Journal of the Nigerian Association of Mathematical Physics
Volume34,(March, 2016), pp117 – 122

Prediction of Cargo Traffic at Nigerian Seaports

Iyeke S.D[1] and Osuji S.O[2]

[1,2]Department of Civil Engineering, Faculty of Engineering,
University of Benin, Benin City, Nigeria.

Abstract

Traffic forecasting is a point of considerable importance for port expansion and logistics to reduce congestion at ports. Thus reasonable and accurate forecasting method should be developed to help government agencies make rational decisions in the effective allocation of limited resources. The forecasting of the cargo traffic was performed using historical cargo traffics throughput for Nigerian ports from 1956-2012 obtained from the Nigerian Port Authority.This research work considered modeling inward cargo with the outward cargo through selective transformation, involving testing some common functional forms to select the one model which best describes the relationship in terms of the model parameters. The linear model was adjudged to be best, since it has the highest coefficient of determination of 0.87 and also both constant and coefficient terms are significant at 5% level.

1.0 Introduction

The productivity of a port as a service facility providing the means of exchanging commodities between land and maritime transport can be assessed in terms of its throughput; the quantity of traffic that passes through it in a given time[1].The volume of cargo throughput at the ports is an important measure of the level of economic development of a country. It gives an indication of the revenue accrued from the ports, and the exports and imports capabilities of a country. The traffic through the Nigerian ports are increasing along with the economic development of the country [1]. It is frequently observed that queues of arriving ships are formed and occasionally ships have to linger for a longer time before berthing. This can be attributed to the inadequacy of existing port facilities to match the ever increasing global trade.Port congestion as massive un-cleared cargo in the port, resulting in delay of ships in the seaport [2]. This occurs when ships spend longer time at berth than usual before being worked on or before berth [2]. Port congestion is a situation whereby cargoes coming into the port are more than the storage facilities can handle [3].This has resulted in the diversion of ships meant for Nigeria ports to other neighbouring country ports[1].Port congestion brought about realization for better planning, port expansion and development and the loss of revenue, unemployment and bad image to the country as its major disadvantages [2]. Any country lacking a good base network of dependable transportation, warehousing communication and other related facilities would hardly be able to configure activity network for sustainable economic survival and development[4]. Investments in port infrastructures are vastly capital intensive and not one ventured into simply because of national pride. The implication is that for investment in these sectors of maritime transport to produce expected dividends, there must be an significant high level of capacity utilization of port infrastructures.

Capacity extension of a seaport is essential when it reaches its limits. Especiallyfor the seaports bounded by city limits, the land value usually generates difficulties in extension works. An adequate storage yard operation has beenconsidered by many researchers in literature. Several metaheuristics were projected to reduce the space provided to containers[5]. A heuristic algorithm was suggested for a seaport to solve the location problem of storage areas for export containers[6].A preliminary methodology was proposed to be used in evaluating the capacity analysis of a seaport[7].In the scope of a capacity expansion, sizing of the container storage area is a major problem. To decide a ample area size, future ship and cargo traffics are required to be estimated. Forecasting cargo traffic can be performed with historical cargo traffics or may be correlated with

Corresponding author: Iyeke S.D, E-mail:solomon.iyeke@uniben.edu, Tel.: +2348039167870

the arrival and departure ship numbers. In literature there are quite a few efforts to predict the future cargo traffic of a seaport [8-12]. The aim of this work is to predict the relationship of the cargoes activities at the Nigerian ports in other to project its future activities and make ground for improvement. A functional relationship that cargoes loaded at the ports will have a significant effect on cargoes discharged at the ports. This research work considers modeling inward cargo with the outward cargo through selective transformation, involving testing some common functional forms to select the one model which best describe the relationship in terms of the model parameters.

2.0 Methodology

2.1 Sources of Data and Data Analysis

In this research work, secondary data were used in the analysis. The data were sourced from Nigerian Ports Authority (NPA). This research made use of descriptive statistics andregressionanalysis in the analysis of the data collected.

2.2 Regression Model Relationships and Framework

In the regression analysis, selective transformation method involves testing some general functional forms, to choose which one model best characterize the data relationship. The functional forms that the author considers will mimic the inward cargoes – outward cargoes relationship are:

Model 1 $Y = a + bX$ (1)

Model 2 $Y = a + b\log X$ (2)

Model 3 $Y = a'e^{bx}$ (3)

Model 4 $Y = a'X^{b}$ (4)

The idea of developing the models presumes the hypothesis that a functional relationship is definable between the variables. This hypothesis is regarded proven in this work in the caset that a model is found significant in terms of the parameters of the model, the regression coefficient of determination and the analysis of variance results (t-test,R^2, and F-ratio, respectively). Selection of the best model is done by contrasting the models' overall statistical significance and the statistical significance of the models' parameters at the 5% level of confidence, as well as the value of the error sum of squares of the residuals.The 95% level of confidence is here being proposed, as it is the level usuallyconsidered the center of the road in research. At this level, there is only 5% chance that a conclusion drawn from the available data analysis is inaccurate or that investigator is 95% certain of the inferences made.The outward cargoes should be the independent variable, whilethe inward cargoes is the dependent variable. The port facilities should give advantages to the export capabilities of the country to foster the GDP of the nation. This is to encourage export trade as against being an import dependent nation.

3.0 Results and Discussions

3.1 Statistical Analysis of Cargo Transportation

Table 1, shows the volume of cargo throughput handled at the Nigerian ports from 1956 to 2012. Cargo throughput is the sum of both the inward and the outward cargo processed by the ports in the given period.

Table 1: Cargo Throughput at Nigerian Ports [13]

S/N	Year	Inward(metric tons)	Outward(metric tons)	Throughput(metric tons)
1	1956	1386480	1356480	2742960
2	1957	1620195	1552752	3172947
3	1958	1680222	1419552	3099774
4	1959	1823506	1720356	3543862
5	1960	2110440	1482901	3593341
6	1961	2256453	1374263	3630716
7	1962	2350087	1664431	4014518
8	1963	2387446	1631560	4019006
9	1964	2527730	1830576	4358306
10	1965	2640672	2037828	4678500
11	1966	2853627	1997834	4851461
12	1967	2428106	1753800	4181906
13	1968	2272681	1562887	3835568
14	1969	2177611	1661517	3839128
15	1970	2719518	1507964	4227482
16	1971	4492152	2816851	7309003
17	1972	5281466	2831638	8113104

S/N	Year	Inward(metric tons)	Outward(metric tons)	Throughput(metric tons)
18	1973	4459164	3103075	7562239
19	1974	5256724	3218696	8475420
20	1975	5979492	2461934	8441426
21	1976	8481284	2518241	10999525
22	1977	11853063	2552183	14405246
23	1978	15694964	2419808	18114772
24	1979	17395286	2679951	20075237
25	1980	15600380	2356815	17957195
26	1981	20728974	2913742	23642716
27	1982	20073797	2537432	22611229
28	1983	16394509	2346700	18741209
29	1984	12372417	2278685	14651102
30	1985	13453939	2947740	16401679
31	1986	9851059	2423520	12274579
32	1987	9288006	2249584	11537590
33	1988	7773258	3402088	11175346
34	1989	8759961	4616226	13376187
35	1990	9338801	6830356	16169157
36	1991	11021521	6819380	17840901
37	1992	13414501	5487925	18902426
38	1993	12897955	5739047	18637002
39	1994	9579969	4281879	13861848
40	1995	9289971	3983082	13273053
41	1996	10224300	5251001	15475301
42	1997	11213624	5369181	16582805
43	1998	14286864	5038854	19325718
44	1999	15751331	6841605	22232936
48	2000	19230496	9702384	28932880
46	2001	24668791	11271901	35940692
47	2002	25206380	11780861	36987241
48	2003	27839293	11926652	39765945
59	2004	26907075	13909872	40816947
50	2005	29254766	15697312	44952078
51	2006	29089268	17061250	46150518
52	2007	35544965	21928385	57473350
53	2008	41195616	22787133	63982749
54	2009	45757149	20018360	65775509
55	2010	46928848	29815879	76744727
56	2011	52010440	31439592	83450032
57	2012	46234240	30870498	77104738
TOTAL		**813310833**	**380721999**	**1194032832**

The descriptive statistics of the cargo traffic in the period under review is presented in Table 2. It can be seen that the minimum value of both inward and outward cargo are slightly close. This coincide with the 1950-1970s when Nigerian economy was agricultural driven and less import dependent, while the maximum occur in recent year2011. Though this is a period of high export, it is worth of note crude oil now constitutes 96% of total exports as against 4% for non-oil exports [14].