

Land Value Determinants and Variability in Commercial Property Values in Emerging Economy: Case Study of Ikeja, Nigeria

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Abstract

This study was carried out to examine the contribution of land value determinants to variability in commercial property values in Ikeja, Nigeria. In doing so, road network in the study area was decomposed into its explanatory variables in consonance with other property value determinants, and multiple regression models adopted to analyze the data. It was found that there was significant relationship between the variables. A model for predicting variability in property values in the study area was consequently derived.

Key words: arterial roads, commercial property, property value, road network, valuation, variability

Introduction

Roads may be classified as international, inter-city or intra-city. International and inter-city roads are usually major or arterial roads, while intra-city roads are routes within a city and may be minor or major. Pattern of road network somewhat influences ease of movements and provides accessibility to various land uses which compete for available spaces along the arterial roads. Commercial properties tend to cluster along such roads to take relative advantages of agglomeration. Competition makes locations along the road to be at their highest and best use also translated in high rental values compared to other locations.

Regardless of the advantages, developers, financiers and investors in commercial properties are faced with dearth of data on what level of rental income a development project could reasonably be expected to realize in a transaction involving willing and able parties. The overall impact of risks and uncertainty in the property market calls for tool to predict future trend in commercial property market with some measure of accuracy. This is to ensure

that income which a given commercial property generates in the nearest future will be sufficient to recoup the capital outlay and be sustained subsequently.

A number of factors affect commercial property values in Nigeria. These include institutional and economic factors, location, complementary uses, competition amongst and between uses, design, degree of obsolescence, accessibility, road network, relationship between landlord and tenant, and negative externalities (McCluskey, et al, 2000; Oyebanji, 2003; Olusegun, 2003; Kauko, 2003; and Omoogun, 2006). For purpose of this study, road network, location, demand and supply, and accessibility that have been established in literature were isolated and regressed with commercial property values. This study therefore focused on arterial roads in the intra-urban network of Ikeja city and the isolated factors against the open market rental value. The aim is to determine the relationship (if any) between arterial road network in the presence of other variables and commercial property values in the study area, while model for predicting variability in commercial property values in the study area were derived.

Related Studies

In explaining pattern of property values, Lean and Goodall (1977) opined that the centre of an urban area is the position of greatest accessibility where transport routes and systems converge. Competition between firms whose revenue is high when in such a position will force up rents and land values above those in the remainder of the urban area. Firms will compete to locate in the centre to take advantage of complementarity, which to large extent, is a function of accessibility. The larger the urban areas the more distinct will the clusters of complementary uses become. Similarly, the higher the degree of accessibility and complementarity the higher the land values in the centre are likely to be.

According to Aderamo (2003), road network constitutes important element in urban development as roads provide accessibility required by different land uses; and proper

functioning of such urban areas depends on efficient transport network, which is backbone to their very existence. The analysis of the road network involves recognition of the patterns and qualities of the roads, which can be emphasized through process of abstraction and symbolization.

Various studies have adopted the graph-theoretic concept amongst which are the works of Garrison and Marble (1960) and Nystuen and Dacey (1961). The former applied graph theory in measuring regional highways in the United States of America, while the latter analyzed functional connection between central places in Washington using communication flows in a network. In addition, Muraco (1972) used the concept in studying intra-urban accessibility in Columbus and Indianapolis, USA, and in estimating traffic flow in Barnsley, U.K. (Ogunsanya, 1986). In Nigeria, Aderamo (2003) studied the growth of intra-urban road network in Ilorin, Nigeria using the graph theoretic analysis. The technique was used to determine degree of accessibility and connectivity of nodal points within a road network using a university community in Nigeria as case study (Oni, 2007a) and in analysing accessibility and connectivity in the road network of a metropolitan area also in Nigeria (Oni, 2007b).

Some earlier studies (Nelson, 1999; Hack, 2002; Fejerang, 1994; Hillier-Parker, 2002; Chesterton, 2002; Cervero, 1994; Sedway Group, 1999; Cervero and Duncan, 2002; Diaz, 1999; and, A.P.T.A., 2002) concluded that properties near rail stations, metro line and roads gain slightly higher value compared with properties farther away. Other studies such as Pharoah (2002) found that sites close to stations were more attractive to commercial and mixed-use developments and those farther from stations are more attractive for residential developments with sites close to station sought for commercial developments.

Stratton (2008) conducted a study of the spatial concentration of office uses and how their combination with other land uses affects value of office properties; this was to

determine the relationship between spatial clustering of office uses and office property values. The variables used were cluster size, regional location and relationship to transportation infrastructure, internal land use mix, and transportation network. The study revealed that recent office development has continued to benefit economically from agglomeration. In addition, office property values were positively affected by intensity of office development, a central regional location, and clustering or agglomeration of office parcels.

Cloete and Chikafalimani (2001) in a study on property industry in Malawi agreed with Stratton (2008). The study identified eight factors that affect property value, which are architectural design, quality of finishing, maintenance condition of the property, size of property, security, condition of the street, and location. Hendon (1971) studied the effect of a park on property values, found that park had stabilizing influence on residential property values, especially among high-valued residential properties, and lower with less-valued ones.

According to Oyebanji (2003), a number of factors affect property values in Nigeria. These include population change, change in fashion and taste, institutional factors (culture, religious belief, and legislation), economic factors, location, complementary uses, transportation and planning control. He stated further that good spread of road network has tendency to increase accessibility with certain areas becoming less accessible as a result of traffic congestion thereby causing value to shift to areas that are accessible.

From the studies, a number of factors that determine property values were identified, which include infrastructural funding, impact of high-speed mode of transportation especially at new station in peripheral sites where the impact is highest; nearness to rail stations, metro lines, and roads especially where transport infrastructure is poor. Others include accessibility relative to location-distance of land uses, change in population, change in fashion and taste, institutional factor, economic factor, location, transportation, complementary uses, road transport network, political factor, planning regulation, environmental quality, aesthetics, and

growth pattern of land use.

In the Nigerian context, earlier studies focused on land use and urban development with considerable works carried out by scholars in various disciplines to explain the determinants, structures and effects of residential land use and land values in the urban areas. Little attention was given to the effects of supply and demand, which interplay to determine values. In this study, accessibility, road network explanatory variables, distance to the most central part of the study area, demand and supply factors were considered to determine variability in commercial property values.

This aim of this study is to examine the relationship between road network in terms of its explanatory variables, demand and supply factors, accessibility, location attributes and commercial property values in Ikeja, Nigeria.

The Study Area

Ikeja city is a large component of the Lagos metropolis. Lagos itself is the largest city in Nigeria, located at 6°34'60"N, 3°19'59"E along the West African coast. There are ninety roads in Ikeja metropolis out of which thirty-seven are arterial. From the thirty-seven arterial roads twenty traverse the commercial axes while others serve institutional, industrial, and residential neighbourhoods. This study covered all major roads serving the commercial axis and inner areas of Ikeja metropolis to the exclusion of inter-city roads such as Lagos/Abeokuta Expressway, Oworonsoki/Apapa Expressway, Ikorodu Road, and Lagos/Ibadan Expressway that form rings around the study area.

Described in terms of its operational structures, Ikeja metropolis is divided into seven sectors. Sector One lies at the north-central part of the metropolis and consists mainly of residential neighbourhoods with occasional commercial users of banks and service offices. Sector Two is of predominantly industrial concerns around WEMPCO, ACME and Lateef

Jakande Roads; Sector Three is almost centrally located in the study area and consists of Oba Akran Avenue, Adeniyi Jones Avenue, Aromire Avenue, and Awolowo Way that serves as demarcation between the Sectors Three and Five. The sector comprises predominantly residential users interspersed by few industrial concerns and commercial outfits that over the years have displaced residential users along the arterial roads.

Sector Four lies at the eastern part of the study area served with Secretariat Road, Ikosi Road, Oregun Road, 7-up Road, bounded by Lagos/Ibadan Expressway and Ikorodu Road. Sector Five is bounded by Sectors Three, Four and Six consists of Allen Avenue, Opebi Road, Ola Ayeni Street, Toyin Street, Olowu Street, Kodesho Street, Simbiat Abiola Road, Otigba Street and Opebi Link-Road. The sector is characterized by concentration of commercial properties and represents the main commercial sector of the study area.

Sector Six occupies the southern part of the study area and consists of Government Residential Area (G.R.A), and institutional properties (Army Barracks, Police Barracks, High and Magistrate Courts, Lagos State Administrative Centre, Passport Office and Nigeria Telecommunication Limited). Properties along major roads in the Sector have undergone changes in use from residential to commercial user. Roads within the Sector include Mobolaji Bank-Anthony Way, Adekunle Fajuyi Way, Isaac John Street, Oba Akinjobi Street while Sector Seven, which lies at the western part, consists entirely the Murtala Muhammed Airport as shown in Fig. 1 below

Materials and Methods

Data were collected from primary and secondary sources. The primary data were obtained through questionnaires complemented with oral interviews of estate surveyors and occupiers of commercial properties involved in the study. The secondary sources of data included Survey Directorate in the Lagos Ministry of Land and Physical Planning, Ministry of Transportation, Directorate of Land Information Systems in the Land Bureau, Governor's Office, Ikeja, and West African Book Publishers Limited, Lagos. Details of road network were derived through the analysis of the satellites road maps while data on volume of traffic was obtained from Lagos State Traffic Management Authority.

The entire Lagos metropolis has 9,197 roads consisting of carriageways, cul-de-sac, lanes, streets, avenue, ways, and crescents (Lagos Street Map, 2008). Out of 9,197 roads in Lagos metropolis, only 350 are arterial. When the three hundred and fifty (350) arterial roads were divided according to zones in Lagos metropolis, Lagos Island has 102 arterial routes (representing 29%); Mainland, 119 (34%); Apapa, 39 (11%) and Ikeja, 90 (26%). From the ninety roads that traverse the study area, twenty (20) serve commercial axes while remaining seventy (70) serve inter-city, institutional, industrial, and residential neighbourhoods. This study covered all major roads serving the commercial axis in Ikeja city to the exclusion of inter-city roads that form outlying ring around the study area. Sampling of the arterial roads was not necessary as hundred percent of roads was considered to make complete network.

There are three hundred and twenty-five registered firms of Estate Surveyors and Valuers practicing in Lagos metropolis out of which one hundred and ten (about 34%) operate in Ikeja metropolis. In respect of population of commercial properties in the study area, there are two thousand and eight commercial properties located along the twenty arterial roads giving an estimated five thousand occupiers. The number of commercial properties along arterial roads in the study area was obtained using application of geographical

information system while population of occupiers was obtained by direct survey. The population of Estate Surveying firms in the study area was obtained from the register of firms at the Lagos State Branch of the Nigerian Institution of Estate Surveyors and Valuers.

In determining the appropriate sample size for each of the study populations, the Bartlett et al (2001) model was used with alpha level set at 0.05. The model specified minimum sample size for continuous and categorical data based on specific population size and different alpha levels. Using the model, the appropriate sample size of Estate Surveyors obtained from population of one hundred and ten firms was ninety-nine, and six hundred for five thousand occupiers.

Questionnaires were administered on the sampled firms of Estate Surveyors and Valuers to obtain average rental values on commercial properties over a five-year study period. Five years was considered after analysis of respondents' open market rental values obtained from their records showed marginal differences within the period, whereas wide variations were observed in years preceding the selected period. The average rental values for the study period were derived by summing up the open market rents obtained from all respondent Estate Surveyors for each of the five-year study period and along each arterial road. Total of rental values for each arterial road was divided by five to arrive at the average rental value per annum expressed in Naira per square metre per annum.

Analysis and Discussion

The attempt was to test the null hypothesis that there is no statistically significant relationship between commercial property values and road network in the presence of other variables. In this respect, the relationship between commercial property value and road network, location, supply and demand, accessibility which were respectively the dependent and independent variables were tested at 0.05 confidence level.

In doing so, road network was decomposed into its explanatory variables of traffic

density, road density, length density, accessibility, connectivity, quality and width of each road in the network. The independent variables were consequently measured. The accessibility and connectivity indexes were derived using graph theoretic analysis of the arterial roads. The process involved tracing out the arterial routes (in Fig. 1) using transparent paper to derive graph of the roads shown in Fig. 2 below.

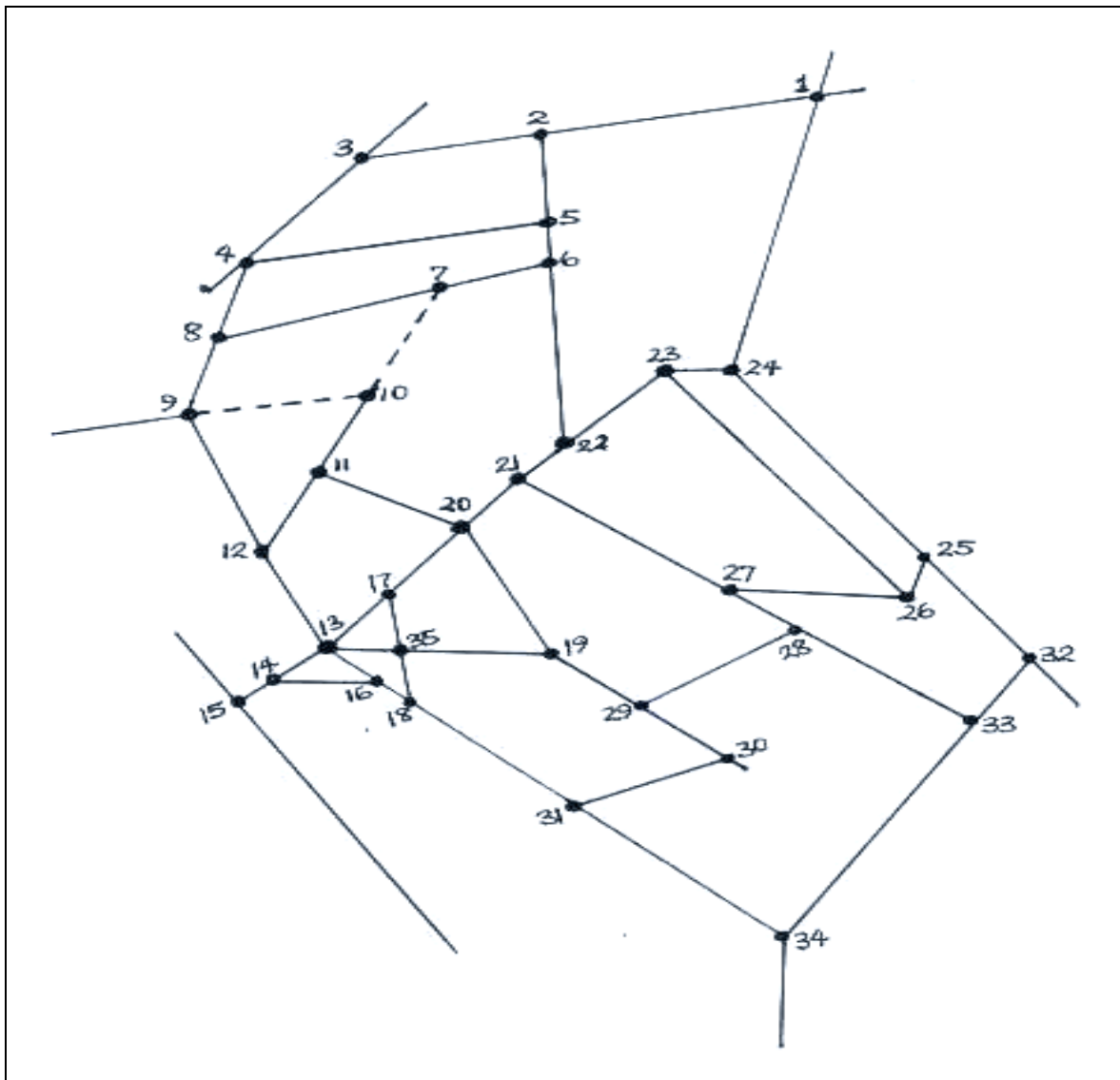


Fig. 2 Graph of Arterial Roads in Ikeja Nigeria
Source: Author's Analysis

Fig. 2 above which is qualitative in nature was transformed into quantitative data using the graph theoretic technique. The levels of accessibility of the arterial road were derived by converting road network into linear graph, each route represented by single line regardless of

width, quality and standard analyzed to obtain required quantitative data using the graph theoretic qualitative technique taking the shortest route possible.

The accessibility matrix was derived from Fig. 2. This involved numbering of the nodal points in the graph serially. Indexes for accessibility were thereafter determined and indicated in Shimbel matrixes in Tables 1 and 2 (see Appendix). The Shimbel matrix summarizes number of edges required to connect each node or vertex with other nodes in the network through the shortest path. The nodal point with the least index was considered as the most accessible. The connectivity matrix shows the number of other nodal points to which a particular node had direct link and the node with the highest number of points was the most connected. The node with the least Shimbel index was regarded as the most accessible in the network.

The twenty arterial roads in the study area encompassed thirty-five nodal points. Consequently, in measuring the accessibility and connectivity indices for thirty-five nodal points in the road network, each road was weighted against the nodal points encompassing it resulting in accessibility and connectivity indices. Eqn. 1 as derived by Oni (2009) was adopted to obtain the indices.

$$\beta a,(c)_i = \frac{\delta p_{1i} + \delta p_{2i}}{\sum (r\delta_1 + r\delta_2)} \times \frac{r\delta_1}{r\delta_2} \quad \dots \text{Eqn. 1}$$

Where,

$\beta a(c)_d$ = weighted accessibility or connectivity index;

δp_{1i} = accessibility or connectivity index of lower nodal point;

δp_{2i} = accessibility or connectivity index of higher nodal point;

$r\delta_1$ = rank for lower nodal point;

$r\delta_2$ = rank for higher nodal point;

Adopting Eqn. 1, the weighted connectivity and accessibility indices derived are shown in

Table 1

Table 1: Weighted Accessibility and Connectivity Indices of Arterial Roads in Ikeja

S/N	Arterial Road	Accessibility Index	Connectivity Index
1	Obafemi Awolowo Way	0.10	0.02
2	Toyin Street	0.55	0.08
3	Bank Anthony Way	0.57	0.10
4	Lateef Jakande Road	0.58	0.14
5	Isheri-Agege Road	0.64	0.15
6	Ogba Road	0.64	0.18
7	Oregun Road	0.65	0.18
8	Opebi Linkroad	0.69	0.23
9	Simbiat Abiola Way	0.72	0.23
10	Aromire Avenue	0.73	0.23
11	Ikosi Road	0.73	0.24
12	Olowu Street	0.73	0.25
13	WEMPCO Road	0.73	0.26
14	Adeniyi Jones Avenue	0.74	0.27
15	Allen Avenue	0.74	0.27
16	Kodesho Street	0.74	0.29
17	Oba Akran Avenue	0.74	0.33
18	Opebi Road	0.74	0.33
19	Opebi/Bank-Anthony Way	0.74	0.34
20	ACME Road	0.75	0.35

Source: Field Survey, 2008

In estimating the density of each road, the unit length of each road in the network was calculated over the total land area in the study area and expressed as length per square metre. Eqn. 4.2 (Oni, 2009) represents the measure of road density.

$$r_d = \frac{\sum_{i=1}^n lr_i}{A} \quad \dots \text{Eqn. 2}$$

where,

r_d = road density

$lr_{1...n}$ = length of individual road

A = entire land area in the study area

Traffic density was measured in terms of volume of vehicles over the entire land area. This determines the number of vehicles per square metre land area and it is an indication of level of congestion in the study area. Length density expresses the relationship between lengths of arterial roads over the total length of all arterial roads in the study area. Similarly,

in determining the relative location advantage of each arterial road, the most accessible nodal point in the network of arterial roads was used as the reference point to which other locations were related. In doing so, the number of links from the farthest point on each road in the network was determined taking the shortest routes possible, the location indices for the roads are shown in Table 2

Table 2: Location indices of Arterial Roads in Ikeja

S/N	Arterial Road	Location index
1	Oba Akran Avenue	4
2	Kodesho Street	6
3	Obafemi Awolowo Way	5
4	Adeniyi Jones Avenue	3
5	Aromire Avenue	2
6	Allen Avenue	2
7	Opebi Road	4
8	Opebi Rd/Bank-Anthony	5
9	Bank-Anthony Way	6
10	Lateef Jakande Road	4
11	ACME Road	4
12	WEMPCO Road	4
13	Ogba Road	6
14	Isheri-Agege Road	5
15	Oregun Road	3
16	Ikosi Road	3
17	Olowu Street	3
18	Simbiat Abiola Way	4
19	Toyin Street	3
20	Opebi Link Road	2

Source: Field Survey, 2008

Demand for commercial properties was determined by analyzing the number of requests for the properties on yearly basis using data obtained from the Estate Surveyors and Valuers over a five-year period, and average of their figures indicated for each arterial road. Similarly, supply of commercial properties was derived from the analysis of data on number of letting transactions effectively completed by the respondents within the same period, and

average number of the transactions determined. Tables 3 and 4 show the details of demand and supply for commercial properties in the study area

Table 3: Demand and Supply of Commercial Properties along Arterial Roads in Ikeja

S/N	Arterial Road	Years/Average Number of Requests					Total
		2003	2004	2005	2006	2007	
1	Obafemi Awolowo Way	18	23	31	54	49	175
2	Bank-Anthony Way	10	12	15	20	28	85
3	Oba Akran Avenue	11	14	20	22	21	88
4	Toyin Street	9	29	20	34	41	133
5	Oregun Road	6	9	11	12	13	51
6	Allen Avenue	23	21	29	33	38	144
7	Opebi Road	12	16	18	25	33	104
8	Adeniyi Jones Avenue	16	19	20	22	25	103
9	Lateef Jakande Road	6	11	11	12	12	53
10	WEMPCO Road	3	4	5	6	9	27
11	Isheri Road	5	4	5	5	8	27
12	Kodesho Street	5	7	8	11	14	46
13	Simbiat Abiola Way	6	8	8	9	11	42
14	Aromire Avenue	7	7	7	11	10	43
15	Olowu Street	6	7	9	9	14	46
16	Opebi Link-Road	3	3	4	6	6	23
17	Ikosi Road	2	3	2	3	4	14
18	Ogba Road	3	4	6	5	7	25
19	Bank-Anthony/Opebi Road	6	5	7	7	9	34
20	ACME	6	6	6	7	7	31
Total		163	212	243	315	357	1290

Source: Field Survey, 2008

Table 4: Supply of Commercial Properties along Arterial Roads in Ikeja

S/N	Arterial Road	Year/Average Number of Letting Transactions					Total
		2003	2004	2005	2006	2007	
1	Obafemi Awolowo Way	16	18	14	11	16	75
2	Bank-Anthony Way	9	7	8	20	19	63
3	Oba Akran Avenue	7	8	12	22	19	68
4	Toyin Street	8	21	19	34	33	115
5	Oregun Road	6	7	10	12	9	44
6	Allen Avenue	14	11	18	33	34	110
7	Opebi Road	6	13	11	25	23	78
8	Adeniyi Jones Avenue	7	14	10	22	22	75
9	Lateef Jakande Road	5	8	6	12	7	38
10	WEMPCO Road	3	3	4	6	8	24
11	Isheri Road	5	4	3	5	7	25
12	Kodesho Street	3	3	4	11	8	29
13	Simbiat Abiola Way	4	4	6	9	7	30
14	Aromire Avenue	5	4	6	11	8	34
15	Olowu Street	5	6	5	9	8	33
16	Opebi Link-Road	3	2	2	6	5	18
17	Ikosi Road	2	2	1	3	3	11
18	Ogba Road	3	4	4	5	6	22
19	Bank-Anthony/Opebi Road	5	4	3	7	6	25
20	ACME	6	5	4	7	5	27
Total		122	148	150	272	253	946

Source: Field Survey, 2008

In determining commercial property values, average rent per square metre along each arterial road was determined from the data obtained from respondents over a five-year period as shown in Table 5

Table 5: Average Rental Values of Commercial Properties along the Arterial Roads in Ikeja

S/ N	Road	Rent (Naira per square metre) per					Mean Rent for
		2003	2004	2005	2006	2007	
1	Allen Avenue	4,500	5,000	6,400	8,000	10,500	6,880
2	Adeniyi Jones Avenue	4,500	5,500	6,500	8,500	9,000	6,800
3	Opebi Road	4,500	4,500	6,000	8,000	10,000	6,600
4	Bank-Anthony Way	3,500	5,000	6,000	7,800	9,500	6,360
5	Oba Akran Avenue	3,600	5,000	6,000	8,000	9,100	6,340
6	Bank-Anthony/Opebi Way	3,500	5,000	6,000	7,500	9,000	6,200
7	Toyin Street	3,600	4,500	5,800	8,000	8,700	6,120
8	Aromire Avenue	4,000	4,500	5,600	7,800	8,500	6,080
9	Kodesho Street	3,000	4,200	5,000	6,500	8,000	5,340
10	Ogba Road	3,600	4,500	5,000	6,000	7,000	5,220
11	Obafemi Awolowo Way	3,500	3,500	5,000	6,000	8,000	5,200
12	Simbiat Abiola Road	3,000	3,500	4,800	6,000	8,000	5,060
13	ACME Road	3,500	4,000	5,000	6,000	6,500	5,000
14	Lateef Jakande Road	3,000	4,000	4,500	6,500	7,000	5,000
15	Olowu Street	3,500	3,500	5,000	6,000	6,500	4,900
16	Opebi Link-Road	3,500	3,600	4,500	5,000	7,000	4,720
17	Oregun Road	3,000	3,500	4,500	6,000	6,500	4,700
18	WEMPCO Road	3,000	3,500	4,000	5,000	6,000	4,300
18	Ikosi Road	3,000	3,000	4,000	4,500	5,700	4,040
20	Isheri/Agege Road	3,000	3,200	3,500	4,000	5,500	3,840
Mean Rental Value		3,515	4,150	5,155	6,555	7,800	

Source: Field Survey, 2008

The results of the analysis of the dependent and independent explanatory variables discussed in this sub-section are summarized in Table 6

Table 6: Summary Details of the Independent Variables

S/N	Road	Traffic volume	Road Length (in metres)	Traffic Density	Road Density	Connectivity	Road Quality	Accessibility	Supply (average number of lettings)	Demand (average number of requests)	Location (number of links to the most accessible locations from farthest point along each road)
1	Oba Akran Avenue	16,651	2,307.18	7.22	0.06	0.18	4	0.74	14	18	4
2	Kodesho Street	16,240	559.465	29.03	0.01	0.08	4	0.74	6	9	6
3	Obafemi Awolowo Way	19,042	4,292.12	4.44	0.11	0.23	5	0.10	15	35	5
4	Adeniyi Jones Avenue	12,211	2,233.46	5.47	0.06	0.27	4	0.74	15	21	3
5	Aromire Avenue	17,414	616.81	28.23	0.02	0.23	4	0.73	7	9	2
6	Allen Avenue	18,038	1,411.30	12.78	0.04	0.23	5	0.74	22	29	2
7	Opebi Road	16,510	1,886.00	8.75	0.05	0.24	4	0.74	16	21	4
8	Opebi Rd/Bank-Anthony Way	18,392	674.13	27.28	0.02	0.26	5	0.74	4	7	5
9	Bank-Anthony Way	17,186	4,718.66	3.64	0.12	0.18	5	0.57	13	17	6
10	Lateef Jakande Road	17,173	2,443.60	7.03	0.06	0.25	4	0.58	8	11	4
11	ACME Road	18,433	2,200.49	8.38	0.06	0.33	4	0.75	6	6	4
12	WEMPCO Road	14,898	1,963.85	7.59	0.05	0.27	4	0.73	5	5	4
13	Ogba Road	15,539	1,121.50	13.86	0.03	0.35	4	0.64	4	5	6
14	Isheri-Agege Road	12,816	5,080.41	2.52	0.13	0.33	5	0.64	5	5	5
15	Oregun Road	18,276	3,888.18	4.70	0.10	0.14	5	0.65	9	10	3
16	Ikosi Road	14,900	1,207.08	12.34	0.03	0.27	3	0.73	2	3	3
17	Olowu Street	14,626	623.96	23.44	0.02	0.34	3	0.73	7	9	3
18	Simbiat Abiola Way	17,517	571.44	30.65	0.02	0.10	4	0.72	6	8	4
19	Toyin Street	13,608	875.48	15.54	0.02	0.15	5	0.55	23	27	3
20	Opebi Link Road	18,796	1,106.57	16.99	0.02	0.02	5	0.69	4	5	2
Total		328,266	39,781.68								

Source: Field Survey, 2008

In determining the relationship between the explanatory variables and commercial property values, attempt was made to test the null hypothesis earlier stated. The variables were represented in the models as follows: dependent variable - commercial property value = y , while the independent variables are traffic density = $traden$, road density = $rodens$,

connectivity = connt, quality of road = qulrd, accessibility = acces, demand = demnd, supply = suply, and location = loctn.

The result of a multiple linear regression of the variables is summarized in Table 7

Table 7: Summary Statistic of the Explanatory Variables

CONSTANT	Parameter Estimate	Standard Error	T-Statistic	P-Value
	-2044.95	2487.33	-0.822148	0.4285
Accessibility	7702.66	2167.5	3.55371	0.0045
Connectivity	633.735	2072.23	0.305823	0.7654
Demand	300.486	75.6406	3.97255	0.0022
Location	217.517	139.035	1.56448	0.1460
Road density	7305.53	9049.88	0.807251	0.4366
Road quality	1.53242	337.26	0.00454373	0.9965
Supply	-315.814	104.256	-3.02921	0.0115
Traffic density	8.48526	32.6862	0.259598	0.8000

The output shows results of fitting a multiple linear regression model to describe the relationship between commercial property values and the independent variables. The model to express the result of the fitting is shown in Eqn. 3

$$y = -2044.95 + 7702.66acces + 633.74connt + 300.49demnd + 217.52loctn + 7305.53rodens + 1.53qulrd - 315.81suply + 8.49traden \quad \dots\text{Eqn. 3}$$

Furthermore, the Analysis of Variance (Table 8 below) shows that F-ratio is 3.11 with a P-value of 0.0423. In addition, details of the R^2 , R^2 (adjusted for degree of freedom), and Durbin-Watson statistics are shown in the Table.

Table 8: ANOVA of the Relationship between Commercial Property Values and Independent Variables

Source	Sum of Squares	Degree of freedom	Mean Square	F-Ratio	P-Value
Model	1.12374E7	8	1.40467E6	3.11	0.0423
Residual	4.96171E6	11	451064.		
Total (Corr.)	1.61991E7	19			

R-squared = **69.3705** percent

R-squared (adjusted for d. f.) = **47.0945** percent

Standard Error of Est. = **671.613**

Mean absolute error = **354.052**

Durbin-Watson statistic = 1.59854 (P = **0.0705**); Lag 1 residual autocorrelation = 0.127051

From Table 8, the R-squared statistic indicates that the model as fitted explains 69.37% of variability in commercial property values. The adjusted R-squared statistic, which is more

suitable for comparing models with different numbers of independent variables, is 47.0945%. The Durbin-Watson (DW) statistic tests the residuals and determines if there is any significant correlation based on the order in which the data occur.

The ANOVA Table shows that the P-value of DW statistic is 0.0705, which is greater than 0.05. This means that there is no indication of serial autocorrelation in the residuals at the 95.0% confidence level. In addition, the analysis of variance of the relationship between explanatory variables and commercial property values shows that the F-ratio is 3.11 and a P-value of 0.0423, which is less than 0.05. This implies that the null hypothesis is rejected, indicating that there is statistically significant relationship between commercial property values and the variables. The analysis shows that the explanatory variables of road network in the presence of other variables jointly explain 47.10% variability in commercial property values in the study area. By implication, other determinants of commercial property values not considered in the study probably account for the remaining 52.90%.

Furthermore, considering Table 7, it would be wrong to assume that all predictor variables with P-values above 0.05 could be removed from the predictive models. In fact, the P-values may change dramatically if one of them is removed. A useful method for simplifying this is to perform a stepwise regression. The stepwise regression analysis involves the addition or removal of the variables in turns. The approach is to obtain a model that contains only significant predictors while not excluding any useful variables.

Two stepwise options were considered which are the Forward Selection and Backward Selection. Forward selection started with the model containing only the constant and bringing variables in one at a time if they improve the fit significantly, while Backward Selection started with a model containing all of the variables and removed them one at a time until all remaining variables are statistically significant. In both methods, the removed variable is re-entered at a later step when they appeared to be useful predictors, or variables

entered early later removed if they were no longer significant. In this study, the Backward selection stepwise regression model is used. It involves the systematic removal of each variable as shown below.

Stepwise regression

Method: backward selection

F-to-enter: 4.0

F-to-remove: 4.0

Step 0:

8 variables in the model. 11 d.f. for error.

R-squared = 69.37% Adjusted R-squared = 47.09% MSE = 451064.

Step 1:

Removing variable road quality with F-to-remove =0.0000206455

7 variables in the model. 12 d.f. for error.

R-squared = 69.37% Adjusted R-squared = 51.50% MSE = 413476.

Step 2:

Removing variable traffic density with F-to-remove =0.0786251

6 variables in the model. 13 d.f. for error.

R-squared = 69.17% Adjusted R-squared = 54.94% MSE = 384171.

Step 3:

Removing variable connectivity with F-to-remove =0.079177

5 variables in the model. 14 d.f. for error.

R-squared = 68.98% Adjusted R-squared = 57.90% MSE = 358903.

Step 4:

Removing variable road density with F-to-remove =1.68386

4 variables in the model. 15 d.f. for error.

R-squared = 65.25% Adjusted R-squared = 55.98% MSE = 375266.

The stepwise regression analysis revealed four variables that entered into the models, these variables are accessibility, demand, location and supply which on their individual bases did not show statistically significant relationship with commercial property values.

Furthermore, the resulting R^2 , R^2 adjusted for degree of freedom, and mean standard error were derived from the analysis of the four explanatory variables that entered into the models. The R^2 indicates the contribution of the variables to variability in commercial property values; d.f. is the degree of freedom, while the mean standard error accounted for errors in the percentage of variability which may be negative or positive of the stated R^2 as shown in Tables 9 and 10

Table 9: Summary Statistics of the Stepwise Regression of Explanatory Variables and Commercial Property Values

Parameter	Estimate	Standard Error	T-Statistic	P-Value
CONSTANT	-990.488	1461.43	-0.67775	0.5083
Accessibility	6802.83	1695.7	4.01181	0.0011
Demand	285.359	63.4553	4.49701	0.0004
Location	266.984	119.619	2.23196	0.0413
Supply	-296.575	83.1178	-3.56813	0.0028

Source: Author's Analysis, 2008

The output (Table 9) shows the results of fitting a multiple linear regression model to describe the relationship between commercial property values and four independent variables. The equation of the fitted model of the variables is therefore:

$$y = -990.488 + 6802.83\text{aces} + 285.36\text{demnd} + 266.98\text{loctn} - 296.58\text{suply} \quad \dots\text{Eqn. 4}$$

The analysis of variance of the variables shows that the F-ratio is 7.04 and a P-value of 0.0021, which is less than 0.05

Table 10: ANOVA of the Relationship between Independent Variables and Commercial Property Values

Source	Sum of Squares	Degree of freedom	Mean Square	F-Ratio	P-Value
Model	1.05701E7	4	2.64253E6	7.04	0.0021
Residual	5.62899E6	15	375266.		
Total (Corr.)	1.61991E7	19			

R-squared = **65.2512** percent

R-squared (adjusted for d.f.) = **55.9849** percent

Standard Error of Est. = **612.589**

Mean absolute error = **395.632**

Durbin-Watson statistic = 1.23421 (P=**0.0208**)

Lag 1 residual autocorrelation = 0.292141

Source: Author's Analysis, 2008

Since the P-value in the ANOVA table (Table 5.10) is less than 0.05, there is statistically significant relationship between the variables at 95.0% confidence level. The R-Squared statistic indicates that the model as fitted explains 65.25% of the variability in commercial property values. The adjusted R-squared statistic is 56%, which is more suitable for comparing models with different numbers of independent variables. In determining whether the model can be simplified, it suffices to note that the highest P-value on the independent variables is 0.0413, belonging to location. Since the P-value is less than 0.05, location is statistically significant at 95.0% confidence level.

Findings

It was found that there are positive relationships between the explanatory variables (except supply, which indicates negative relationship) and commercial property values. As accessibility and connectivity in the road network improves, together with increases in demand for commercial properties; with improvements in location attributes, road density, quality of roads and traffic density, commercial property values would increase. In addition, as supply decreases, commercial property values would increase, all things being equal. As quality of roads improves, accessibility in terms of ease of getting to the locations of commercial activities would increase. The effects would be evident in the number of pedestrian and commercial activities taking advantage of ease of movements in the study area. The consequence would also be noticeable in demand for service products and commercial activities along the arterial roads with concomitant increase in commercial property values.

Further analysis using a stepwise regression revealed four variables that entered into the models, these variables are accessibility, demand, location and supply which on their individual bases did not show statistically significant relationship with commercial property values.

For instance, when accessibility is improved probably through factors that induce it while all other variables remain constant, commercial property values would be N14,206.34/m²p.a. {That is, $y = -2044.95 + 7702.66(2) + 633.74(1) + 300.49(1) + 217.521(1) + 7305.53(1) + 1.539(1) - 315.81(1) + 8.49(1)$ }. Assuming, there is impedance to movement as evident in impedance to accessibility, other variables remaining constant, commercial property value would be N 9,957.88 /m² p.a., all things being equal {i.e. $y = -2044.95 + 7702.66(0.5) + 633.74(1) + 300.49(1) + 217.521(1) + 7305.53(1) + 1.539(1) - 315.81(1) + 8.49(1)$ }. This implies that when there is impedance to movements to the extent

that accessibility is adversely affected, commercial property values would decrease by about 30% in the long run. This finding is valid and the equation would be useful as a predictive model.

Recommendation and Concluding Remarks

The following recommendations are made based on the researcher's findings, to point the way forward on the part of the Estate Surveyors and Valuers, the Nigerian Institution of Estate Surveyors and Valuers (NIESV), investors, and the Government.

An analytical mind will be required in an emerging competitive professional terrain in which other professionals are currently challenging Estate Surveyors and Valuers over their relevance. However, the study found that most Estate Surveyors and Valuers have not been actively involved in the use of scientific techniques to measure accessibility in relation to property value. The propensity of error in judgment based on intuitive decisions is very high and the best way to reduce such misjudgment is to adopt scientific techniques. This study has tested and found the technique to be useful tool in analyzing road network.

Empirical decision-making process has become necessary judging from the importance of accessibility delivered by road network in real estate development appraisals, particularly in advising on choice of best sites for development projects. It is therefore suggested that Estate Surveyors and Valuers should consider the use of scientific techniques to assist in making decisions that are reliable. This could be accomplished through seminar, workshops and conferences, while current curriculum in Polytechnics and Universities offering Estate Management should be broadened to include road network analysis. This is achievable through funding of research in this regard. In U.K., the Royal Institution of Chartered Surveyors (RICS) over the years have been funding research towards determining the impacts of rails, roads, and air transportation on property values. Professional bodies in

Africa are advised to fund research into the impacts of various modes of transportation on property values. Discussion of the results of such research works should be communicated to Estate Surveyors and Valuers through regular Mandatory Continuous Professional Development (MCPD) Programmes, national and international conferences.

When carrying out feasibility and viability appraisal, attention must be given to the issue of road network, which actually delivers greater accessibility, along with demand, location and supply as major variables in valuation of commercial properties in the study area for their opinions of values to be reliable.

The study has further reinforced the importance of accessibility for development and investors wishing to embark on real estate development in the study area should be conversant with the level of accessibility of the arterial roads along which such development will locate. Decision on the location of such development project should be based on a pragmatic approach such that selected locations would bring the highest return that is adequate and sufficient to compensate investors in such projects.

A model was derived to explain relationships between commercial property value, road network and individual explanatory variables. The models would be useful for predicting commercial property values along the arterial roads in the study area. It may become tools useful to Estate Surveyors and Valuers in expressing valuation opinions, and predicting commercial property values especially in feasibility and viability appraisal. However, a tool may not be useful until it is put into proper use. It is recommended that practical approach be taken to adopt the models and assist in making reliable judgments that would stand the test of time.

APPENDIX I

Table 1: Accessibility Indices of Arterial Roads in Ikeja Metropolis

NP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	-	1	2	3	2	3	4	4	5	5	6	6	7	8	9	8	6	7	6	5	4	3	2	
2	1	-	1	2	1	2	3	3	4	4	5	5	6	7	8	7	6	8	6	5	4	3	3	
3	2	1	-	1	2	3	3	2	3	4	5	4	5	6	7	6	6	7	7	6	5	4	4	
4	3	2	1	-	1	2	2	1	2	3	4	3	4	5	6	5	5	6	6	5	4	3	4	
5	2	1	2	1	-	1	2	2	3	3	4	4	5	6	7	6	5	7	5	4	3	2	3	
6	3	2	3	2	1	-	1	2	3	2	3	4	5	6	7	6	4	6	4	3	2	1	2	
7	4	3	3	2	2	1	-	1	2	1	2	3	4	5	6	5	4	6	4	3	3	2	3	
8	4	3	2	1	2	2	1	-	1	2	3	2	3	4	5	4	4	5	5	4	4	3	4	
9	5	4	3	2	3	3	2	1	-	1	2	1	2	3	4	3	3	4	4	3	4	4	5	
10	5	4	4	3	3	2	1	2	1	-	1	2	3	4	5	4	3	5	3	2	3	3	4	
11	6	5	5	4	4	3	2	3	2	1	-	1	2	3	4	3	2	4	2	1	2	3	4	
12	6	5	4	3	4	4	3	2	1	2	1	-	1	2	3	2	2	3	3	2	3	4	5	
13	7	6	5	4	5	5	4	3	2	3	2	1	-	1	2	1	1	2	2	2	3	4	5	
14	8	7	6	5	6	6	5	4	3	4	3	2	1	-	1	1	2	2	3	3	4	5	6	
15	9	8	7	6	7	7	6	5	4	5	4	3	2	1	-	2	3	3	4	4	5	6	7	
16	8	7	6	5	6	6	5	4	3	4	3	2	1	1	2	-	2	1	3	3	4	5	6	
17	6	6	6	5	5	4	4	4	3	3	2	2	1	2	3	2	-	2	2	1	2	3	4	
18	7	8	7	6	7	6	6	5	4	5	4	3	2	2	3	1	2	-	2	3	4	5	6	
19	6	6	7	6	5	4	4	5	4	3	2	3	2	3	4	3	2	2	-	1	2	3	4	
20	5	5	6	5	4	3	3	4	3	2	1	2	2	3	4	3	1	3	1	-	1	2	3	
21	4	4	5	4	3	2	3	4	4	3	2	3	3	4	5	4	2	4	2	1	-	1	2	
22	3	3	4	3	2	1	2	3	4	3	3	4	4	5	6	5	3	5	3	2	1	-	1	
23	2	4	5	4	3	2	3	4	5	4	4	5	5	6	7	6	4	6	4	3	2	1	-	
24	1	2	3	4	3	3	4	5	6	5	5	6	6	7	8	7	5	6	5	4	3	2	1	
25	2	3	4	5	5	4	5	6	7	6	5	6	6	7	8	6	5	5	5	4	3	3	2	
26	3	4	5	5	4	3	4	5	6	5	4	5	5	6	7	6	4	6	4	3	2	2	1	
27	4	5	6	5	4	3	4	5	5	4	3	4	4	5	6	5	3	5	3	2	1	2	2	
28	5	6	7	6	5	4	5	6	6	5	4	5	4	5	6	5	4	4	2	3	2	3	3	
29	6	7	8	7	6	5	5	6	5	4	3	4	3	4	5	4	3	3	1	2	3	4	4	
30	7	8	9	7	8	6	6	7	6	5	4	5	4	4	5	3	4	2	2	3	4	5	5	
31	6	7	8	7	8	7	7	6	5	6	5	4	3	3	4	2	3	1	3	4	5	6	6	
32	3	4	5	6	5	5	6	7	8	7	6	7	6	6	7	5	6	4	4	5	4	4	3	
33	4	5	6	7	6	5	6	7	7	6	5	6	5	5	6	4	5	3	3	4	3	4	4	
34	5	6	7	8	7	6	7	7	6	7	6	5	4	4	5	3	4	2	4	5	4	5	5	
35	7	7	6	5	6	5	5	4	3	4	3	2	1	2	3	2	1	1	1	2	3	4	5	

NP - nodal point; AI - accessibility indices

APPENDIX II

Table 2 : Connectivity Indices of Arterial Roads in Ikeja Metropolis

NP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	-	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
7	0	0	0	0	0	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	1	0	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	1	-	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0	1	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	1	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-	0	1	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-	0	0	1	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	1	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	-	1	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0	0	0
22	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0
24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0

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