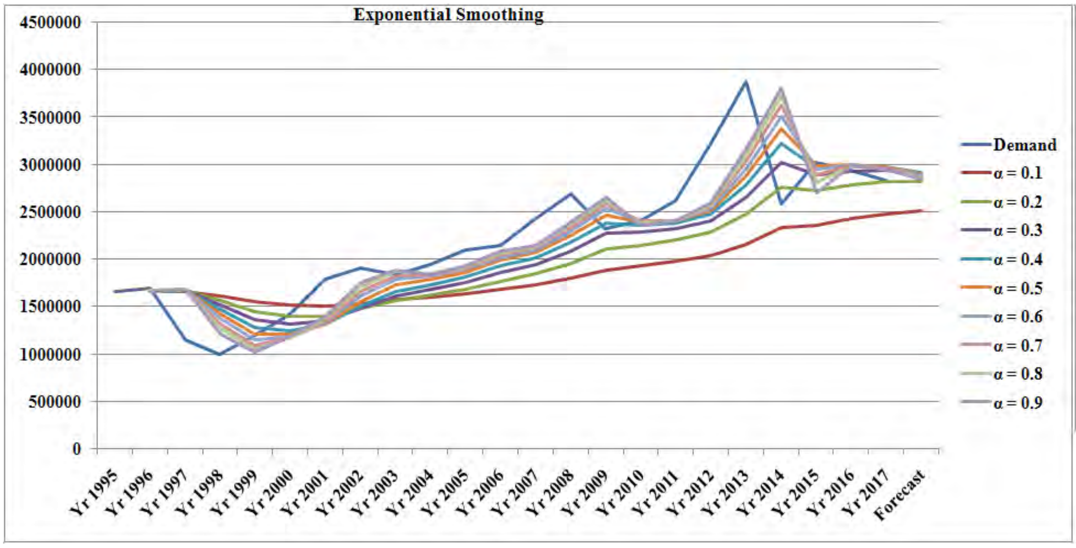

Figure 4. Line graph showing the comparison of revenue passenger demand in MMIA and forecasts from simple exponential smoothing.

Table 5. Computation of forecast using simple exponential smoothing for revenue passenger demand in MAKIA.

Years	Demand	α=0.1	α=0.2	α=0.3	α=0.4	α=0.5	α=0.6	α=0.7	α=0.8	α=0.9
Yr 1995	123464									
Yr 1996	82958	123464	123464	123464	123464	123464	123464	123464	123464	123464
Yr 1997	141820	119413	115363	111312	107262	103211	99160.4	95110	91059	87009
Yr 1998	153545	121654	120654	120465	121085	122516	124756	127807	131668	136339
Yr 1999	208103	124843	127232	130389	134069	138030	142029	145824	149170	151824
Yr 2000	154082	133169	143407	153703	163683	173067	181674	189419	196316	202475

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Yr 2001	225632	135260	145542	153817	159842	163574	165119	164683	162529	158921
Yr 2002	216854	144298	161560	175361	186158	194603	201427	207347	213011	218961
Yr 2003	222228	151553	172619	187809	198437	205729	210683	214002	216085	217065
Yr 2004	216537	158621	182540	198135	207953	213978	217610	219760	220999	221712
Yr 2005	240702	164412	189340	203655	211387	215258	216966	217504	217429	217054
Yr 2006	246444	172041	199612	214769	223113	227980	231208	233743	236047	238337
Yr 2007	219666	179482	208979	224272	232445	237212	240349	242634	244365	245633
Yr 2008	217235	183500	211116	222890	227334	228439	227939	226556	224606	222263
Yr 2009	134760	186874	212340	221194	223294	222837	221517	220031	218709	217738
Yr 2010	146854	181662	196824	195263	187880	178798	169463	160341	151550	143058
Yr 2011	975881	178181	186830	180741	171470	162826	155897	150900	147793	146474

Yr 2017	Yr 2016	Yr 2015	Yr 2014	Yr 2013	Yr 2012
182543	202589	162486	175336	122146	155183
220489	222477	229143	235122	247674	257951
227111	233241	250930	269828	306749	344640
214889	220160	244877	274681	340053	419283
202233	201995	228334	263667	358014	493234
194109	185629	208772	242207	362268	569354
191091	173843	190879	214194	352265	647888
191939	167089	177829	183645	327144	728387
194919	164241	171260	154957	286199	810263
198665	163346	171085	132827	228959	892940

Source: Author’s work

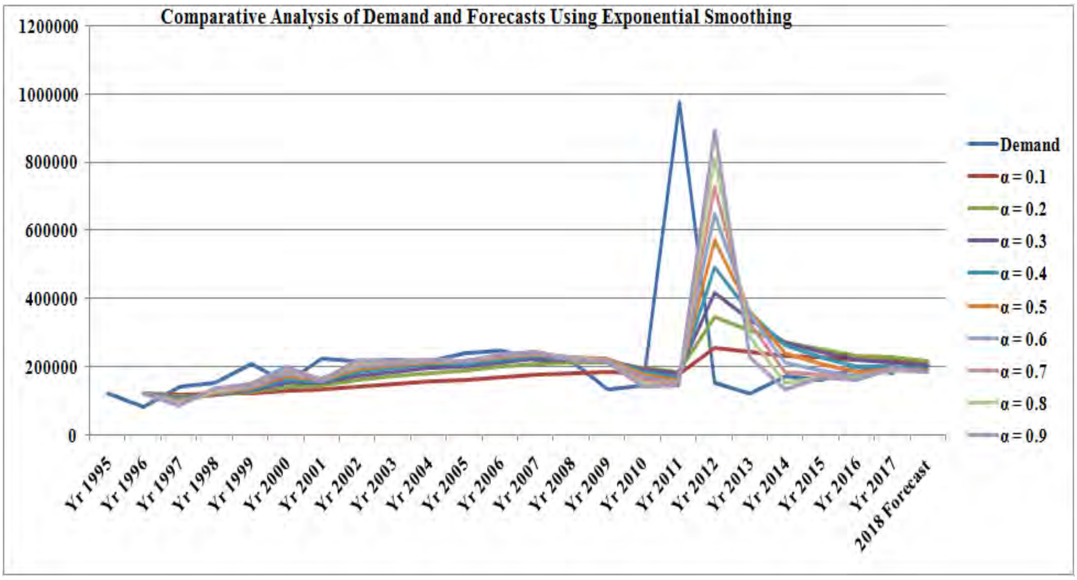

Figure 5. Line graph showing the comparison of revenue passenger demand in MAKIA and forecasts from simple exponential smoothing.

EVALUATION OF FORECASTS

The accuracy of the forecasting methods adopted in this study was coefficient of description (correlation coefficient), the coefficient of explanation (regression), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Root Mean Square Error (RMSE).

From Table 6 and Figures 6-9 for MMIA, the coefficient of description (correlation coefficient) and coefficient of explanation (regression) reveal that 2 yearly moving average (n=2) is most accurate, as it has the highest correlation and regression value. The correlation and regression value imply that the forecast of 2 yearly moving averages has a strong relationship with revenue passenger demand in MMIA. Also, Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Mean Square Error (RMSE) for single moving average shows that the 2 yearly moving average (n=2) has the lowest value. Hence, for the three assessment of accuracy for the single moving average, 2 yearly moving averages are the most accurate. It can be deduced from the result that the lower than for the single moving average, the more realistic or reliable the forecast. This deduction is possible because the time series data are ordered overtime as it satisfies the assumption of linearity, and large sample size of non-experimental or observational data with respect to time. This corroborates the views of Hsiao (2003) and Wooldridge (2001).

Table 6. Evaluation of accuracy for single moving averages for MMIA.

Evaluation	n=2	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
Correlation	0.822	0.816	0.810	0.810	0.792	0.764	0.727	0.666	0.599
Regression	0.675	0.666	0.657	0.656	0.628	0.584	0.529	0.444	0.359
MAD	84741.05	148086.1	214055.2	283370.1	347714.2	393220	435940.3	488890.9	543844.2
MSE	1.80E+11	1.88E+11	1.99E+11	2.14E+11	2.47E+11	2.84E+11	3.28E+11	3.90E+11	4.56E+11
RMSE	291.1032	384.8196	462.661	532.3251	589.673	627.0726	660.2578	699.2074	737.4579

Source: Author’s work

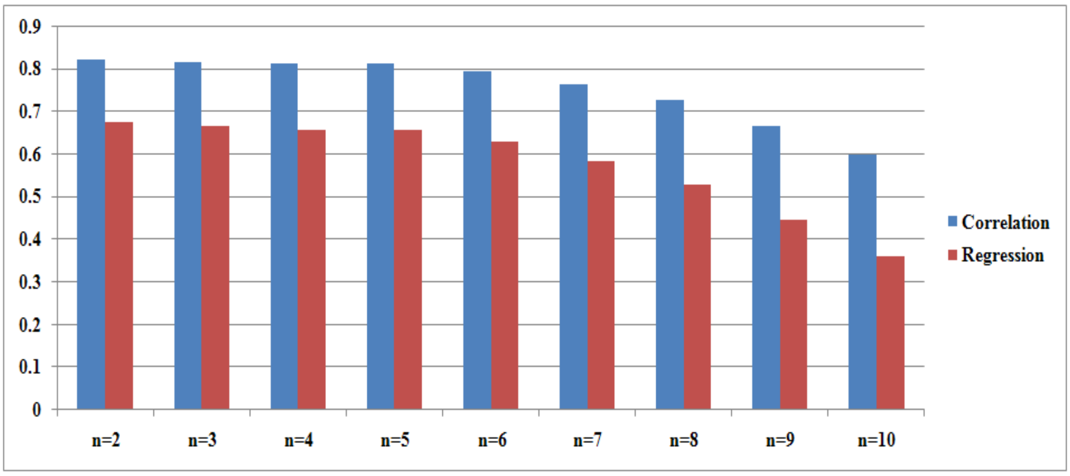

Figure 6. Bar chart showing correlation and regression of forecasts for single moving average.

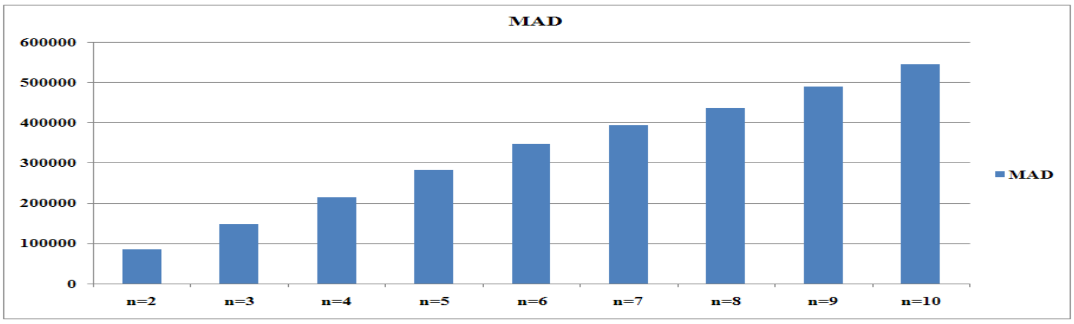

Figure 7. Bar chart showing the mean absolute deviation of forecasts for single moving average.

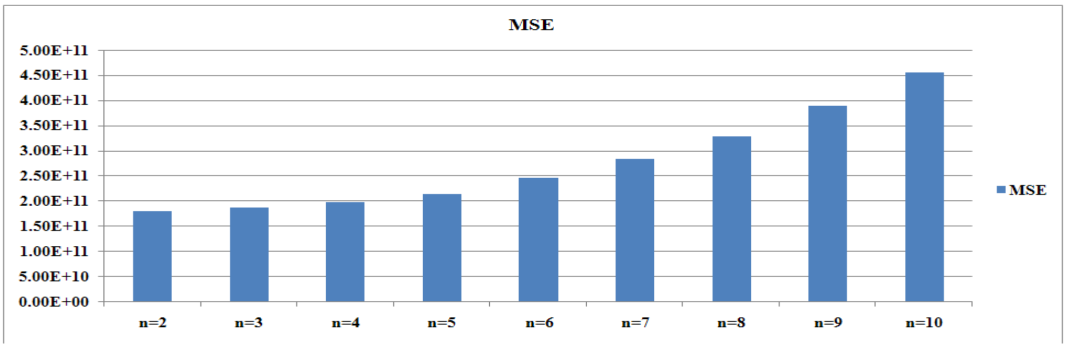

Figure 8. Bar chart showing the mean square error of forecasts for single moving average.

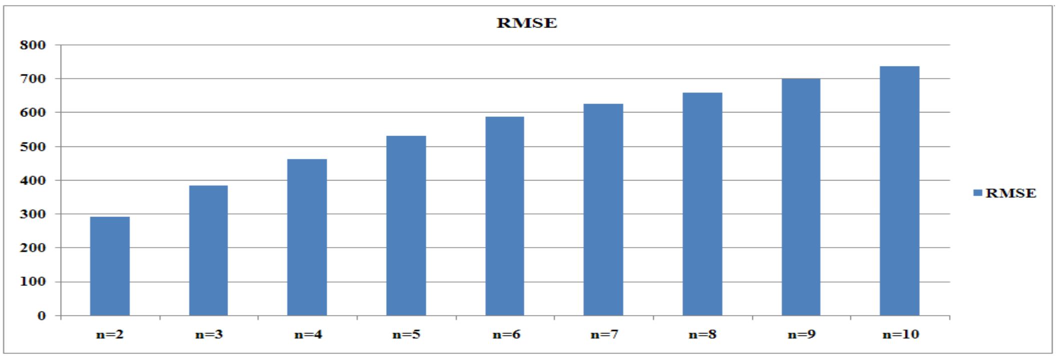

Figure 9. Bar chart showing the relative mean square error of forecasts for single moving average.

From the analysis shown in Table 7 and Figures 10-13 for MAKIA, the coefficient of description (correlation coefficient) and coefficient of explanation (regression) reveals that 10 yearly moving average (n=10) is most accurate, as it has the highest correlation and regression value. The correlation and regression value imply that the forecast of 10 yearly moving averages has a strong relationship with revenue passenger demand in MAKIA. Also, Mean Absolute Deviation (MAD) for single moving average shows that the 5 yearly moving average (n=5) has the lowest value. Also, Mean Square Error (MSE) for single moving average shows that the 5 yearly moving average (n=5) has the lowest value, and Relative Mean Square Error (RMSE) for single moving average shows that the 5 yearly moving average (n=5) has the lowest value. Hence, for the three evaluation of accuracy for the single moving average, 5 yearly moving averages is the most accurate. Although the data involved in MMIA and MAKIA are both historical and long on twenty-three years, their evaluated results are quite different. This difference can be as a result of the fact that data of MMIA satisfies the assumption of linearity and consistency, while the data of MAKIA does not.

Table 7. Evaluation of accuracy for single moving averages in MAKIA.

Evaluation	Correlation	Regression	MAD	MSE	RMSE
n=2	0.193	0.037	6625.857	5.1491E+10	81.39937
n=3	0.201	0.041	6674.1	4.51E+10	81.69517
n=4	0.236	0.056	6700.158	4.37E+10	81.85449
n=5	0.225	0.050	3486.778	4.26E+10	59.04894
n=6	0.277	0.077	3819.647	4.35E+10	61.80329
n=7	0.283	0.080	7020.813	4.46E+10	83.79029
n=8	0.290	0.084	9787.8	4.64E+10	98.93331
n=9	0.295	0.087	11367.14	4.89E+10	106.6168
n=10	0.298	0.089	13399.23	5.19E+10	115.755

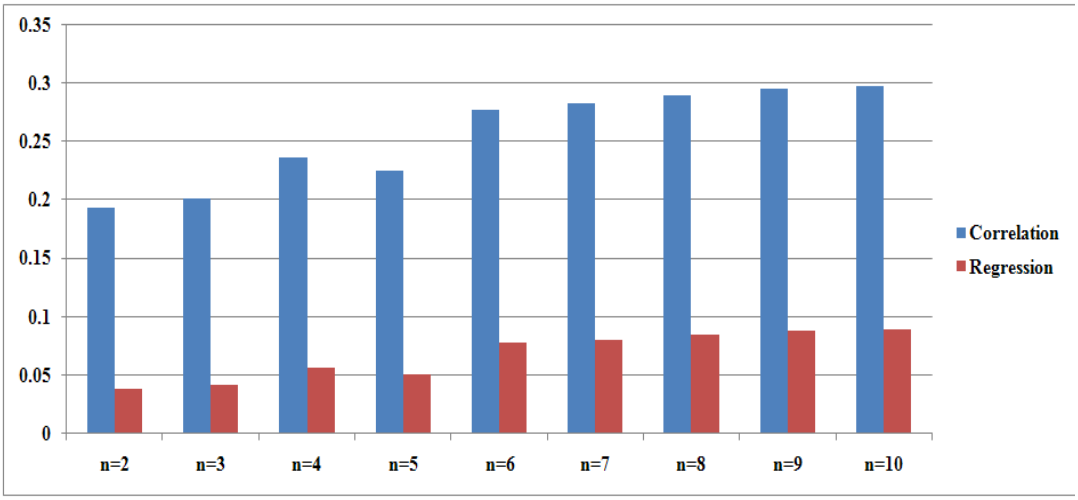

Figure 10. Bar chart showing the correlation and regression of forecasts for single moving average.

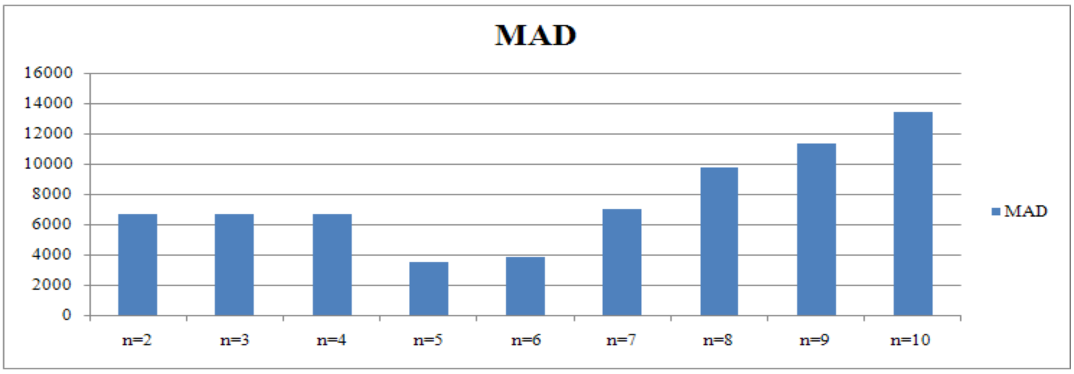

Figure 11. Bar chart showing the mean absolute deviation of forecasts for single moving average.

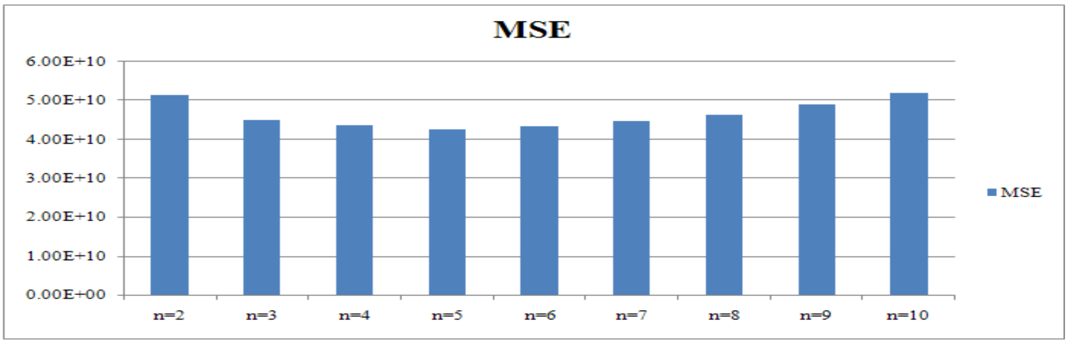

Figure 12. Bar chart showing the mean square error of forecasts for single moving average.

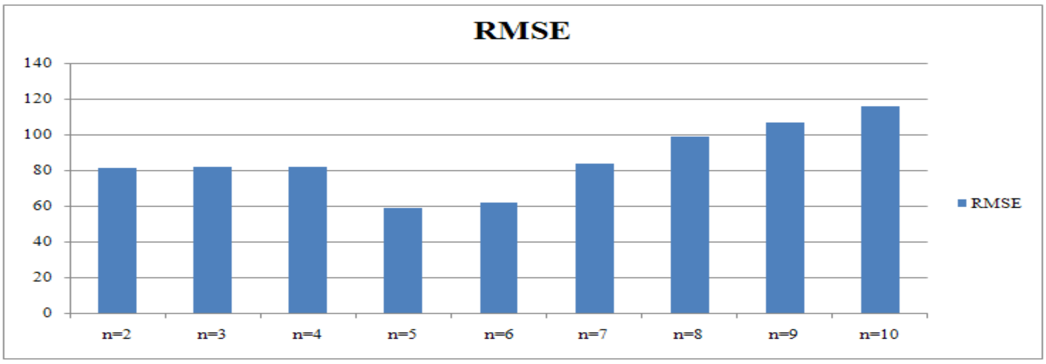

Figure 13. Bar chart showing the relative mean square error of forecasts for single moving average.

Furthermore, the analysis is shown in Table 8 and Figures 14-17, coefficient of description (correlation coefficient) and coefficient of explanation (regression) for simple exponential smoothing for MMIA reveals that a smoothing constant of 0.7 is most accurate, as it has the highest correlation value and regression value. The correlation value and regression value implies that the forecast of smoothing constant of 0.7 has a strong relationship with revenue passenger demand in MMIA. Also, Mean Absolute Deviation (MAD) and Relative Mean Square Error (RMSE) for simple exponential smoothing for MMIA show that the smoothing constant of 0.9 has the lowest value. However, Mean Square Error (MSE) for simple exponential smoothing shows that the smoothing constant of 0.7 has the lowest value. Since three methods of assessing the forecasting techniques explain that simple exponential smoothing with smoothing constant of 0.7 gives the lowest value, hence the results of Mean Square Error (MSE) will be retained. On this note, it can be deduced that for simple exponential smoothing, 0.7 smoothing constant is the most accurate for forecasting as it tends closer to 1. This corroborates the study of Hossein (2015); Lucey (2007); Montogomery & (1997); Kahn & Mentzer (1995); Brown (1963) that the higher the values of smoothing constant nearer to 1, the more sensitive the forecast becomes the current condition.

Table 8. Evaluation of accuracy for simple exponential smoothing in MMIA.

Evaluation	Correlation	Regression	MAD	MSE	RMSE
α=0.1	0.766	0.587	385678.8	4.08E+11	621.0304
α=0.2	0.802	0.644	262211.2	2.56E+11	512.0656
α=0.3	0.822	0.676	187921	1.98E+11	433.4985
α=0.4	0.834	0.695	142178.1	1.73E+11	377.0652
α=0.5	0.840	0.705	112593.6	1.61E+11	335.5497
α=0.6	0.843	0.711	92519.95	1.56E+11	304.1709
α=0.7	0.844	0.713	78280.6	1.54E+11	279.787
α=0.8	0.844	0.712	67730	1.55E+11	260.2499
α=0.9	0.842	0.708	59583.09	1.59E+11	244.0965

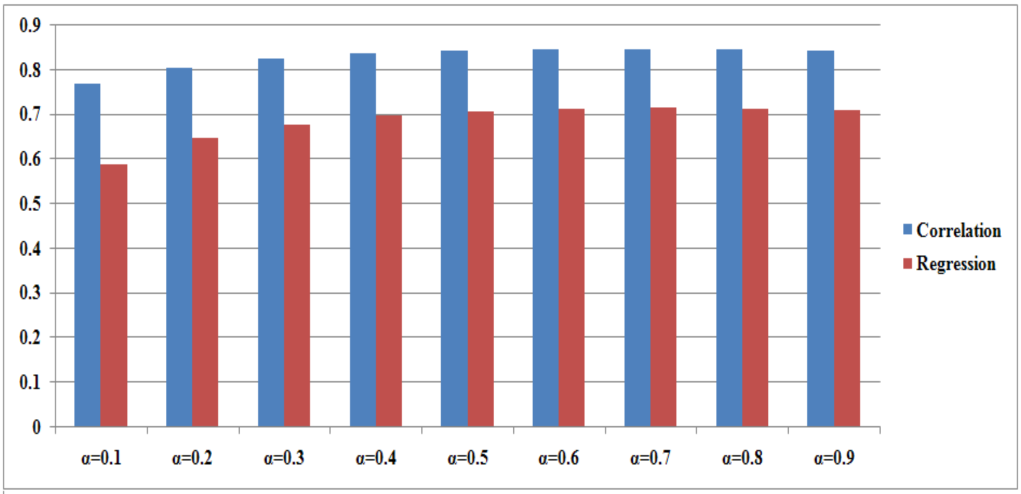

Figure 14. Bar chart showing the correlation and regression of forecasts for simple exponential smoothing.

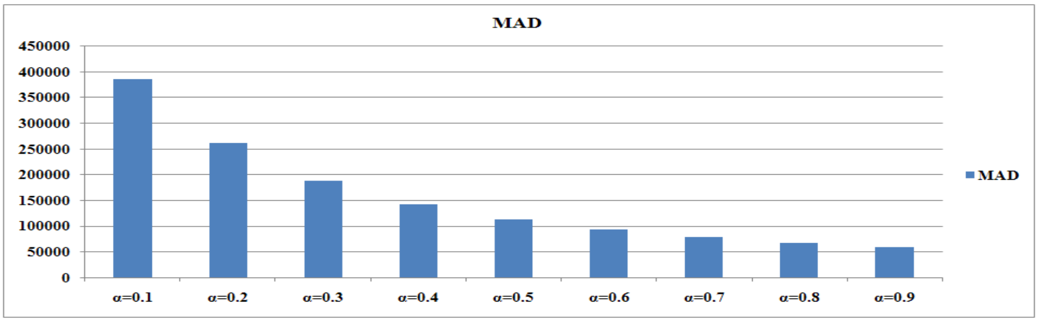

Figure 15. Bar chart showing the mean absolute deviation of forecasts for simple exponential smoothing.

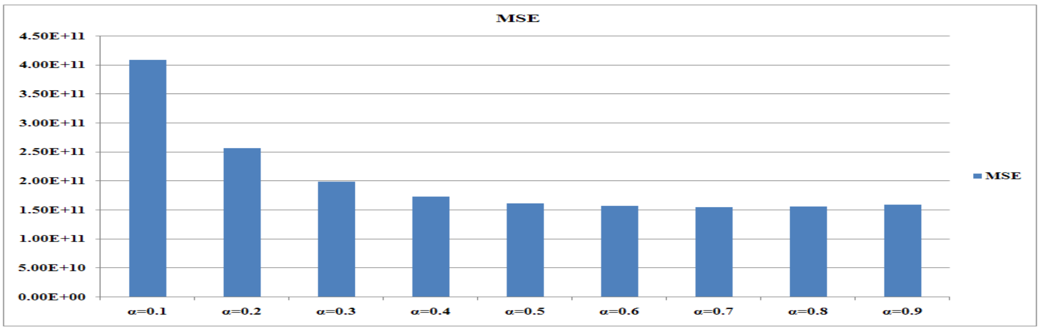

Figure 16. Bar chart showing the mean square error of forecasts for simple exponential smoothing.

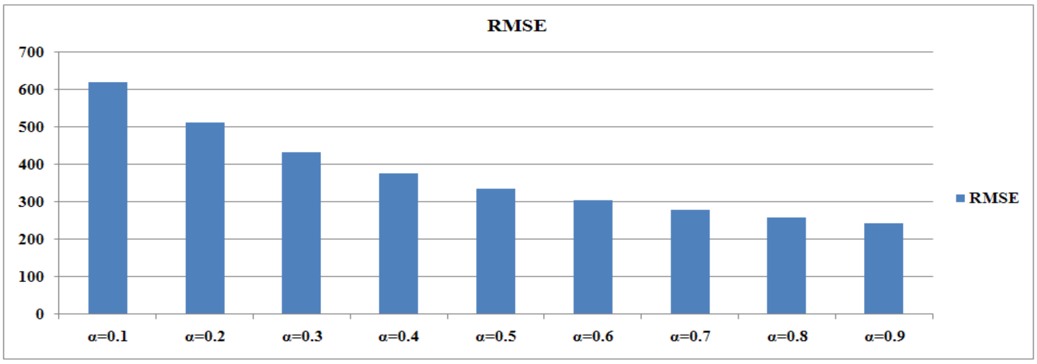

Figure 17. Bar chart showing the relative mean square error of forecasts for simple exponential smoothing.

The analysis is shown in Table 9 and Figures 18-21 revealed that coefficient of description (correlation coefficient) and coefficient of explanation (regression) for simple exponential smoothing for MAKIA reveals that smoothing constant of 0.5 and 0.6 is most accurate, as they have the highest correlation and regression value. The correlation and regression value implies that the forecast of smoothing constants of 0.5 and 0.6 has a strong relationship with revenue passenger demand in MAKIA. Also, Mean Absolute Deviation (MAD) for simple exponential smoothing for MAKIA shows that the smoothing constant of 0.9 has the lowest value. However, Mean Square Error (MSE) for simple exponential smoothing shows that the smoothing constant of 0.1 has the lowest value, meanwhile in support of MAD but contrary to MSE, Relative Mean Square Error (RMSE) for simple exponential smoothing shows that the smoothing constant of 0.9 has the lowest value. Hence, the evaluation of accuracy for simple exponential smoothing, MAD and RMSE will be acceptable, therefore 0.9 smoothing constant is the most accurate for forecasting. This corroborates the study of Lucey (2007) that the higher the value of smoothing constant nearer to 1, the more sensitive the forecast becomes the current condition.

Table 9. Evaluation of accuracy for simple exponential smoothing in MAKIA.

Evaluation	Correlation	Regression	MAD	MSE	RMSE
α=0.1	0.013	0.000	42377.32	3.29E+10	205.8575
α=0.2	0.054	0.003	21530.14	3.4E+10	146.7315
α=0.3	0.091	0.008	12381.91	3.63E+10	111.274
α=0.4	0.113	0.013	8055.955	3.89E+10	89.75497
α=0.5	0.123	0.015	5896.5	4.19E+10	76.78867
α=0.6	0.123	0.015	4734.664	4.52E+10	68.80889
α=0.7	0.117	0.014	4019.364	4.89E+10	63.39845
α=0.8	0.107	0.011	3497.5	5.3E+10	59.13967
α=0.9	0.095	0.009	3065.227	5.77E+10	55.36449

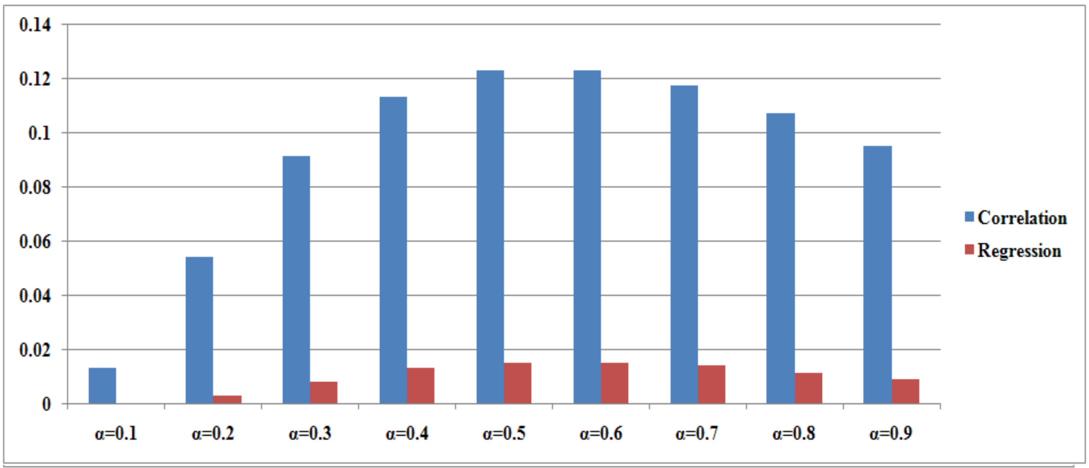

Figure 18. Bar chart showing the correlation and regression of forecasts for simple exponential smoothing.

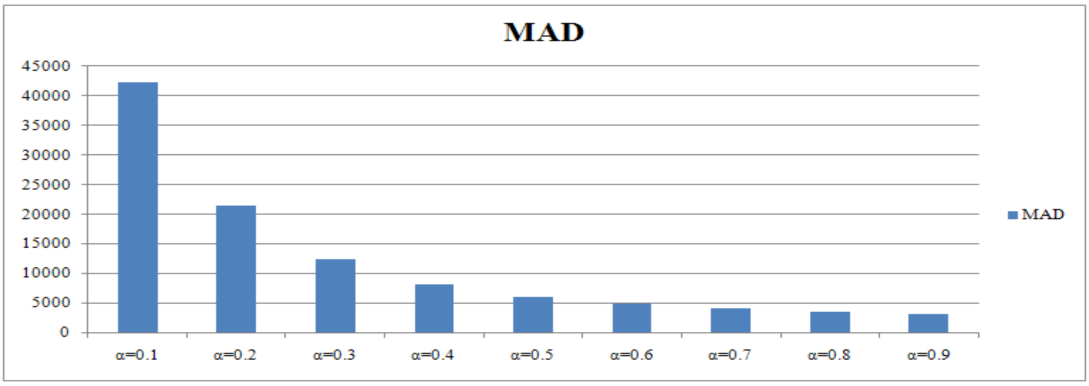

Figure 19. Bar chart showing the mean absolute deviation of forecasts for simple exponential smoothing.

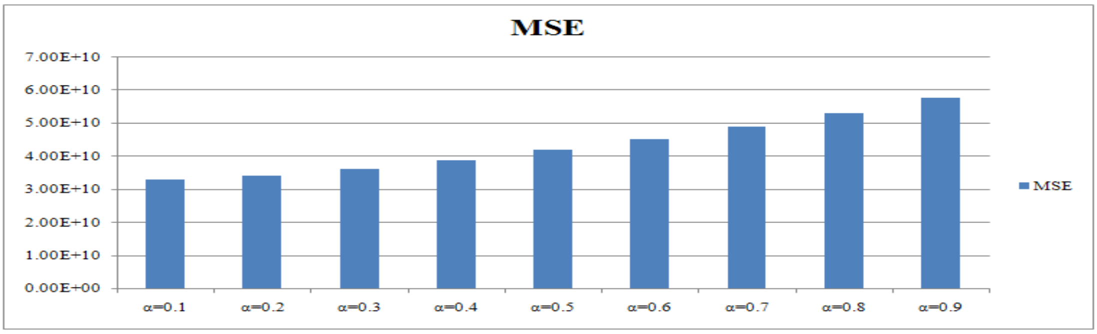

Figure 20. Bar chart showing the mean square error of forecasts for simple exponential smoothing.

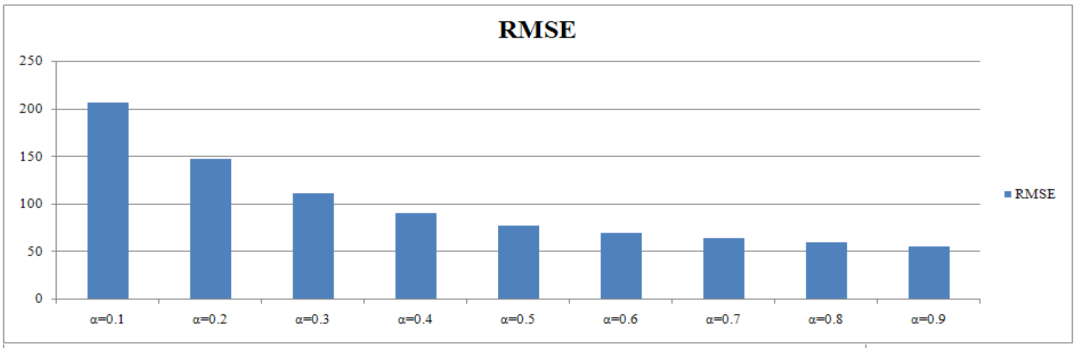

Figure 21. Bar chart showing the relative mean square error of forecasts for simple exponential smoothing.

In addition, there is a need to find out which forecasting method is more accurate from single moving average and simple exponential smoothing. The evaluation of forecast with data in MAKIA will not be used as it might give an inconclusive result, but the data in MMIA will be useful and reliable.

Hence, from the data of revenue passenger in MMIA, correlation and regression reveal that simple exponential smoothing with a smoothing constant of 0.7 has a strong relationship than 2 yearly single moving averages. This corroborates the findings achieved by Mean Square Deviation (MSD) which shows that simple exponential smoothing with smoothing constant of 0.7 has low deviation than 2 yearly single moving averages. This implies that simple exponential smoothing with smoothing constant of 0.7 will give accurate forecast than 2 yearly single moving averages. Also, simple exponential smoothing with a smoothing constant of 0.9 was revealed by Mean Absolute Deviation (MAD) and Relative Mean Square Error (RMSE) to have low deviation than 2 yearly single moving averages. This implies that simple exponential smoothing with smoothing constant of 0.9 will give accurate forecast than 2 yearly single moving averages. It can, therefore, be affirmed that simple exponential smoothing is more reliable than single moving average.

The findings of this study corroborate the findings of Adeniran & Stephens (2018); Hossein (2015); Lucey (2007); Hsiao (2003) & Wooldridge (2001) Montogomery & Johnson (1997); Kahn & Mentzer (1995); Brown (1963), but it opposes the findings of Adeniran, Kanyio & Owoeye (2018) which chooses single moving average over simple exponential smoothing. The findings of Adeniran, Kanyio & Owoeye (2018) seems different because the sample size of their data is lesser (n=7). In order to achieve a more plausible result for time series analysis, a larger sample size of non-experimental is requested. From simple exponential smoothing with smoothing constant of 0.9, the 2018 forecast of international air passenger travel demand in Murtala Muhammed International Airport will be 2,844,230.

CONCLUSION

This study identified the most appropriate forecasting method based on accuracy and ease of use (simplicity) to forecast the future demand of international air passenger in Murtala Muhammed International Airport. Data involved in MMIA and MAKIA are both historical and long on twenty-three years, but their evaluated results are quite different. This difference can be because the data of MMIA satisfies the assumption of linearity and consistency, while the data of MAKIA does not. Hence, the evaluation of forecast with data in MAKIA will not be used as it might give an inconclusive result, but the data in MMIA will be useful and reliable. From simple exponential smoothing with smoothing constant of 0.7, the 2018 forecast of revenue passenger demand in MMIA will be 2,870,005. Also, from simple exponential smoothing with smoothing constant of 0.9, the 2018 forecast of revenue passenger demand in MMIA will be 2,844,230.

The following contributions emanate from this study: time series analysis requires large sample size of non-experimental or observational data with respect to time; the observational data with respect to time must satisfy the assumption of linearity and consistency; the higher the value of smoothing constant nearer to 1, the more sensitive the forecast become the current conditions; the lower the value of n for the single moving average, the more realistic or reliable the forecast; and simple exponential smoothing is more reliable than single moving average.

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