PARKING CHARACTERISTICS OF HOTELS IN KANO METROPOLIS

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DECLARATION

I hereby declare that this dissertation has been composed by myself and that it is a record of my own research work. It has not been accepted in any previous application for a higher degree. All sources of information are specifically acknowledged by means of references.

JOEL, M.

September, 1999

CERTIFICATION

This thesis entitled:

"PARKING CHARACTERISTICS OF HOTELS IN KANO METROPOLIS"

by Joel Manasseh meets the regulations governing the award of the degree of master of science of Engineering in Highway and Transportation Engineering of Ahmadu Bello University, Zaria, and it is approved for its contribution to knowledge and literary presentation.

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ABSTRACT.

The parking generating potential of hotels arc studied. A twelve (12) hours parking habit survey was carried out at the premises of twenty (20) hotels in Kano metropolis. Relevant inventories of facilities were also taken at each hotel.

Results obtained were used to formulate mathematical models which showed that a linear relationship exist between the number of parking stalls as well as peak parking demand, and the total number of rooms and the area covered by the hotel.

The Regression models showed that the number of parking stalls is linearly related to the number of rooms in the hotel. The average number of parking stalls presently supplied by hotels per room is approximately 0.3204 stalls. The location of hotels was found to be a significant influencing factor. Hotels located in the central business districts, outskirts of business district and outside the central business district had intercepts of 6.4652, 7.1583 and 1.5833, respectively.

Similarly, the peak parking demand generated per room is 0.19920 vehicles, with intercepts of 2.3423,6.2324 and 4.01693 for hotels located at

the central business district, at the periphery of the central business districts, outside the central business district, respectively. The peak parking demand per area covered by hotel is $3.286967x10^2$ per square meter of area covered by hotel, with intercepts at 8.6923, 10.6921 and 11.58755 vehicles for hotels located at the central business district, periphery of the central business district and outside the central business district respectively.

On the basis of the strong statistical relationship established from the study, hotels in Kano metropolis should provide about 0.32 parking stalls per room in addition to a minimum of seven (7) for service and staff vehicles irrespective of the location of the hotel.

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ABBREVIATIONS

CDB - - - - Central Business District

PCBD - - - - Periphery of Central Business District

OCBD - - - - outside central Business District

SPSS/pc+ -Statistical Package for social sciences for personal computer

YD - - - - - - - Number of Double

YF - - - - - - - Number of staff

YS - - - - - - Number of parking stalls

YP - - - - - - Peak parking Demand

YA - - - - - - Total Area covered by Hotel

Chapter 1

INTRODUCTION

1.1 Preamble

Parking deserves special consideration in traffic operations, since vehicles which operate on streets and highways have a TERMINAL POINT where they require parking. As an illustration, let us consider a case where a vehicle is being driven to a destination and there is a delay or difficulty in parking, it means, its usefulness is greatly diminished.

To be efficient, a motor vehicle transportation system must include adequate parking facilities at all places that attract trips (of which hotel premises is one.). Due to lack and inadequate parking supply, vehicles result to on street parking which does not go down well with traffic on the street.

The demand for parking in a given area is strongly influenced by land use and the available form of transportation. As the use of a parcel of land is changed from agricultural to residential to industrial or to commercial use, or as the development density or bulk of a given activity increases, parking demand increases. These parking problems are likely to develop in areas devoted to multistoried residences and industrial buildings and are especially acute in commercial or business districts. The problem of parking in the above mentioned areas is due to the non-provision of and inadequate parking spaces.

The provision of adequate parking spaces for motorists in busy urban areas is becoming more difficult due to increase in population which leads to increase in the number of cars. Land in the neighbourhood of business areas is also becoming increasingly expensive, this aspect being aggravated by the necessity of having to re-house firms and individuals when their land is to be acquired to provide space for car-parking.

Due to inadequate parking spaces in most urban centers, motorists are forced to compete for the very few available parking spaces, and most of the time result to on-street parking which normally hinders the free flow of traffic in such areas.

The importance of parking, according to Brierley (1962) can hardly be over-estimated. There are 8,760 hours in a year, if it is assumed that the average distance covered per year per car is 16,000 km (10,000 miles) and the average speed is 40 km (25 miles) per hour, the total travelling time will be 400 hours. This leaves 8360 hours per year when the car is parked.

Recognizing the importance of parking, Abbett (1956) recommended the use of on-street parking, supplemented where feasible by the development of off-street facilities, to solve parking problem.

Kano, the catchment area of the study is the capital of Kano State, which from ancient time, has been well known for its commercial activities. The central business district of Kano is not spared of parking problems which are associated with most urban centers. Its own case has been worsened by the lack of adequate off-street and on-street parking facilities, and the large number of storey buildings existing within these areas. Some of these buildings have inadequate spaces while many others have no parking provisions for motorists and users of such buildings. These storey buildings which are potential parking generators are subjected to different uses, which attract parking.

The Central Business District (CBD) of most towns are well known for parking generation. The parking generating potential of the CBD is due to the generating potentials of elements within the CBD. The generating potentials of such elements, which are usually large buildings or properties and storey buildings, are normally a function of the activities to which such elements are put to. The use of tall and large buildings as hotels and motels is one of the use a building can be subjected to, which can generate parking; as hotels are known to provide recreational, relaxation, seminar halls or conference halls for seminar, and accommodation for both visitors and residents of the town.

It is the desire to understand the generating potentials of such elements that prompted this work. The aim is to "investigate the parking generating potential of large buildings or properties and storey buildings used as hotels.

1.2 Study Objectives

The main aim of this study is to investigate the parking generating potentials of multi-storey and large buildings used as hotels. The data obtained from the investigation is used to develop mathematical models. Such models will be used as a guide in estimating the extent of parking demand that a particular building used as hotel is likely to generate and, hopefully, use findings to articulate policy on same. This kind of information will assist in alleviating parking problem. Thus the study objectives involve:

(i) To collect data on the parking generating characteristics of storey and large properties used as hotels within and outside the CBD of Kano through parking survey.

(ii) To use the data in to formulate regression models that would explain cause and effect relationships between parking demand and the use of building as a hotel.

(iii) To use the results in (ii) to formulate appropriate policies on provision of parking facilities f or hotels at different location within the urban area.

(iv) To propose appropriate implementation strategies for policies formulated in (iii) above.

1.3 Scope of Work

The study is restricted to the CBD (central business district) of Kano, and the surrounding areas where parking appears to be problematic. Generators that will be considered are large properties and storey buildings used as hotel

1.4 Structure of Thesis

This thesis has been presented in six chapters, with chapter one giving a brief introduction into the subject under study. Chapter two is a review of literatures, it comprises basically of what others did on the concept of parking, problems associated with parking and the different ways it can be solved. Chapter three is a brief description of the work done. Chapter four deals with the analysis of the data obtained from the field, while Chapter five discussed the results obtained from the analysis; Conclusions were drawn in Chapter six.

Chapter 2

LITERATURE REVIEW

2.1 Parking Problems In Cities

Pignataro (1973) described parking as a major urban land use and that any one who drives a car needs no introduction to the difficulties of finding a parking space in areas which are intensively used for business, commercial and residential purposes. The parking problem becomes more pronounced as the size of the city increases, which gives rise to increase in population and increase in the number / ownership of cars.

Historically, expenditures for parking facilities have not kept pace with those for highways, and this lack of balance in investments has compounded the traffic congestion problem which is witnessed daily in major urban centers.

According to Ernest (1960), the problem of parking has reached an acute stage, in towns and city centers of developed regions, were massive building exert the greatest pressures on traffic and parking space. A sensible policy is to make more parking space available and at the same time to control the demand for decentralization of parking "generators". Major cities of developing regions are also fast approaching the same level of crisis situation.

The problem of parking may be studied from two perspectives: The origins and purposes of drivers who park their cars in cities, and the characteristics of various types of buildings when regarded as sources of generators of concentrations of parked vehicles. Leeming (1962).

2.2 Other Problems Associated with Parking

Kadiyali (1983) considered parking related problems under the following headings:

(i) Congestion and Accessibility.

(ii) Accidents.

(iii) Obstruction of vehicles on Emergency services.

(iv) Environment

(v) Draw back of Business in the CBD.

2.2.1 Congestion and Accessibility

Brierley(1962) described traffic congestion as "a malignant disease which unless arrested, will surely bring death to the heart of the city. This is because where there is traffic congestion and lack of car parking facilities in the center of cities, land values will tend to fall". In most cases, congestion is caused by parked vehicles simply because such vehicles occupy road space that could be used by moving vehicles, thus reducing capacity. (This is especially noticeable if the parked vehicles are at or close to an intersection). If the volume of traffic is fixed, then parked vehicles will also reduce traffic speed and, hence increase journey time which in turn, reduces town center accessibility. O'Flaherty (1974).

2.2.2 Accidents

The manoeuvres associated with parking and un-parking are known to cause road accidents. Careless opening of the doors of parked vehicles, moving out of a parked position and bringing a car to the parking location from the main stream of traffic are some of the causes of parking accidents (Kadiyali,1983). Study carried out by Smith (1947) showed that 17 percent of city accidents and 10 percent of rural road accidents involved vehicles which were parked. Accident study carried out by Garwood (1950) showed that about 80 children, mostly under the age of 4years were killed each year in Great Britain when stationary vehicles moved away. In 1958, about 7 percent of the cyclist casualties in Great Britain were attributed to the careless opening of the doors of parked cars, O'Flaherty (1974).

<u>**Obstruction Of Vehicles On Emergency Services**</u> : Parked vehicles obstruct the free movements of vehicles on emergency services and greatly impede their operations. An example of such vehicles is the fire fighting vehicles in which the parked vehicles could block access to hydrants and access to buildings. Kadiyali (1983).

<u>**Environment**</u> : An environmental dis-amenity which receives very little attention is the aesthetic deterioration often associated with the parking of vehicles. Parked vehicles degrade the environment of the town center. Stopping and starting of vehicles result in noise and fumes. Cars parked into every little available space debase the visual aesthetics and buildings seem to rise from a plinth of cars. O'Flaherty (1974).

Draw Back Of Business In The Central Business District : Commercial interests consider that they are directly affected by the parking situation and, even in this day, many merchants and business people in city centers tend to regard vehicles parked on streets as necessary visual evidence of trade prosperity. Although, inadequate parking spaces is widely believed to be one of the main drawbacks of the central area of a large town, as it inhibits people from moving into such areas for business. Research carried out by the Regional Planning Research Ltd., showed that between one-tenth and one-fifth of the respondents in the households queried (belonging to Automobile Association members in Britain) stated that they avoided going to town centers whenever possible because of parking difficulties. O'Flaherty (1974).

2.3 Parking Provisions In Urban Centers

According to Dyfverman (1967) as increasing traffic fills our streets, it becomes necessary to provide ancillary facilities for cars in, under or on buildings, garages, parking areas, etc.

Seeley (1992) stated that the demands for car parking vary between long duration parking for commuters, short stay parking for shoppers, and short to medium term for people using the town for entertainment, business and other similar activities. In view of variation in parking duration and parking demand, he proposed that urban parking problem can be solved through a judicious combination of the on-street parking and off-street parking facilities.

2.3.1 On-Street Parking Facilities

Kulkarni (1968) refers to on-street parking or curb parking facilities as parking provisions made on the streets. The vehicles are parked parallel to the kerb or at an angle to the kerb stones, which is used to show the end of the street. The common methods of on-street parking are:

(i) parallel parking.

(ii) 30^0 angle parking.

(iii) 45^0 angle parking.

(iv) 60^0 angle parking.

(v) Right angle parking

Parallel parking consumes the maximum curb length, which decreases as the angle of parking increases. The minimum curb length is consumed by right angle parking, which accommodates nearly two (2) times the number of vehicles as parallel parking. On the other hand, parallel parking makes the least use of the width of the street, and this is an important consideration in narrow streets. As the parking angle increases the width of street used also increases Leeming.(1962)

In terms of safety, Evans (1950) observed that angle parking is more accident prone than parallel parking and that parallel parking is more favoured for on street parking except on exceptionally wide and low volume streets, where consideration might be given to angle parking.

Pignataro (1973) further classified on-street parking into two:

(i) Restricted Curb parking .

(ii) Unrestricted Curb parking.

Restricted Curb Parking: According to O'Flaherty(1974), restricted curb parking is employed in the bid to prohibit parking at certain locations and for a given period of time to ensure safety and convenience. Such locations include:

(i) Locations near intersections.

(ii) Locations near narrow streets.

(iii) Pedestrian crossings.

(iv) Road – bridges and Tunnels.

(v) Entrance drive ways.

UNRESTRICTED CURB PARKING: The unrestricted curb parking or free parking, according to Kadiyali(1983) is allowed in designed stalls / spaces for a limited period. The enforcement is done by traffic police or wardens. The conditions which favour the adoption of this scheme include the availability of sufficient parking spaces to meet the demand and the knowledge that the parkers usually leave their vehicles for a time which is less than the posted time limits. However, other measures might be employed to discourage long time parking on streets. Some of the measures are the use of parking meters and discs.

Oglesby and Hicks (1982) observed that parking meters have proved to be an effective means for regulating on-street parking. First installed in Okhlahoma city in 1935, there are now roughly (2) two million of them in use in some 4,000 cities of the United State of America.

Davis (1960) describes the meter scheme in West minister which was the first to be introduced in Britain and has been acclaimed by the city

Engineer, as having left motorists in no doubt as to precisely where they may or may not park and for how long.

The parking disc was first introduced by the prefecture of police in the Paris Blue Zone in 1957. It was introduced because Paris then had a parking problem which could not be solved by parking meters or other means of charging a motorist who wished to park on a highway for a long time. The scheme promotes short-term parking with adequate enforcement of the parking duration limit. Davis (1960)

According to Brierley (1962), the Paris discs consists of a thin piece of Cardboard 100mm (4in) diameter, one side has times for morning and the other for afternoon parking. The left hand half of each face is for the arrival times, and the other half has the expiry times, usually in red print. The disc is contained between two thin pieces of cardboard forming an envelop and secured at the center. On each side of the "envelope" are the two windows, one for the arrival time and the other for the expiry time. The disc is placed behind the windscreen, when the motorist parks his car.

Problems Created By Curb Parking: Maston, Smith and Hurd (1955) enumerated the problems associated with curb parking or on-street parking as below:-

(i) STREET CAPACITY: Curb parking adversely affects street capacity through the narrowing of the roadway available for moving traffic. The placement of vehicles at the curb, and the frictions created by cars moving in and out of parking spaces combine to effectively reduce the capacity.

(ii) ACCIDENTS: A high percentage of accidents on downtown city streets involves cars which are parking and un-parking. Parking manoeuvres also cause many collisions in which the parking car is not directly involved, moving out of a parked position and bringing a car to the parking location from the main stream of traffic are some of the common causes of on-street parking accidents.

(iii) FIRE HAZARDS: In some cities, parking regulations have been affected because of the fire hazards created by improper parking which congests the movement of fire apparatus and block access to hydrants, driveways and key buildings.

(iv) INCREASED TRAVEL TIME: On-street parking causes the loss of street width and traffic congestion which leads to the drop in the journey speed which subsequently leads to increase in travel time.

2.3.2 Off Street Parking

Due to increase in automobile traffic, kerb parking, according to Kulkarni (1968) is becoming insufficient. At the same time, it is increasing congestion in busy streets, hence off-street parking facilities are becoming a necessity. In traffic planning, off-street parking devices should be encouraged. Kulkarni (1968) further opined that the problem of parking would be reduced if provision for parking a suitable number of cars is made a requirement to be fulfilled before a new building is allowed to be constructed in a business locality.

Whitlock, Smith and Associates (1973) warn that the success of off-street parking facilities depends largely on their location relative to generators of parking demand. Other factors, such as charges, ease of access, and functional design, also affect usage.

Brierley (1962) classified off-street parking facilities as follows:

(i) Surface car parks or garages.

(ii) Multi-storey car parks.

(iii) Roof parks.

(iv) Mechanical car parks.

(v) Peripheral car parks.

Surface Car Parks Or Garages : Brierley (1962) describes a surface car park as a spare piece of land on which as many cars as possible are crowded, or it may be large car park of good design and layout surrounding a shopping center and occupying three times as much land as the buildings occupy.

According to Kadiyali (1983) surface car parks which are properly located and developed on a piece of vacant land or surrounding an office complex or supermarket can solve motorists parking problem. However, he cautioned that care is needed in their design and operation. The over all aesthetics of the area should receive due attention. A variety of layouts can be possible depending upon the land area.

Multi-Storey Car Parks : Surface parks consume too much of the precious land in the heart of the city and are not therefore always feasible.

One of the alternatives suggested by Kulkarni(1968) where land is costly is the multi – storey car parks. Such facilities have become common and popular in many cities.

Multi – storey car parks are designed for a capacity of about 400-500 cars. Large capacity tends to increase the time for un-parking a car . About five floors is also the upper limit for the same reason, access to the floors is through ramps. An example of multi-storey car park is the stock exchange house in Lagos, Nigeria.

Roof Parks : A very popular method of solving the parking problems adopted in many cities is to park the vehicles on roof tops. Access ramps or mechanical lifts provide the necessary access to the roofs. To economize, many roofs may be linked together served by a single access ramp. In addition to the ramps, extra cost is involved in designing the roof tops and the structural elements for the parking load. An extensive system of linked car parks at roof level, integrated with multi-story parking garages is in use at Conventry, United Kingdom Brierley (1962).

Mechanical Car Parks : According to O'Flaherty (1974) mechanical car parks provide for lifting of the cars from floor to floor by means of a lift and transfer of cars to and from the parking stall by means of wheeling or mechanically operated transfer dollies or cradles. Since the ramps are eliminated in this system, it is more economical in space as compared to the ramped system, and multi-storey garages. Example of mechanical parks are the space-o-matic system in Brompton, place parking garage of Harrods Limited, Knightsbridge, London. (Brierley ,1962)

Underground Car Parks : Kadiyali (1982) refered to the underground car parks as parks which cause the least intrusion, to the aesthetics of a place. An excellent example is the underground parking space below Hyde park in London. These parks can be built in the basement of any multistorey building or below open spaces. Since the work involves retaining walls, ventilation and lighting such car parks tend to be very costly. The underground car parks can be single-storey or multi-storey, though the latter tends to be very costly.

Peripheral Parking : According to O'Flaherty (1974), peripheral parking is aimed at persuading motorists to park their cars at prior-selected locations and then use another form of transport to travel to the central business district (CBD) and back again. There are three types of peripheral parking systems in use, namely:

(i) Park-and-walk

(ii) Park-and-ride

(iii) Kiss-and-ride

Austin, Lee, Bradwell and Associates (1973) studying the use of peripheral parking in Los Angeles in an effort to cater for the growth in automobile traffic destined for the CBD discovered that with suitable headway times on the people-mover-system, 10 to 15% of all day parkers could be induced to use peripheral sites. The shift represents a significant amount of land area that would otherwise be devoted to automobile parking in the CBD. In addition to relieving the congestion within the CBD, a successful peripheral parking system could allow greater flexibility in development plans; there would be no need to plan so extensively for automobile circulation and parking.

However, Austin (1973) warns that the provision of low-cost peripheral parking areas, for example, may be of little value if drivers do not patronize them because of preferable alternatives. To fully evaluate such proposals, the identification of locations where drivers will park in relation to their actual destinations is required.

Application Of Management Stategies In Controlling Parking: Demetsky and Parker Jnr. (1978) acknowledge that transportation system management strategies can be used to control parking, and such strategies are categorized into two, those that affect the supply of parking and those that regulate the price of parking. The two strategies as described by Demetsky and Parker Jnr. (1978) is below:

Supply Controls : Supply controls are those parking management strategies that affect the restriction, removal or re-allocation of parking spaces to increase roadway capacity or to alter automobile use patterns. The measure that restrict parking include the provision of short-term on-street parking, restriction on long-term-on-street parking, and the issuance of residential parking permits. These measures are aimed at discouraging commuters form tying up parking spaces all day and hence require alternative travel arrangement such as selective off-street parking and public transportation.

Price Controls : Price controls of parking are those related management measures that attempt to provide an improved transportation system through the use of selective pricing mechanisms. The strategies in this classification include high parking rates for single occupancy vehicles, low rates for short-term parkers coupled with high rates for long-term users, a general increase in all parking rates and taxes on users and operators of parking facilities.

In addition to the above discussed strategies, Ryall (1966) proposed the following policies:

I. The Authority in charge of urban parking problems can leave parking to private firms. This policy makes no constructive contribution to traffic problems.

II. The Authority can provide cheap parking as much as is needed, subsidized by all rate payers. This policy is unfair politically, and undesirable to all rate payers, because it attracts vehicles into the center or the central business district (CBD) and it is un-equitable.

III. The Authority can provide parking, matched to the road capacity in each area, at an economic cost. This policy is fair, and restricts central area traffic by price rather than by congestion. Prices can also be fixed to ensure that parks are never quite full, thereby ensuring that a driver does not have to look far for parking space. It is suggested that the third policy is most in keeping with modern traffic engineering aims and techniques.

2.4 PARKING GENERATORS

O'Flaherty (1974) termed those on-street and off-street features which influence the demand for parking space as parking generators. These features are normally a function of the land use, such land use ranges from Offices, Banks, Hotels, Restaurants, Commercial centers, Places of Worship (Churches and Mosques) Schools, Hospitals etc.

Davies (1975) in his works classified parking generators into four groups:

A. The Regular steady parking generators: These are Churches, Mosques, Public houses, Further Education establishments, Embassies, Hospitals, Nursing homes, Health Centers etc.

B. The normal small parking generators with occasional peak demand for parking include town halls, museums, and art galleries, dance halls, premises for indoor games, exhibition halls, meeting halls, sports stadia, zoos etc.

C. Generators in District Centers and Central Areas visited by the public in a way similar to Retail trade Establishments. These include Police stations, Amusement parks, Government offices, etc.

D. Generators not visited by the public, these are Ambulance stations, Fire stations, etc.

E.

The generation of parking by these potential generators is very much based on the law of supply and demand, where by supply is the total number of spaces available within a given area, or provided by the generators, while the demand is the desire to park based solely on the location of the trip destination. O'Flaherty (1974)

Kadiyali (1983) gave the British standard also used in India for different land use as shown in Table 2.1

2.5 Parking Studies

According to Robert, Byrd and Mickle (1974), before any parking problem can be solved, there is need for parking studies, the studies may be made to identify parking inadequacies or to develop proposals to improve parking supply in a specific area such as the central business district (CBD) or along certain traffic corridors.

A parking study may have to determine not only where motorists can and do park but also where they would like to park and how their parking practices affects the use of other transportation modes.

Robert Byrd and Mickle (1974) gave the five basic element essential to any parking study as follows.

I. Preparation which includes planning and organizing the study.

II. Data collection : surveying existing parking conditions.

III. Data analysis : determining needs and developing alternatives.

IV. Evaluation: examining the effects of each alternative.

V. Implementation, recommendations : selecting a program of improvement.

2.6 Parking Surveys

Kulkarni (1968) stated that for adequate parking facilities to be provided for any particular area or zone in a city, parking surveys have to be carried out to determine the demand. The outlines of the survey as given by Kulkarni (1968) are:

I. Inventory: A study of the existing facilities for parking is made to determine the deficiencies and trends of requirements.

II. Parking Interviews: Drivers are interviewed during the busy hours, and the time of arrival during the busy hours, and departure and the number and type of each vehicle is noted.

III. Cordon counts: The area is cordoned and the vehicles entering and leaving the area by all streets are counted during business hours of the day

The review of literatures showed that parking is a problem that has to be dealt with, as it can cause parking related problems such as congestion and accessibility, accidents obstruction of vehicles on emergency services, etc. However, the problem of parking could be solved through the use of on-street and off-street parking facilities. In this study, the use of models developed from some mathematical principles will be used to explain the cause / effect relationship between parking and measures of intensity of use of the hotels. Some of the principles used in model formulation are thus explained below:

2.7 Methods Used In Analysis

The methods used in data analysis to formulate model is the stepwise option of multiple linear regression analysis, dummy variables were also used, some of the principles are thus explained below.

2.7.1 Multiple Linear Regression Model.

The multiple linear regression model expresses the mean of the response variable Y as a function of one or more district predictor variables $X_1, X_2, ---, X_k$. It takes the form –

$$\mu_Y / X_1, X_2 -- , X_K = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ----- + \beta_k X_k \text{ ---------- } (2.1)$$

To apply the method of least squares to estimate the parameter β_0, β_1 ------, β_k, we rewrite the model in the form.

$$Y / X_1, X_2 -- , X_K = \beta_0 + \beta_1 X1 + \beta_2 X_2 + ----- + \beta_k X_k + \in$$

Where $Y/X_1, X_2$ --- X_k denotes the response variable when the predictor variables X_1, X_2 --- X_k assume the values X_1, X_2, --- X_k and $\in$ denotes the random difference between $Y/X_1, X_2$, --- X_k and its mean value.

A random sample of size n consists of a set of n(k+1) – tuples and takes the form-

$\{X_{1i}, X_{2i}, ---, X_{ki}, Y/X_{1i}, X_{2i} ---- X_{ki}): i=1,2,3, --- N\}$

where the first k members of each (k+1) tuple denotes a real number, and the last, a random variable. Dropping the conditional notation, the sample is expressed as

$\{X_{1i}, X_{2i}, ---, X_{ki}, Y_i), I=1,2,3, --- N\}$

where $Yi = \beta_0 + \beta_1X_{1i} + \beta_2X_{2i} + ----- + \beta_kX_{ki} + E_i$. We again make the assumption that the random errors E1, E2, ---, En are independent with mean O and common variance 2.

The estimated curve of regression of Y on X1, X2, ---- Xk is

$\hat{Y} = \mu y / X_1, X_2 -- , X_K = b_0 + b_1x_1 + b_2x_2 + ----- + b_kx_k$

Where $b_o, b_1, b_2, ---- b_k$ are the least – squares estimates for $\beta_0, \beta_1, \beta_2$, --- β_k respectively.

To minimize the sum of the squares of the residuals we minimize

$$SSE = \sum_{i=1}^{n} e_i^2 + \sum_{i=1}^{n}[y_i - (b_o + b_ix_{1i} + b_2x_{2i} + --- b_kx_{ki})]$$

By taking the k+1 partial derivatives

$\partial SSE / \partial b_o, \partial SSE / \partial b_1, \partial SSE / \partial b_2, -------, \partial SSE / \partial b_k,$

And setting them each equal to 0, we obtain these normal equations

$$b_{0}n = b_1\sum_{i=1}^{n} x_{1i} + b_2\sum_{i=1}^{n} x_{2i} + \text{------} b_k\sum_{i=1}^{n} x_{ki} = \sum_{i=1}^{n} y_i$$

$$b_0\sum_{i=1}^{n} x_{1i} + b_1\sum_{i=1}^{n} x^2_{1i} + b_2\sum_{i=1}^{n} x_{1i}\, x_{2i} + b_k\sum_{i=1}^{n} x_{1i}x_k = \sum_{i=1}^{n} x_{1i}y_i \text{ ------------ } (2.2)$$

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$$b_0\sum_{i=1}^{n} x_{ki} + b_1\sum_{i=1}^{n} x_{ki}\, x_{1i} + b_2\sum_{i=1}^{n} x_{ki}\, x_{2i} + b_k\sum_{i=1}^{n} x^2_{ki} = \sum_{i=1}^{n} x_{ki}y_i$$

Solving the equations above simultaneously the value of b_0, b_1,b_2 ---- b_k are obtained.

2.7.2 Stepwise Method

Stepwise regression is a modified version of the forward selection process. In forward selection, once a variable enters the model it stays. Unfortunately, it is possible for a variable entering at a later stage to render a previously selected variable unimportant because of the Inter relationships of the variables. This usually occurs when the two predictor variables are themselves closely related. Forward selection does not consider this possibility. In stepwise regression, each time a new variable is entered into the model, all the variables in the previous model are checked for continued importance.

Dummy Variables : The variables considered in regression equations usually can take values over some continuous range. Occasionally, we must introduce a factor that has two or more distinct levels. For example, the parking survey data was obtained from hotels sited at different location from the CBD. In such a case we cannot set up a continuous scale for the variables but we could assign to these variables some levels in order to take account of the location of the hotel variables of this sort are usually called "dummy variables" or indicators. They are usually (but not always) un-related to any physical levels that might exist in the factors themselves. In the analysis of data obtained from the parking survey the location of the hotels were coded as below using dummy variables.

	X_1	X_2
Central Business District,	1	0
Periphery of Central Business District,	0	1
Outside Central Business District	0	0

Significance Of Multiple Regression Model As A Whole (F - Test) :

Sometimes, the assumed regression equation may prove to be statistically not significant. Whether this is so is determined by a comparison of the variance by the regression and the error variance S^2y/x, using the F – Test. For three coefficients, b_o, b_1, and b_2 ($k = 2$) the sum of squares of deviations in y accounted for by regression is

$$\sum c^2 = b_1\sum Yx_1 + b_2\sum Yx_2$$

Therefore, we compute F as

$$F = [(\sum c^2) / k] / S^2Y/X \quad \text{-----------------------------} \quad (2.3)$$

With the number of degrees of freedom $V_1 = k - 2$ for the numerator, since there are only two parameters, and $V_2 = n - (k + 1) = n - 3$, for the denominators.

If the computed F is greater than the value tabulated in the Table of Distribution of significance, then the hypothesis that all the true partial regression coefficients are equal to zero is rejected.

Multiple – Correlation Coefficient : The square of the population multiple correlation coefficient is defined as the fraction of the total variance of Y which is contributed by its regression upon the variables X1, X2, ------ . This coefficient may be estimated from the square of the sample multiple correlation coefficient;

$$r^2 = \sum e^2 / \sum Y^2 \quad \text{-------------------------------------} \quad (2.4)$$

Where r is the multiple – correlation coefficient. As in the case of simple linear regression, a value of zero gives no correlation between Y and the variables X_1, X_2, -----------, whereas a value of 1 means that all the sample points lie exactly on the regression plane. To test the significance of r, we compare the determined value of r from statistical data obtained from the field with the values of r given in statistical tables at the given degree of freedom and level of significance. If the calculated value is greater than that in the table, the result is then considered significant.

CHAPTER 3

FIELD WORK

3.1 Parking Survey

The survey work commenced with the location of twenty tall and large buildings used as hotels in Kano's central business district (CBD), the periphery and outside the CBD where parking seems to be a problem. The Central Business District (CBD) of Kano which is the center of business activity comprises of Yankura, Bata, and Sabon Gari areas.

The names of the hotels within the CBD mapped out for the survey are:- Hotel De Mekila, Mbass Hotel, De-Frienship Motel, International Hotel, Elison Hotel, Criss Park Hotel, K.F.C Hotel, Motel La Mirrage, Fresh Lily Hotel, King's Hotel, and Tower Hotel. Royal Tropicana Hotel, Akija Hotel, Gab Hotel, are located within the periphery of the CBD, while Daula Hotel, Kano Residential Hotel, Prince Hotel, and Tahir Guest Inn are located outside the CBD.

The criteria used in the mapping and identification of these hotels for the study was the number of rooms, as hotels with less than twenty rooms were not selected for the work, as parking generated by such hotels looks small or insignificant when compared to others with more number of rooms, as a result of low patronage by car user and owners. The selection was carried out in such a way that hotels identified will have a good spread in terms of the number of rooms. The level of activity or patronage was another criteria that was used in the selection of the hotels for the survey.

3.2 Inventory Of Facilities

The identification of the hotel was followed by parking space inventory, the inventory included determining the number and size of parking stalls as well as a categorization of inadequacies of parking provisions, at the premises of each hotel. In addition to the Inventory, the area of land covered by hotels (that is the vertical and horizontal area) were also determined. At each hotel, the Inventory of the number of staff, number of rooms and facilities at each hotel were taken. The Inventory so gathered are as shown in Table 3.1.

TABLE 3.1 (a): TABLE OF INVENTORY TAKEN AT THE DIFFERENT HOTELS.

S/NO	NAME OF HOTELS	LOCATION	TOTAL NUMBER OF Rooms	NUMBER OF STAFF	CATEGORY OF HOTEL(*)	NUMBER OF DOUBLE ROOMS	NUMBER OF SINGLE ROOMS	No. OF CONFERENCE HALLS	No OF FLOORS	VERTICAL DISTANCE(M)	TOTAL AREA COVERED BY HOTEL(M^2)	TOTAL AREA OF LAND COVERED (M^2)
1	Hotel – De – Mikela	CBD	100	16	2	75	25	-	2	6.3	1,910	710
2	Mbass Hotel	CBD	62	16	2	12	50	-	2	6.3	646	200
3	De friendship motel	CBD	58	35	3	18	40	1	2	6.3	702	108
4	International Hotel	CBD	56	45	3	44	8	1	2	6.3	820	274
5	Elisons Hotel	CBD	38	15	3	28	10	-	2	6.3	540	180
6	Criss Park Hotel	CBD	38	22	2	29	9	1	2	6.3	740	380
7	Sky World Hotel	CBD	36	16	3	20	10	1	2	6.3	594	198
8	People's Resort Hotel	CBD	35	26	3	23	12	1	2	6.3	584	325
9	K.F.C. Hotel	CBD	35	16	2	25	10	-	2	6.3	440	180
10	Motel – La – Mirrage.	CBD	30	28	3	21	9	-	2	6.3	692	389
11	Fresh Lily Hotel	CBD	28	14	2	10	18	-	2	6.3	526	176
12	King's Hotel	CBD	26	12	2	12	14	-	2	6.3	510	170
13	Tower Hotel	CBD	23	18	2	4	19	2	2	6.3	486	162
14	Royal Tropicana Hotel	PCBD	200	300	4	106	94	3	5	15.8	12,775	4,455
15	Akija Hotel	PCBD	93	150	3	80	13	1	2	6.3	2,888	1,216
16	Gab Hotel	PCBD	80	35	3	37	43	1	3	9.45	2,872	1,352
17	Daula Hotel	OCBD	200	250	4	184	16	3	-	-	9000	9000
18	Kano Residental Hotel	OCBD	70	35	3	56	14	1	2	6.3	800	236
19	Prince Hotel	OCBD	36	107	3	23	13	2	2	6.3	700	330
20	Tahir Guest Inn	OCBD	30	105	3	22	8	1	2	6.3	650	350

CBD = Central Business District; OCBD = Outside Central business District; PCBD = Periphery of Central Business District.

TABLE 3.1 (b): TABLE OF INVENTORY TAKEN AT THE DIFFERENT HOTELS.

S/NO	NAME OF HOTELS	LOCATION	AREA COVERED BY FLOOR (M2)	LEVEL OF ACTIVITY.	NUMBER OF VEHICLES PARKED ON STREET.	No. OF PARKING STALLS	PEAK PARKING DEMAND (VEHICLES)	SIZE OF PARKING STALL (M x M)
1	Hotel – De – Mikela	CBD	600	LOW	-	20	15	2.4 x4.90
2	Mbass Hotel	CBD	446	HIGH	8	8	16	2.4x5
3	De friendship motel	CBD	297	HIGH	2	12	14	2.5x5.0
4	International Hotel	CBD	273	HIGH	3	10	13	2.4x4.95
5	Elisons Hotel	CBD	180	HIGH	5	4	9	2.5x4.90
6	Criss Park Hotel	CBD	360	MODERATE	-	12	11	2.5x5.0
7	Sky World Hotel	CBD	198	HIGH	10	-	10	2.5x5.0
8	People's Resort Hotel	CBD	259	HIGH	4	8	12	2.5x4.9
9	K.F.C. Hotel	CBD	130	MODERATE	4	5	9	2.5x4.9
10	Motel – La – Mirrage.	CBD	240	HIGH	4	12	16	2.5x50
11	Fresh Lily Hotel	CBD	176	MODERATE	7	-	7	2.5x4.8
12	King's Hotel	CBD	170	HIGH	6	-	6	2.5x4.9
13	Tower Hotel	CBD	162	MODERATE		6	5	2.5x4.95
14	Royal Tropicana Hotel	PCBD	2,080	HIGH		80	50	2.5x5.0
15	Akija Hotel	PCBD	836	HIGH		36	23	2.5x5.0
16	Gab Hotel	PCBD	760	HIGH		25	20	2.5x5.0
17	Daula Hotel	OCBD	-	MODERATE		64	44	2.5x5.0
18	Kano Residental Hotel	OCBD	282	MODERATE		20	17	2.5x5.0
19	Prince Hotel	OCBD	370	HIGH		15	12	2.5x5.2
20	Tahir Guest Inn	OCBD	300	HIGH	-	15	10	2.5x5.0

CBD = Central Business District; OCBD = Outside Central business District; PCBD = Periphery of Central Business District.

3.3 Parking Habit Survey

The parking survey was designed to involve a twelve (12) hours monitoring with periodic intervals spaced at thirty minutes (30), of vehicles that are parked at the hotel premises, and those that parked at other positions but with the hotel serving as the occupants' destination. The count spanned from 8.00am to 8.00pm. each day for a week. The parking habit survey count was recorded as indicated in format shown in Table 3.2. The result of the parking habit survey was transformed into the form shown in Table 3.3.1 to 3.3.20 for ease of analysis, because it is easier using figures than the vehicle registration number. From the result of the count, the peak parking demand at each hotel premises was determined.

Table 3.2: FORMAT FOR PARKING HABIT SURVEY RECORDING

LOCATION: -	
NAME OF HOTEL: -	
DATE: -	PARKING RESTRICTION:
DAY OF WEEK: -	
TIME	VEHICLE REGISTRATION NUMBER.
8.00-8.30	AA95RGG, AA591KRA, AS04LSR, AQ479MKB
8.30-9.00	AH927NSR, AJ760LSD, AA824FGE, AE939NSR
9.00-9.30	AE939NSE, AP445ABJ, AA450SML, AA54GML

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.1 DATE: 9-15/3/98

NUMBER OF ROOMS = 100

NAME OF HOTEL: Hotel De Mikela

LOCATION : Church Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	9	2	-	-	1	-
8.30 – 9.00	3	1	1	-	2	1	-
9.00 – 9.30	2	-	1	-	2	-	2
9.30 – 10.00	1	-	1	2	3	1	2
10.00 – 10.30	1	-	-	2	3	-	-
10.30 – 11.00	1	-	-	3	2	-	-
11.00 – 11.30	-	2	1	1	1	-	-
11.30 – 12.00	-	3	-	-	-	2	-
12.00 – 12.30	-	2	2	-	-	-	-
12.30 – 1.00	-	1	-	-	-	-	-
1.0 – 1.30	-	1	1	2	1	-	2
1.30 – 2.00	-	1	2	1	2	-	-
2.00 – 2.30	2	-	1	-	-	-	-
2.30 – 3.00	-	-	-	3	-	-	3
3.00 – 3.30	1	-	-	2	-	2	3
3.30 – 4.00	-	-	-	1	1	3	5
4.00 – 4.30	-	-	1	2	-	3	7
4.30 – 5.00	-	-	-	3	-	5	7
5.00 – 5.30	-	-	2	4	3	6	9
5.30 – 6.00	1	2	-	7	2	8	11
6.00 – 6.30	2	4	3	6	5	9	10
6.30 – 7.00	8	6	5	8	8	12	9
7.00 – 7.30	11	7	8	10	7	15	7
7.30 – 8.00	11	7	9	9	8	13	7

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.2 DATE: 9-15/3/98

NUMBER OF ROOMS = 62

NAME OF HOTEL: Mbass Hotel

LOCATION : Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	-	1	-	-	-	-
8.30 – 9.00	1	-	-	-	-	-	-
9.00 – 9.30	1	1	-	2	-	-	-
9.30 – 10.00	1	2	-	1	-	-	-
10.00 – 10.30	-	-	-	-	-	-	-
10.30 – 11.00	-	-	2	-	-	-	-
11.00 – 11.30	-	1	-	-	-	-	-
11.30 – 12.00	-	-	-	-	-	-	-
12.00 – 12.30	2	-	-	3	-	-	-
12.30 – 1.00	3	-	1	-	-	-	-
2.0 – 1.30	2	-	-	-	-	-	-
1.30 – 2.00	1	-	-	-	-	-	1
2.00 – 2.30	-	-	2	-	-	-	-
2.30 – 3.00	-	-	-	-	-	-	1
3.00 – 3.30	-	-	-	-	-	-	2
3.30 – 4.00	-	-	-	-	-	-	1
4.00 – 4.30	2	-	2	-	-	1	1
4.30 – 5.00	1	1	3	-	-	2	1
5.00 – 5.30	-	2	4	5	-	7	1
5.30 – 6.00	3	4	6	5	3	8	2
6.00 – 6.30	4	6	7	6	5	10	3
6.30 – 7.00	7	8	8	7	7	13	5
7.00 – 7.30	10	9	11	9	10	16	6
7.30 – 8.00	10	11	12	10	9	15	8

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.3 DATE: 9-15/3/98

NUMBER OF ROOMS = 58

3. NAME OF HOTEL: Defriendship Motel

LOCATION : Zun geru Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	5	1	3	4	2	2	3
8.30 – 9.00	3	3	4	3	1	3	4
9.00 – 9.30	4	5	4	3	3	5	4
9.30 – 10.00	4	3	3	4	3	4	5
10.00 – 10.30	5	3	2	6	2	7	6
10.30 – 11.00	7	2	3	5	5	5	3
11.00 – 11.30	7	4	2	4	6	4	2
11.30 – 12.00	4	3	-	3	7	3	1
12.00 – 12.30	3	5	2	3	7	5	1
12.30 – 1.00	3	3	3	2	5	4	2
3.0 – 1.30	2	4	-	2	4	3	2
1.30 – 2.00	1	4	5	1	4	3	4
2.00 – 2.30	2	5	4	1	3	4	5
2.30 – 3.00	1	3	6	4	2	4	6
3.00 – 3.30	3	2	2	8	5	5	5
3.30 – 4.00	4	1	3	6	6	5	4
4.00 – 4.30	3	1	4	7	5	3	4
4.30 – 5.00	2	4	4	7	6	5	3
5.00 – 5.30	4	7	5	8	8	7	6
5.30 – 6.00	5	6	6	9	8	9	7
6.00 – 6.30	6	8	7	7	5	11	7
6.30 – 7.00	9	11	10	10	7	13	5
7.00 – 7.30	11	11	12	14	9	14	7
7.30 – 8.00	6	10	9	12	7	10	6

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.4 DATE: 9-15/3/98

NUMBER OF ROOMS = 56

4. NAME OF HOTEL: International Hotel

LOCATION : Enugu Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	3	1	1	2	2	-	-
8.30 – 9.00	3	2	2	2	1	-	2
9.00 – 9.30	2	-	1	1	2	1	1
9.30 – 10.00	2	-	2	3	3	-	1
10.00 – 10.30	1	3	3	2	2	2	2
10.30 – 11.00	-	2	4	3	3	3	3
11.00 – 11.30	-	1	2	2	4	3	1
11.30 – 12.00	1	-	3	1	3	1	2
12.00 – 12.30	2	2	2	5	2	2	-
12.30 – 1.00	-	1	1	4	-	3	-
4.0 – 1.30		-	2	3	1	2	-
1.30 – 2.00	2	3	1	1	-	1	-
2.00 – 2.30	1	5	1	2	2	-	1
2.30 – 3.00	3	7	3	2	1	1	2
3.00 – 3.30	4	7	2	-	2	2	2
3.30 – 4.00	-	6	1	1	3	3	3
4.00 – 4.30	3	5	-	1	1	5	2
4.30 – 5.00	-	4	1	-	2	6	3
5.00 – 5.30	-	6	-	2	4	10	4
5.30 – 6.00	2	5	2	3	5	9	5
6.00 – 6.30	4	7	4	5	6	10	5
6.30 – 7.00	5	9	5	7	7	12	6
7.00 – 7.30	9	11	6	8	7	13	8
7.30 – 8.00	10	9	6	8	5	11	6

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.5 DATE: 9-15/3/98

NUMBER OF ROOMS = 38

5. NAME OF HOTEL : Elison Hotel

LOCATION : AZIKIWE Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	-	1	2	1	-	2
8.30 – 9.00	2	-	1	1	-	-	3
9.00 – 9.30	1	2	-	2	2	-	-
9.30 – 10.00	1	3	-	1	1	1	1
10.00 – 10.30	-	1	1	-	1	1	-
10.30 – 11.00	3	-	-	2	-	2	2
11.00 – 11.30	1	2	-	-	-	3	3
11.30 – 12.00	1	-	1	-	2	-	-
12.00 – 12.30	-	1	-	-	1	4	-
12.30 – 1.00	2	1	-	1	-	3	2
5.0 – 1.30	3	-	2	-	1	-	1
1.30 – 2.00	1	-	-	2	-	2	1
2.00 – 2.30	2	2	-	1	-	1	-
2.30 – 3.00	-	1	2	-	2	-	-
3.00 – 3.30	-	-	1	3	-	3	-
3.30 – 4.00	1	-	-	-	3	-	2
4.00 – 4.30	-	1	-	1	-	2	1
4.30 – 5.00	-	-	2	-	2	3	-
5.00 – 5.30	2	1	-	2	-	3	2
5.30 – 6.00	4	2	1	3	3	4	3
6.00 – 6.30	5	3	4	5	4	5	3
6.30 – 7.00	8	5	5	5	6	8	4
7.00 – 7.30	8	6	7	6	7	9	5
7.30 – 8.00	6	6	8	4	6	7	6

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.6 DATE: 9-15/3/98

NUMBER OF ROOMS = 38

6. NAME OF HOTEL : Criss Park Hotel

LOCATION : Ball athuge Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	1	-	-	2	1	1
8.30 – 9.00	-	1	1	-	2	2	1
9.00 – 9.30	1	-	-	2	2	12	-
9.30 – 10.00	1	-	2	-	-	2	-
10.00 – 10.30	2	-	3	2	-	2	1
10.30 – 11.00	1	-	-	1	-	-	-
11.00 – 11.30	1	-	-	3	-	-	1
11.30 – 12.00	-	-	-	2	1	-	-
12.00 – 12.30	-	-	1	3	2	1	-
12.30 – 1.00	1	1	2	-	3	-	1
6.0 – 1.30	-	2	-	1	-	1	2
1.30 – 2.00	2	-	1	-	-	2	-
2.00 – 2.30	3	2	3	1	1	-	2
2.30 – 3.00	2	3	-	-	2	1	-
3.00 – 3.30	3	2	4	1	1	-	1
3.30 – 4.00	2	1	3	2	-	-	1
4.00 – 4.30	1	-	-	3	-	3	-
4.30 – 5.00	2	1	-	-	3	4	1
5.00 – 5.30	1	1	-	-	3	-	-
5.30 – 6.00	3	2	3	2	2	6	2
6.00 – 6.30	5	3	4	5	5	8	3
6.30 – 7.00	6	5	5	6	6	9	6
7.00 – 7.30	9	8	5	9	6	11	7
7.30 – 8.00	7	6	4	6	5	11	7

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.7 DATE: 9-15/3/98

NUMBER OF ROOMS = 36

7. NAME OF HOTEL : Sky World Hotel

LOCATION : Niger Street, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	1	2	1	2	3	2	-
8.30 – 9.00	-	2	-	1	2	-	-
9.00 - 9.30	-	1	-	3	2	2	2
9.30 – 10.00	1	1	-	3	2	1	-
10.00 – 10.30	2	1	-	1	-	1	1
10.30 – 11.00	3	2	-	1	-	1	-
11.00 – 11.30	4	1	1	1	2	1	1
11.30 – 12.00	2	-	2	2	-	2	1
12.00 – 12.30	2	1	-	1	2	3	3
12.30 – 1.00	1	-	1	3	-	2	1
7.0 – 1.30	1	2	2	-	1	-	2
1.30 – 2.00	-	4	1	1	-	2	3
2.00 – 2.30	-	2	-	1	-	-	1
2.30 – 3.00	-	-	2	2	-	2	-
3.00 – 3.30	1	-	4	3	-	1	-
3.30 – 4.00	-	2	3	5	-	1	-
4.00 – 4.30	2	-	2	4	2	-	-
4.30 – 5.00	1	3	2	2	-	1	-
5.00 – 5.30	2	2	4	3	3	1	2
5.30 – 6.00	2	2	5	5	6	5	1
6.00 – 6.30	3	5	6	7	5	4	3
6.30 – 7.00	5	7	8	7	6	6	4
7.00 – 7.30	7	8	7	7	8	10	5
7.30 – 8.00	8	8	5	5	7	10	2

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.8 DATE: 9-15/3/98

NUMBER OF ROOMS = 35

8. NAME OF HOTEL: People's Resort Hotel

LOCATION : Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	-	1	3	-	1	-
8.30 – 9.00	1	-	-	2	-	-	-
9.00 – 9.30	-	-	-	1	1	1	-
9.30 – 10.00	1	-	-	1	2	2	1
10.00 – 10.30	-	1	-	-	1	2	1
10.30 – 11.00	2	-	1	-	-	2	3
11.00 – 11.30	-	2	2	-	-	1	3
11.30 – 12.00	-	1	1	-	1	-	-
12.00 – 12.30	-	-	-	-	-	-	-
12.30 – 1.00	-	-	-	-	-	-	3
8.0 – 1.30	1	-	-	-	1	-	2
1.30 – 2.00	-	-	-		*-	-	2
2.00 – 2.30	-	-	-	1	-	-	1
2.30 – 3.00	-	1	1	1	-	-	-
3.00 – 3.30	-	1	2	-	1	1	-
3.30 – 4.00	1	-	3	-	-	2	-
4.00 – 4.30	-	-	-	-	-	-	-
4.30 – 5.00	-	-	-	-	1	-	-
5.00 – 5.30	3	-	2	-	2	4	3
5.30 – 6.00	2	1	3	4	1	5	2
6.00 – 6.30	5	3	4	6	-	7	3
6.30 – 7.00	8	4	4	8	6	9	4
7.00 – 7.30	10	5	6	8	6	12	7
7.30 – 8.00	8	3	2	7	2	11	4

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.9 DATE: 9-15/3/98

NUMBER OF ROOMS = 35

9. NAME OF HOTEL : K.F.C Hotel.

LOCATION : AZIKIWE Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	1	-	1	-	-	1	-
8.30 – 9.00	-	-	-	-	-	-	-
9.00 – 9.30	2	-	1	-	-	-	-
9.30 – 10.00	-	-	2	-	-	2	1
10.00 – 10.30	-	-	1	-	-	-	-
10.30 – 11.00	-	-	-	1	-	3	*-
11.00 – 11.30	3	-	-	1	-	2	1
11.30 - 12.00	-	2	-	1	-		-
12.00 – 12.30	-	1	-	-	1	-	-
12.30 – 1.00	-	1	-	-	-	-	-
9.0 - 1.30	-	1	-	-	-	-	-
1.30 – 2.00	-	-	-	1	5	-	-
2.00 – 2.30	-	-	-	-	-	-	-
2.30 – 3.00	1	-	-	-	-	-	-
3.00 – 3.30	-	2	1	-	-	-	-
3.30 – 4.00	2	1	-	-	-	-	-
4.00 – 4.30	-	-	-	-	3	3	-
4.30 – 5.00	3	2	-	-	1	-	-
5.00 – 5.30	4	5	1	-	1	1	2
5.30 – 6.00	6	5	1	2	3	2	-
6.00 – 6.30	7	6	-	3	-	4	-
6.30 – 7.00	7	6	5	6	2	6	2
7.00 – 7.30	8	6	7	6	4	9	4
7.30 – 8.00	6	5	6	5	3	7	2

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.10 DATE: 9-15/3/98

NUMBER OF ROOMS = 30

10. NAME OF HOTEL: Motel – La - Mirrage

LOCATION : Enugu Avenue, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	3	4	2	3	2	3	2
8.30 – 9.00	4	3	2	3	3	4	2
9.00 – 9.30	3	3	1	2	2	3	3
9.30 – 10.00	5	5	2	1	1	2	4
10.00 – 10.30	3	6	3	2	2	2	-
10.30 – 11.00	2	4	3	2	1	2	-
11.00 – 11.30	1	3	4	3	2	3	-
11.30 – 12.00	1	2	5	4	1	4	-
12.00 – 12.30	-	-	3	3	1	4	-
12.30 – 1.00	-	-	2	2	1	-	-
10.0 – 1.30	2	-	1	1	-	-	-
1.30 – 2.00	3	-	-	-	-	-	2
2.00 – 2.30	1	-	1	-	1	-	1
2.30 – 3.00	-	-	2	-	-	-	1
3.00 – 3.30	-	-	-	-	-	-	-
3.30 – 4.00	2	1	2	3	-	1	2
4.00 – 4.30	4	3	4	3	1	-	-
4.30 – 5.00	5	5	6	2	-	3	-
5.00 – 5.30	7	6	5	3	1	5	4
5.30 – 6.00	7	8	6	5	3	8	4
6.00 – 6.30	8	11	7	7	4	11	6
6.30 – 7.00	10	13	9	7	5	14	7
7.00 – 7.30	10	14	10	9	8	16	10
7.30 – 8.00	9	11	10	11	7	16	11

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.11 DATE: 9-15/3/98

NUMBER OF ROOMS = 28

11. NAME OF HOTEL: Fresh Lily Hotel.

LOCATION : Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	-	-	1	1	-	-
8.30 – 9.00	1	1	2	2	-	-	-
9.00 – 9.30	1	-	1	2	-	-	-
9.30 – 10.00	-	-	-	1	-	-	
10.00 – 10.30	-	1	-	1	-	-	
10.30 – 11.00	1	-	-	2	-	-	1
11.00 – 11.30	1	2	1	1	1	-	1
11.30 – 12.00	-	-	-	1	2	1	-
12.00 – 12.30	-	3	2	-	2	1	1
12.30 – 1.00	-		1	-	-	-	-
11.0 – 1.30	1		1	-	3	-	-
1.30 – 2.00	-	-	-	1	-	2	-
2.00 – 2.30	1	2	-	-	-	1	-
2.30 – 3.00	-	-	-	2	-	1	1
3.00 – 3.30	-	-	1	1	-	-	2
3.30 – 4.00	-	-	2	1	-	2	1
4.00 – 4.30	2	1	1	-	2	1	-
4.30 – 5.00	-	-	-	2	-	-	-
5.00 – 5.30	-	2	-	-	3	1	-
5.30 – 6.00	-	-	2	3	-	3	-
6.00 – 6.30	2	1	3	2	4	4	2
6.30 – 7.00	3	4	4	4	3	6	5
7.00 – 7.30	5	6	5	6	4	7	5
7.30 – 8.00	5	4	4	6	3	5	4

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.12 DATE: 9-15/3/98

NUMBER OF ROOMS = 26

12. NAME OF HOTEL: King's Hotel

LOCATION : Aba Road, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	1	-	1	-	-	1	-
8.30 – 9.00	-	-	-	-	-	1	-
9.00 – 9.30	1	-	-	-	-	2	-
9.30 – 10.00	-	-	-	2	-	-	1
10.00 – 10.30	-	-	1	3	-	1	1
10.30 – 11.00	-	-	1	2	-	-	-
11.00 – 11.30	-	-	1	1	-	-	1
11.30 – 12.00	-	-	-	-	-	-	-
12.00 – 12.30	-	-	-	-	-	-	-
12.30 – 1.00	1	-	-	-	-	-	-
12.0 – 1.30	1	-	-	-	-	-	-
1.30 2.00	-	-	1	-	-	-	-
2.00 – 2.30	-	-	1	-	-	-	-
2.30 – 3.00	-	-	-	-	-	-	-
3.00 – 3.30	-	-	-	-	2	1	-
3.30 – 4.00	-	-	-	-	3	2	1
4.00 – 4.30	-	-	-	-	1	-	-
4.30 – 5.00	-	-	-	-	1	-	-
5.00 – 5.30	-	-	-	-	-	-	-
5.30 – 6.00	-	-	-	-	-	3	1
6.00 – 6.30	2	1	3	3	5	4	2
6.30 – 7.00	3	4	4	3	4	5	3
7.00 – 7.30	5	5	4	5	6	6	5
7.30 – 8.00	5	6	3	5	4	6	4

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.13 DATE: 9-15/3/98

NUMBER OF ROOMS = 23

13. NAME OF HOTEL: Tower Hotel.

LOCATION : Niger Street, Sabon Gari (CBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	-	-	1	1	-	-	1
8.30 – 9.00	-	-	-	1	-	-	-
9.00 – 9.30	-	-	-	2	-	1	1
9.30 – 10.00	1	-	-	2	1	-	-
10.00 – 10.30	2	-	-	-	-	-	-
10.30 – 11.00	1	-	2	-	-	-	-
11.00 – 11.30	-	1	-	-	-	-	-
11.30 – 12.00	-	-	-	-	2	-	-
12.00 – 12.30	-	2	-	-	-	-	-
12.30 – 1.00	2	2	-	-	-	-	-
13.0 – 1.30	-	-	-	-	-	-	2
1.30 – 2.00	-	-	-	2	-	-	-
2.00 – 2.30	-	-	-	2	-	-	1
2.30 – 3.00	2	-	1	-	-	3	-
3.00 – 3.30	-	-	3	-	-	-	-
3.30 – 4.00	1	-	-	-	-	-	-
4.00 – 4.30	-	-	-	-	3	-	-
4.30 – 5.00	-	-			1	-	-
5.00 – 5.30	-	-	-	-	2	-	-
5.30 – 6.00	2	3	-	-	-	-	-
6.00 – 6.30	3	-	2	-	-	4	2
6.30 – 7.00	4	2	3	4	-	3	1
7.00 – 7.30	5	3	4	5	2	5	2
7.30 – 8.00	1	-	2	3	3	4	-

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.14 DATE: 9-15/3/98

NUMBER OF ROOMS = 200

14. NAME OF HOTEL: Royal Tropicana Hotel

LOCATION : Niger Road (PCBD)

TIME	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	12	9	7	13	12	13	8
8.30 – 9.00	13	11	13	12	14	15	13
9.00 – 9.30	10	15	19	16	16	13	12
9.30 – 10.00	16	13	22	17	17	12	16
10.00 – 10.30	21	11	18	20	12	14	17
10.30 – 11.00	20	13	22	18	14	16	12
11.00 – 11.30	18	16	21	15	15	12	11
11.30 – 12.00	23	17	26	17	16	15	12
12.00 – 12.30	24	14	25	16	19	17	13
12.30 – 1.00	21	12	24	18	22	20	14
14.0 – 1.30	25	13	29	20	20	23	15
1.30 – 2.00	24	14	19	18	18	24	18
2.00 – 2.30	18	13	13	17	19	29	21
2.30 – 3.00	17	15	12	16	17	36	26
3.00 – 3.30	22	16	15	16	18	39	27
3.30 – 4.00	24	18	17	20	20	40	25
4.00 – 4.30	21	22	20	23	22	44	23
4.30 – 5.00	18	23	21	27	24	50	29
5.00 – 5.30	16	21	18	25	21	48	32
5.30 – 6.00	19	20	19	23	19	43	30
6.00 – 6.30	20	18	19	19	18	38	27
6.30 – 7.00	18	316	17	16	18	32	23
7.00 – 7.30	16	15	13	14	12	28	20
7.30 – 8.00	13	13	11	12	11	22	18

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.15 DATE: 9-15/3/98

NUMBER OF ROOMS = 93

15. NAME OF HOTEL: Akija Hotel

LOCATION : Katsina Road, (PCBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	8	5	9	10	6	7	8
8.30 – 9.00	8	7	10	11	7	9	11
9.00 – 9.30	10	9	12	10	10	11	12
9.30 – 10.00	12	10	10	12	14	13	9
10.00 – 10.30	13	11	13	13	15	12	10
10.30 – 11.00	14	11	11	15	13	13	12
11.00 – 11.30	14	13	12	14	12	14	11
11.30 – 12.00	11	12	11	14	13	16	10
12.00 – 12.30	13	11	13	13	14	18	9
12.30 – 1.00	14	14	11	14	15	17	13
15.0 – 1.30	15	13	16	13	16	15	15
1.30 – 2.00	12	15	15	15	17	12	11
2.00 – 2.30	11	14	14	16	15	15	12
2.30 – 3.00	11	15	15	17	16	17	11
3.00 – 3.30	13	12	11	15	17	17	11
3.30 – 4.00	15	16	14	14	15	19	12
4.00 – 4.30	16	15	16	15	16	21	15
4.30 – 5.00	15	17	16	17	17	23	17
5.00 – 5.30	14	11	11	14	16	21	15
5.30 – 6.00	14	11	10	11	17	19	13
6.00 – 6.30	16	9	8	8	18	16	11
6.30 – 7.00	13	7	9	6	13	14	10
7.00 – 7.30	12	6	7	5	10	9	10
7.30 – 8.00	11	6	6	5	9	7	5

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.16 DATE: 9-15/3/98

NUMBER OF ROOMS = 80

16. NAME OF HOTEL: Gab Hotel

LOCATION : Murtala Mohammed Way (PCBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	3	1	-	3	2	3	1
8.30 – 9.00	3	-	-	2	2	4	1
9.00 – 9.30	2	2	2	3	3	3	2
9.30 – 10.00	1	2	1	1	4	4	2
10.00 – 10.30	1	4	2	1	5	2	3
10.30 – 11.00	3	5	3	2	5	2	4
11.00 11.30	2	3	2	1	6	3	5
11.30 – 12.00	1	3	1	2	5	5	3
12.00 – 12.30	5	2	1	1	4	5	3
12.30 – 1.00	7	1	-	4	5	8	2
16.0 – 1.30	6	4	2	5	3	8	2
1.30 – 2.00	5	3	3	6	2	10	4
2.00 – 2.30	4	2	2	7	3	11	4
2.30 – 3.00	7	6	1	5	3	12	3
3.00 – 3.30	7	8	4	5	4	13	5
3.30 – 4.00	8	9	7	8	5	17	3
4.00 – 4.30	10	11	9	10	6	19	6
4.30 – 5.00	11	13	9	13	8	20	7
5.00 – 5.30	9	14	7	13	8	17	7
5.30 – 6.00	10	12	6	12	7	18	5
6.00 – 6.30	8	11	5	11	2	16	4
6.30 – 7.00	7	8	7	8	4	15	3
7.00 – 7.30	7	7	8	7	3	14	3
7.30 – 8.00	7	6	9	6	3	12	4

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.18 DATE: 9-15/3/98

NUMBER OF ROOMS = 70

18. NAME OF HOTEL : Kano Residential Hotel.

LOCATION : Katsina Road (OCBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	5	3	5	6	4	3	5
8.30 - 9.00	5	4	6	7	5	5	7
9.00 – 9.30	6	7	6	7	6	6	9
9.30 – 10.00	7	8	7	6	7	7	6
10.00 – 10.30	8	9	7	5	5	9	8
10.30 – 11.00	10	9	11	5	8	9	8
11.00 – 11.30	11	10	10	7	9	8	9
11.30 - 12.00	13	9	10	8	9	9	8
12.00 – 12.30	12	9	9	7	7	10	6
12.30 – 1.00	11	10	10	6	11	12	8
18.0 – 1.30	13	12	9	8	12	13	11
1.30 – 2.00	14	14	11	12	13	14	9
2.00 – 2.30	13	14	12	11	11	15	8
2.30 – 3.00	12	13	12	12	10	15	6
3.00 – 3.30	12	12	11	14	9	13	5
3.30 – 4.00	11	11	9	12	7	10	7
4.00 – 4.30	10	9	7	13	6	14	8
4.30 – 5.00	10	8	9	11	7	17	11
5.00 – 5.30	10	7	9	11	8	16	12
5.30 – 6.00	11	7	9	8	6	11	9
6.00 – 6.30	12	5	5	7	6	13	8
6.30 – 7.00	9	4	4	6	5	11	6
7.00 – 7.30	7	4	3	5	4	9	4
7.30 – 8.00	5	2	1	5	4	7	2

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.19 DATE: 9-15/3/98

NUMBER OF ROOMS = 36

19. NAME OF HOTEL: Prince Hotel.

LOCATION : Behind Kano State Polytechnic (OCBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	3	4	3	4	2	3	2
8.30 – 9.00	4	5	2	3	1	2	2
9.00 – 9.30	3	3	2	2	1	2	3
9.30 – 10.00	2	4	3	1	-	3	2
10.00 – 10.30	5	5	2	1	-	4	1
10.30 – 11.00	6	7	3	4	2	5	1
11.00 – 11.30	7	6	4	5	6	6	1
11.30 – 12.00	8	7	5	5	5	7	3
12.00 – 12.30	7	7	6	6	3	8	4
12.30 – 1.00	5	8	3	4	2	7	3
19.0 – 1.30	4	5	5	6	3	5	4
1.30 – 2.00	9	4	3	7	2	4	5
2.00 – 2.30	10	4	4	5	3	7	6
2.30 – 3.00	9	3	4	4	5	8	6
3.00 – 3.30	8	4	5	7	6	9	5
3.30 – 4.00	9	8	7	8	4	9	6
4.00 – 4.30	8/	7	5	9	7	10	8
4.30 – 5.00	6	8	6	7	6	12	6
5.00 – 5.30	5	6	4	5	6	9	4
5.30 – 6.00	4	5	3	4	5	7	3
6.00 – 6.30	3	4	4	3	4	6	2
6.30 – 7.00	2	4	3	4	3	5	1
7.00 – 7.30	4	3	2	5	3	5	3
7.30 – 8.00	5	3	4	4	2	3	2

SUMMARY OF PARKING HABIT SURVEY

TABLE 3.3.20 DATE: 9-15/3/98

NUMBER OF ROOMS = 30

30. NAME OF HOTEL: Tahir Guest Inn

LOCATION : Lamido Criscent, Off Ahmadu Bello Way. (OCBD)

TIME.	MON.	TUE.	WED.	THUR.	FRI.	SAT.	SUN.
8.00 – 8.30 a.m.	2	1	2	3	1	1	1
8.30 – 9.00	1	2	1	4	1	2	2
9.00 – 9.30	3	1	2	3	1	3	1
9.30 – 10.00	2	1	3	1	2	2	3
10.00 – 10.30	3	2	4	2	2	2	2
10.30 – 11.00	4	3	4	3	3	3	1
11.00 – 11.30	5	3	5	4	4	4	3
11.30 – 12.00	4	4	7	3	4	3	4
12.00 – 12.30	6	4	8	4	5	4	5
12.30 – 1.00	5	3	6	3	4	6	3
20.0 – 1.30	3	3	5	4	3	5	2
1.30 – 2.00	6	2	4	3	3	4	1
2.00 – 2.30	7	1	4	4	7	3	2
2.30 – 3.00	5	2	3	3	6	6	1
3.00 – 3.30	4	3	2	4	5	5	4
3.30 – 4.00	6	4	4	5	6	7	5
4.00 – 4.30	7	5	6	5	8	10	8
4.30 – 5.00	5	6	6	6	8	10	6
5.00 – 5.30	4	3	4	5	7	7	4
5.30 – 6.00	3	4	3	3	5	5	3
6.00 – 6.30	2	2	2	2	4	6	2
6.30 – 7.00	1	3	2	2	3	5	1
7.00 – 7.30	3	2	1	3	3	3	3
7.30 – 8.00	3	3	1	1	2	3	2

3.4 Parking Interview

Parking interview was carried out to determine the origin and trip purpose of drivers that park at the hotel premises, destination of drivers and occupant(s) of vehicles that park, mode of transportation to the hotel, and the level of satisfaction of drivers with current arrangements at the hotel in term of parking provisions, was not successful due to poor response from patrons. In future, questionnaires that can be completed and returned by mail may be a good alternative.

CHAPTER 4

ANALYSIS OF RESULTS

4.1 Analysis Of Parking Survey Data

Using the result obtained from the parking survey, and data obtained from the parking inventory and other inventories carried out at each hotel, multiple linear regression models were developed to deduce the relationship between the different variables measured and determined from the parking survey. Before the multiple linear regression was carried out, dummy variables were used to account for the different locations of the hotels.

The multiple linear regression was carried out using the statistical package for Social Science ($SPSS/PC^{+}$) computer program, the stepwise method was adopted in the Analysis, the results obtained from the Analysis is as summarized in Appendix A.

The models developed for the relationship between the different variables were subjected to standard statistical test, to determine their level of significance. The tests undertaken are the multiple – correlation coefficient test (r^2), the F-test, while the significance of the individual coefficients in the model was tested using the t-test. In some cases, the coefficient in the models were found to fail the t-test, however, the models were subjected to the Extra sum of square principle, and since the result of this test showed that the inclusion of the variables shown by the t-test not to be significant, proved significant, the use of those coefficient was upheld. The models developed are shown in Table 4.1

With the aid of the models developed from the field data, the regressed value of Y (Y – dependent variable) were calculated for each regression as shown in Table 4.2 – 4.10. While the plots are shown in Fig 4.1 – 4.10.

TABLE 4.1: MODELS DEVELOPED FROM THE ANALYSIS OF DATA

Model No.	Y (dependent variable)	Model without Dummy Variables	S^2 = SS / degree of freedom	Model with Dummy Variables	R^2	S_1
	REGRERSSION OF Y ON THE TOTAL NUMBER OF ROOMS (X_3)					
1	No. of Double rooms	$Y_d = -6.938 + 0.760X_3$	289.500	$Y = 5.232 - 14.697x_1 - 28.616X_2 + 0.786X_3$	0.88959	15.44231
2	Number of Staff	$Y_f = 22.657 + 1.345X_3$	1969.809	$Y_f = 35.846 - 60.125X_1 - 5.031X_2 + 1.0786X_3$	0.89886	39.12408
3	Number of Parking stalls	$Y_s = -6.734 + 0.382X_3$	43.710	$Y_s = 1.583 - 8.048X_1 + 5.576X_2 + 0.320X_3$	0.94754	5.18773
4	Peak Parking Demand	$Y_p = 2.204 + 0.216X_3$	10.040	$Y_p = 4.017 - 1.675X_1 + 2.215X_2 + 0.199X_3$	0.93920	3.11212
5	Total Area Covered by Hotel	$Y_a = -1770.949 + 58.267$	1249395.194	$Y_a = -1808.892 + 132.799X_1 + 1183.84X_2 + 54.719X_3$	0.89706	1120.49544
	REGRESSION OF PEAK PARKING DEMAND Y ON THE FOLLOWING VARIABLES (X_3)					
	X_3 (independent variable					
6	Total area covered by Hotel	$Y_P = 9.220 + 3.467X10^{-3}X_3$	11.253	$Y_p = 11.588 - 2.895X_1 - 0.896X_2 + 3.287X10\text{-}3X_3$	092984	3.34334
7	Number of double Rooms	$Y_P = 6.219 + 0.235X_3$	35.806	$Y_p = 6.041 - 0.139X_1 + 9.613X_2 + 0.206X_3$	0.83081	5.19169
8	Number of Staff	$Y_P = 7.922 + 0.127X_3$	26.740	$Y_p = 4.558 + 3.645X_1 + 5.374X_2 + 0.130X_3$	0.83336	5.15240
9	Number of Parking stalls	$Y_P = 6.394 + 0.543X_3$	7.191	$Y_p = 3.763 + 2.790X_1 - 0.777X_2 + 0.596X_3$	0.95794	2.58860

Where X_1, X_2 = dummy variables, X_3= Independent variable, S1 = Standard error of estimate, $\overline{Y}$ = Mean value of dependent variable
R^2 = Coefficient of determination. SS = Sum of squares of Residual

Model No.	Y (dependent variable)	$\overline{Y}$	$S/\overline{Y}$	Extra sum of squares	S^2 extra sum of squares	$S^2 - Se^2$	Remarks
REGRERSSION OF Y ON THE TOTAL NUMBER OF ROOMS (X_3)							
1	No. of Double rooms	40.428	0.38197	1395.497	87.218	202.2	Use of dummy variable upheld
2	Number of Staff	62.74	0.623591	10965.470	685.34	1284.460	Use of dummy variable upheld
3	Number of Parking stalls	17.601	0.294741	356.181	22.260	21.448	Use of dummy variable upheld
4	Peak Parking Demand	15.95	0.1951172	25.753	1.610	8.390	Use of dummy variable upheld
5	Total Area Covered by Hotel	1940.813	0.577335	2400952.990	150059.560	1099335.63	Use of dummy variable upheld
REGRESSION OF PEAK PARKING DEMAND Y ON THE FOLLOWING VARIABLES (X_3)							
	X_3 (independent variable						
6	Total area covered by Hotel	15.95	0.2096138	23.714	1.482	9.771	Use of dummy variable upheld
7	Number of double Rooms	15.95	0.3254978	213.245	13.32	22.470	Use of dummy variable upheld
8	Number of Staff	15.95	0.3230345	56.565	3.535	23.200	Use of dummy variable upheld
9	Number of Parking stalls	15.95	0.1622947	22.225	1.389	5.800	Use of dummy variable upheld

Where X_1, X_2 = dummy variables, X_3 = Independent variable, S1 = Standard error of estimate, $\overline{Y}$ = Mean value of dependent variable
R2 = Coefficient of determination. SS = Sum of squares of Residual
$S^2 - S_e^2$ = Difference between the two mean square of Residuals
x,x =(1,0) for CBD Hotels,x,x = (0,1) for PCBD Hotels, x,x = (0,0) for OCBD Hotels.

Table 4.2 Values obtained from the Regression of number of Double Rooms Y_D on Total number of rooms X_3

Model: $Y_D = 5.232 - 14.697X_1 - 28.616X_2 + 0.786X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\dot{Y}_i$ obtained form field	$\dot{Y}_i - Y_i$
1	1	0	100	69.12	75	5.88
2	1	0	62	39.26	12	-27.66
3	1	0	58	36.12	18	-18.12
4	1	0	56	34.55	44	9.45
5	1	0	38	20.40	28	7.60
6	1	0	38	20.40	29	8.60
7	1	0	36	18.83	20	1.17
8	1	0	35	18.04	23	4.96
9	1	0	35	18.04	25	6.96
10	1	0	30	14.11	21	6.89
11	1	0	28	12.54	10	-2.54
12	1	0	26	10.97	12	1.03
13	1	0	23	8.61	4	-4.61
14	0	1	200	133.80	106	-27.8
15	0	1	93	49.70	80	-30.3
16	0	1	80	39.49	37	-2.49
17	0	0	200	162.41	184	21.59
18	0	0	70	60.25	56	-4.25
19	0	0	36	32.52	23	-10.52
20	0	0	30	28.80	22	-6.8

TOTAL = -55.95

Table 4.3 Values obtained from the Regression of number of Staff Y_f on Total number of rooms X_3

Model: $Y_F = 35.846 - 60.125X_1, - 5.031X_2 + 1.052X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\hat{U}_i$ obtained form field	$\hat{Y}_i - Y_i$
1	1	0	100	80.96	16	-64.96
2	1	0	62	40.97	196	-24.97
3	1	0	58	36.76	35	-1.76
4	1	0	56	34.66	45	10.34
5	1	0	38	15.71	15	-0.71
6	1	0	38	15.71	22	6.29
7	1	0	36	13.61	16	2.39
8	1	0	35	12.56	26	13.44
9	1	0	35	12.56	16	3.44
10	1	0	30	7.29	28	20.71
11	1	0	28	5.19	14	8.81
12	1	0	26	3.08	12	8.92
13	1	0	23	-0.07	18	18.07
14	0	1	200	241.215	300	58.79
15	0	1	93	128.69	150	21.31
16	0	1	80	115.01	35	-80.01
17	0	0	200	246.33	250	3.67
18	0	0	70	109.51	35	-74.51
19	0	0	36	73.73	107	33.27
20	0	0	30	67.41	105	37.59

TOTAL = 0.12

Table 4.4 Values obtained from the Regression of number of Parking stalls Y_s on the Total number of rooms X_3

Model: $Y_s = 1.583-8.048X_1,+5.576X_2 + 0.320X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\acute{Y}_i$ obtained form field	$\acute{Y}_i - Y_i$
1	1	0	100	25.58	20	-5.58
2	1	0	62	13.40	8	-5.40
3	1	0	58	12.12	12	-0.12
4	1	0	56	11.48	10	-1.48
5	1	0	38	5.71	4	-1.71
6	1	0	38	5.71	12	6.29
7	1	0	36	5.07	0	-5.07
8	1	0	35	4.75	8	3.25
9	1	0	35	4.75	5	0.25
10	1	0	30	3.15	12	8.85
11	1	0	28	2.51	0	-2.51
12	1	0	26	1.87	0	-1.87
13	1	0	23	0.91	6	5.09
14	0	1	200	71.25	80	8.75
15	0	1	93	36.96	36	-0.96
16	0	1	80	32.80	25	-7.8
17	0	0	200	65.67	64	-1.67
18	0	0	70	24.01	20	-4.01
19	0	0	36	13.12	15	1.88
20	0	0	30	11.20	15	3.80

TOTAL = -0.02

Table 4.5 Values obtained from the Regression of Total area covered by Hotel Y_A on Total number of rooms X_3
Model: $Y_A = -1808.892 + 132.799X_1, + 1183.84X_2 + 54.719X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\acute{Y}_i$ obtained form field	$\acute{Y}_i - Y_i$
1	1	0	100	3795.81	1910	-1885.81
2	1	0	62	176.49	646	-1070.49
3	1	0	58	1497.70	702	-795.7
4	1	0	56	1388.17	820	-568.17
5	1	0	38	403.23	540	136.77
6	1	0	38	403.23	740	336.77
7	1	0	36	293.79	594	300.21
8	1	0	35	239.07	584	344.93
9	1	0	35	239.07	440	200.93
10	1	0	30	-34.43	629	663.43
11	1	0	28	-143.96	526	669.96
12	1	0	26	-253.40	510	763.40
13	1	0	23	-417.56	486	903.56
14	0	1	200	10318.75	12775	2456.25
15	0	1	93	4463.81	2888	-1575.81
16	0	1	80	3752.47	2872	-880.47
17	0	0	200	9134.91	9000	-134.91
18	0	0	70	2021.44	800	-1221.44
19	0	0	36	160.99	700	539.01
20	0	0	30	-167.32	650	482.68

TOTAL = -334.9

Table 4.6 Values obtained from the Regression of Peak Parking Demand Y_p on Total number of rooms X_3

Model: $Y_p = 4.017-1.675X_1,+2.215X_2 + 0.199X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\dot{Y}_i$ obtained form field	$\dot{Y}_i - Y_i$
1	1	0	100	22.26	15	-7.26
2	1	0	62	14.69	16	1.31
3	1	0	58	13.90	14	0.1
4	1	0	56	13.50	13	-0.51
5	1	0	38	9.91	9	-0.91
6	1	0	38	9.91	11	1.09
7	1	0	36	9.51	10	0.49
8	1	0	35	9.31	12	2.69
9	1	0	35	9.31	9	-0.31
10	1	0	30	8.32	16	7.68
11	1	0	28	7.92	7	-0.92
12	1	0	26	7.52	6	-1.52
13	1	0	23	6.92	5	-1.92
14	0	1	200	46.07	50	3.93
15	0	1	93	24.76	23	-1.76
16	0	1	80	22.17	20	-2.17
17	0	0	200	43.86	44	0.14
18	0	0	70	17.96	17	-0.96
19	0	0	36	11.19	12	0.81
20	0	0	30	10.00	10	0

TOTAL = 0.01

Table 4.7 Values obtained from the Regression of Peak Parking Demand Y_P on Total area covered by hotel X_3

Model: $Y_p = 11.5888 - 2.895X_1, -0.896X_2 + 3.287X410^{-3}X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\acute{Y}_i$ obtained form field	$\acute{Y}_i - Y_i$
1	1	0	1910	14.97	15	0.03
2	1	0	646	10.81	16	5.19
3	1	0	702	10.99	14	3.01
4	1	0	820	11.39	13	1.61
5	1	0	540	10.46	9	-1.46
6	1	0	740	11.12	11	-0.12
7	1	0	594	10.64	10	-0.64
8	1	0	584	10.61	12	1.39
9	1	0	440	10.14	9	1.14
10	1	0	629	10.76	16	5.24
11	1	0	526	10.42	7	-3.42
12	1	0	510	10.37	6	-4.37
13	1	0	486	10.29	5	-5.29
14	0	1	12775	52.68	50	-2.68
15	0	1	2888	20.19	23	2.81
16	0	1	2872	20.13	20	-0.13
17	0	0	9000	41.17	44	2.83
18	0	0	800	14.217	17	2.783
19	0	0	700	13.89	12	-1.89
20	0	0	650	13.72	10	-3.72

Table 4.8 Values obtained from the Regression of Peak Parking Demand Y_p on number of double rooms X_3

Model: $Y_p = 1.583 - 8.048X_1, + 5.576X_2 + 0.320X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\hat{Y}_i$ obtained form field	$\hat{Y}_i - Y_i$
1	1	0	75	21.38	15	-6.38
2	1	0	12	8.38	16	7.62
3	1	0	18	9.62	14	4.38
4	1	0	44	14.98	13	-1.98
5	1	0	28	11.68	9	-2.68
6	1	0	29	11.88	11	-0.88
7	1	0	20	10.03	10	-0.03
8	1	0	23	10.65	12	1.35
9	1	0	25	11.06	9	-0.94
10	1	0	21	10.24	16	5.76
11	1	0	10	7.96	7	-0.96
12	1	0	12	8.38	6	-2.38
13	1	0	4	6.73	5	-1.73
14	0	1	106	37.53	50	12.47
15	0	1	80	32.17	23	-9.17
16	0	1	37	23.29	20	-3.29
17	0	0	184	44.03	44	-0.03
18	0	0	56	17.60	17	-0.60
19	0	0	23	10.79	12	1.21
20	0	0	22	10.58	10	0.58

Table 4.9 Values obtained from the Regression of Peak Parking Demand Y_p on number of staff X_3

Model: $Y_p = 4.558+3.645X_1,+5.374X_2 + 0.130X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\acute{Y}_i$ obtained form field	$\acute{Y}_i - Y_i$
1	1	0	16	10.29	15	4.71
2	1	0	16	10.29	16	5.71
3	1	0	35	12.76	14	1.24
4	1	0	45	14.06	13	1.06
5	1	0	15	10.16	9	-10.6
6	1	0	22	11.07	11	-0.07
7	1	0	16	10.29	10	-0.29
8	1	0	26	11.59	12	0.41
9	1	0	16	10.29	9	-1.29
10	1	0	28	11.85	16	4.15
11	1	0	14	10.02	7	-3.02
12	1	0	12	9.76	6	-3.76
13	1	0	18	10.55	5	-5.55
14	0	1	300	49.03	50	0.97
15	0	1	150	29.48	23	-6.48
16	0	1	35	14.49	20	5.51
17	0	0	250	37.14	44	6.86
18	0	0	35	9.12	17	7.88
19	0	0	107	18.50	12	-6.50
20	0	0	105	18.24	10	-8.24

Table 4.10 Values obtained from the Regression of Peak Parking Demand Y_p on number of parking stalls X_3

Model: $Y_p = 3.763+2.790X_1-0.777X_2 + 0.596X_3$

S/No.	X_1	X_2	X_3	Y_i calculated from model	$\dot{Y}_i$ obtained form field	$\dot{Y}_i - Y_i$
1	1	0	20	18.48	15	-3.48
2	1	0	8	11.32	16	-4.68
3	1	0	12	13.71	14	0.29
4	1	0	10	12.51	13	0.49
5	1	0	4	8.94	9	0.06
6	1	0	12	13.71	11	-2.71
7	1	0	0	6.56	10	3.44
8	1	0	8	11.32	12	0.68
9	1	0	5	9.53	9	-0.53
10	1	0	12	13.71	16	2.29
11	1	0	0	6.56	7	0.44
12	1	0	0	6.56	6	-0.56
13	1	0	6	10.13	5	-5.13
14	0	1	80	50.67	50	-0.67
15	0	1	36	24.45	23	-1.45
16	0	1	25	17.89	20	2.11
17	0	0	64	41.91	44	2.09
18	0	0	20	15.69	17	1.31
19	0	0	15	12.70	12	-0.70
20	0	0	15	12.70	10	-2.70

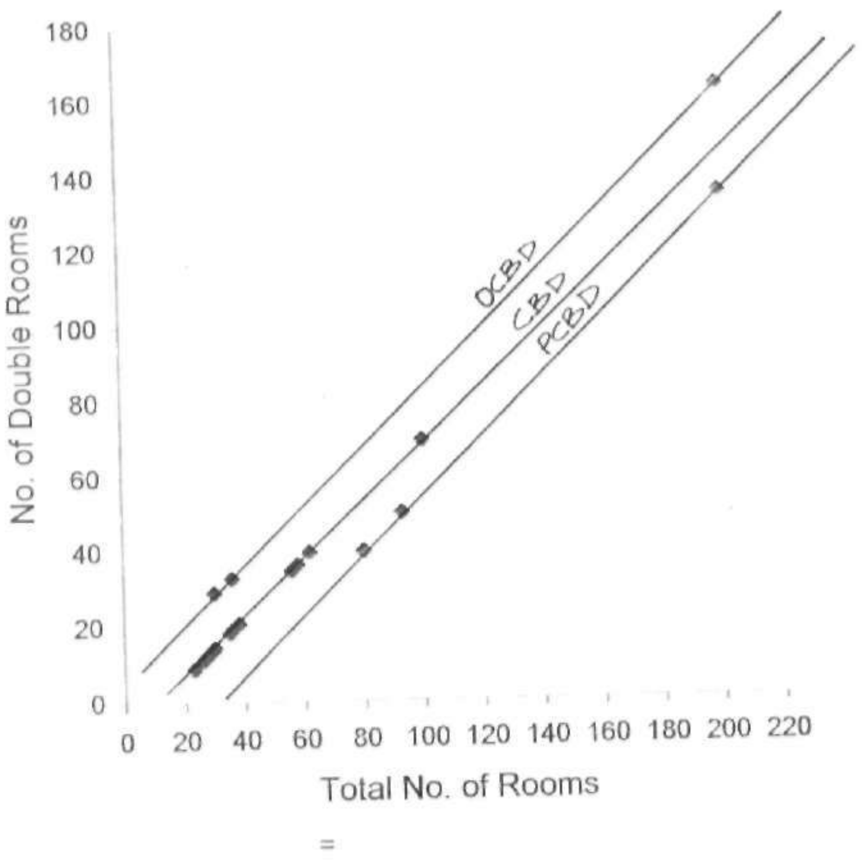

Fig. 4.1 Regression of No. of Double Rooms on Total No. of Rooms.

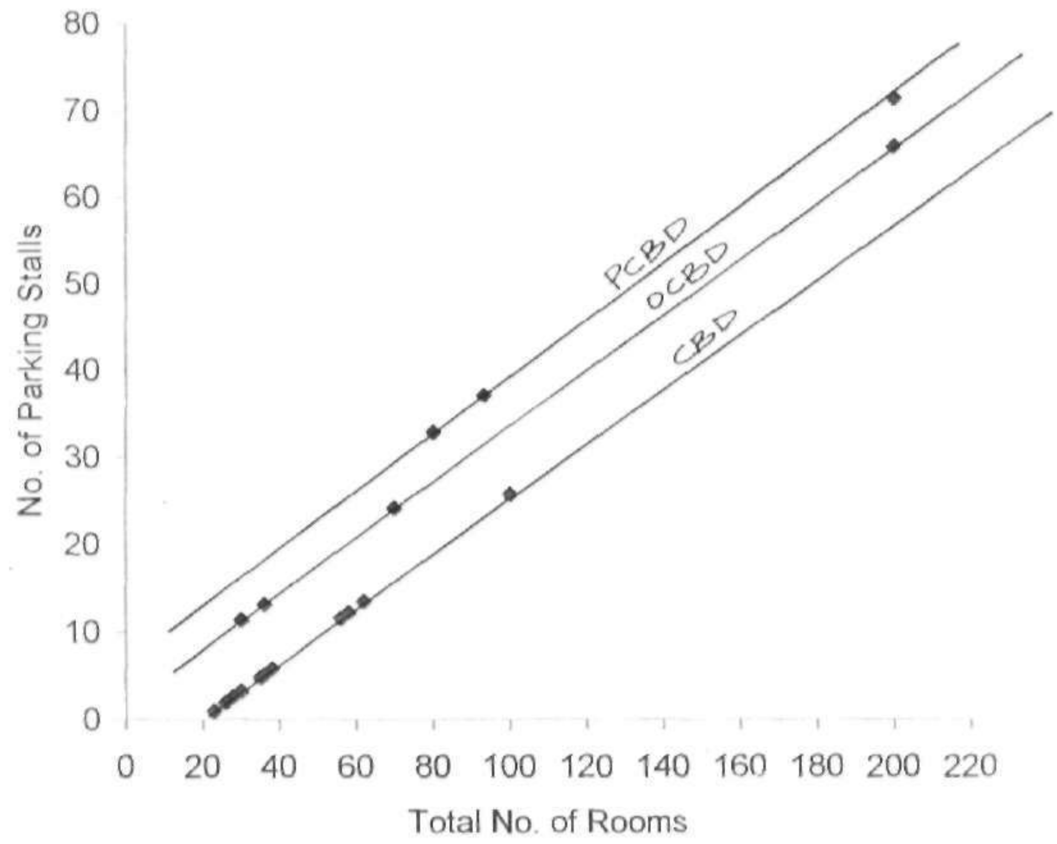

Fig. 4.3 Regression of No. of Parking stalls on Total No. of Rooms

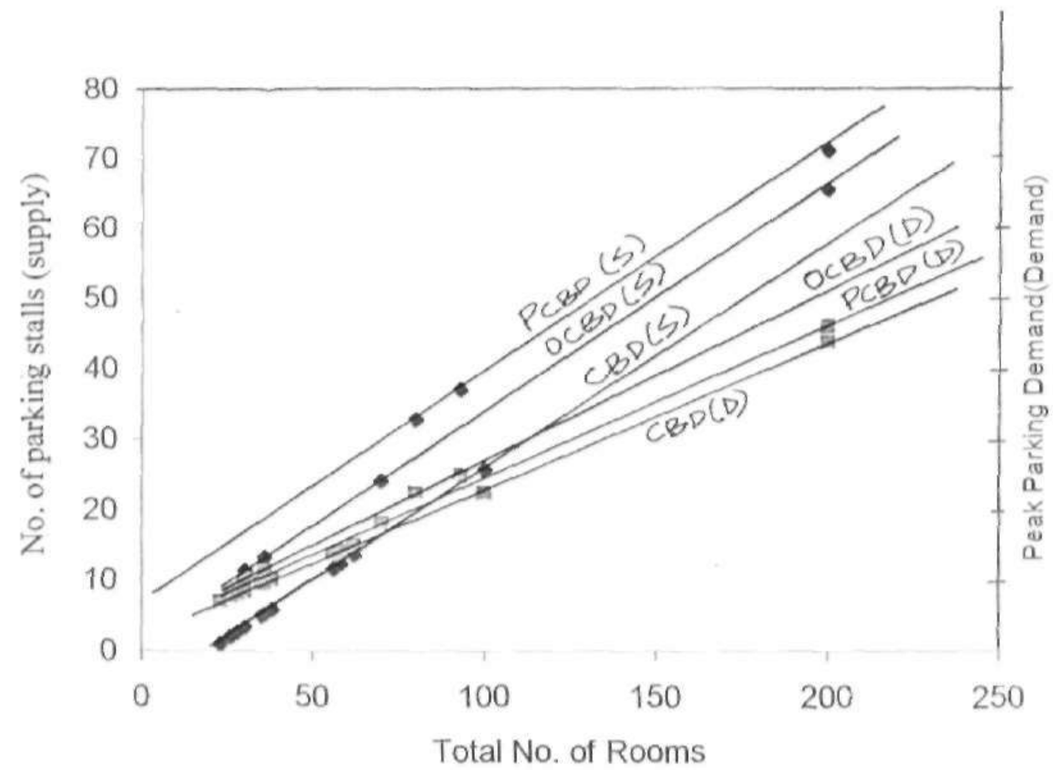

Fig. 4.4 Parking Supply\Demand Relationship

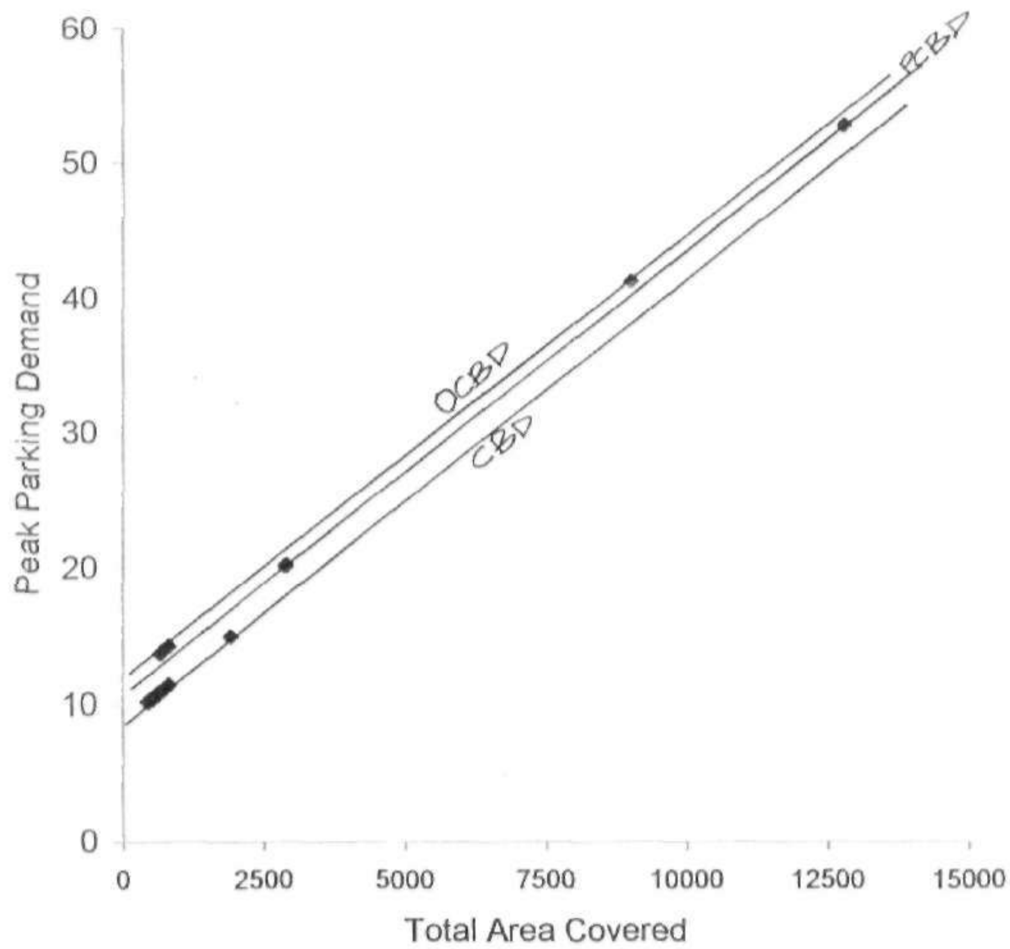

Fig. 4.6 Regression of Peak Parking Demand on Total Area Covered

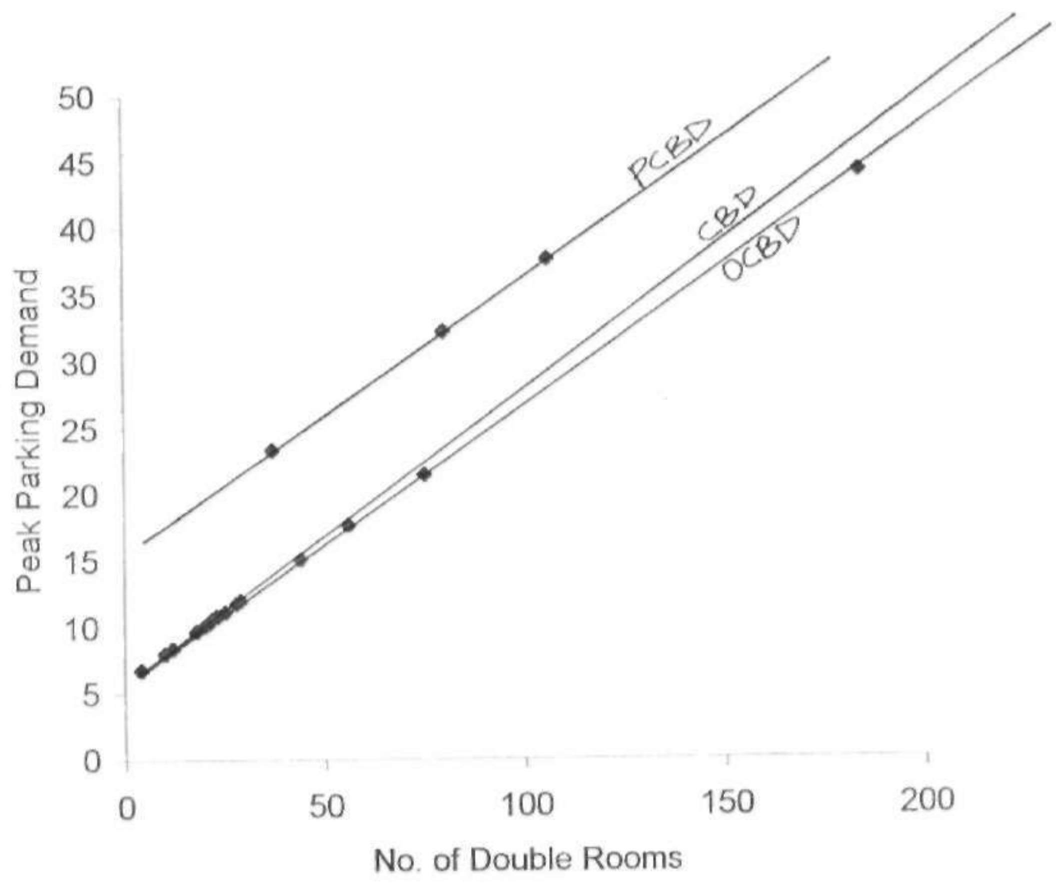

Fig. 4.7 Regression of Peak Parking Demand on No. of Double Rooms

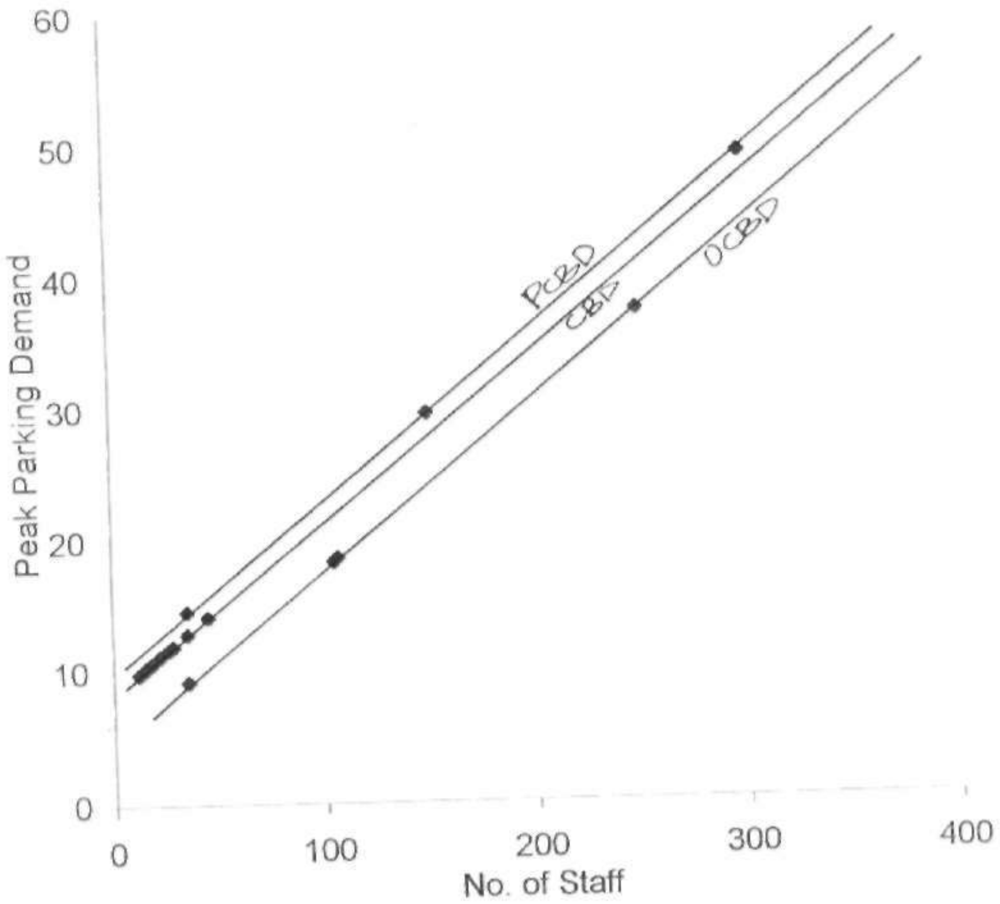

Fig. 4.8 Regression of Peak Parking Demand on No. of Staffs

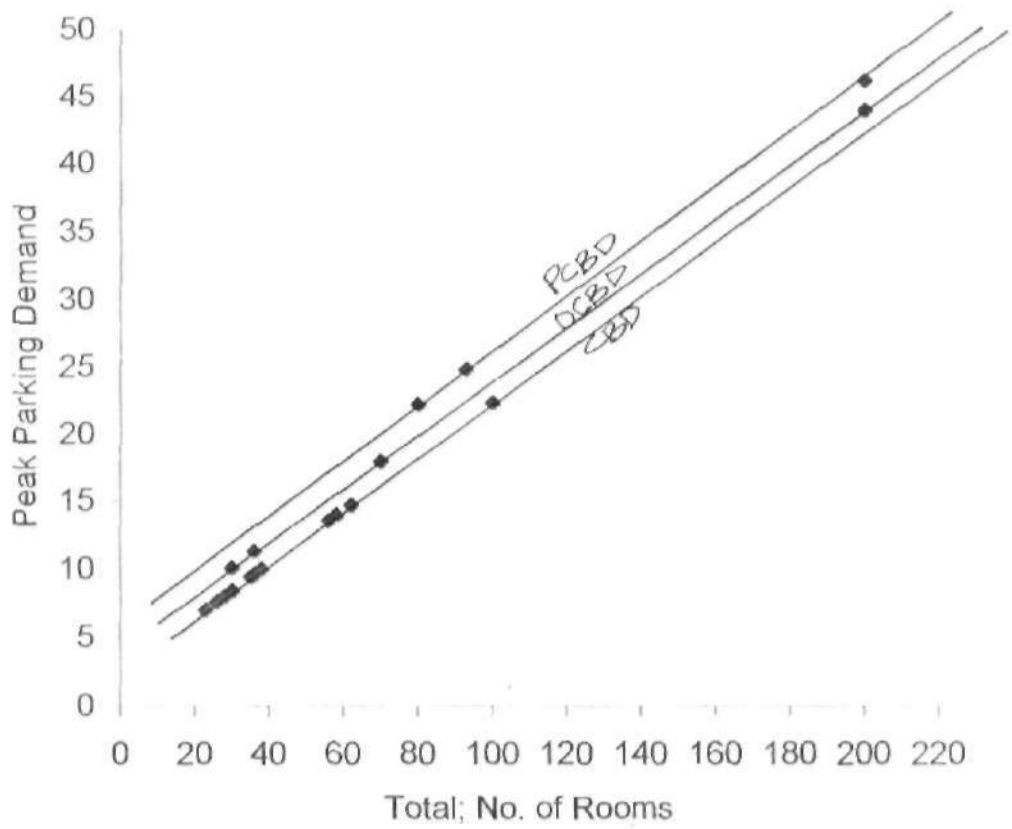

Fig. 4.10 Regression of Peak Parking Demand on Total No. of Rooms

Chapter 5

DISCUSSION OF RESULTS

5.1 Introduction

Since the aim of the work is to study parking generated by hotels and develop models that can be used to predict the likely parking demand in given situations, models that focus more on parking and number of rooms or other attributes of the hotel would be more relevant to us. The choice of the number of rooms in addition to parking related variables is because hotels are normally described in terms of their capacity which is the number of rooms. Similarly, even at the design stage, the total area covered by a proposed hotel is known, and an appropriate capacity for the parking facility could be, if possible be inferred.

5.2 Number Of Parking Stalls / Total No. Of Rooms Model.

Fig 4.3 and model No.3 in Table 4.1 both describe the relationship between the number of parking stalls and total no. of rooms at the hotels where the survey work was carried out. The model is thus:

$$Y_s = 1.5833 - 8.048461X_1 + 5.57573X_2 + 0.32044X_3 \quad \text{.........} \quad (5.1)$$

Y_s = Number of Parking stalls, X_1 X_2 = dummy variable, X3 = total number or rooms.

Taking note of the use of Dummy variables which accounts for the location of the hotels. The model will be as below:

For hotels located in the CBD

$Y_s = 1.5833 - 8.048461 + 0.32044X_3$

$YsCBD = -6.4652 + 0.32044X_3$ ------------------------------ (5.2)

For hotels located at the PCBD

$Y = 1.5833 + 5.5757 + 0.32044X_3$

$Y_sPCBD = 7.1583 + 0.32044X_3$ ------------------------------ (5.3)

For hotels located OCBD

$Y_sOCBD = 1.5833 + 0.32044X_3$ ------------------------------ (5.4)

The model shows that the number of parking stalls supplied by hotels per room is 0.32044, irrespective of the location of the hotel. In addition to the above, the model also shows that the number of parking stalls at each hotel increases with the number of rooms irrespective of the location of the hotels. The result generalizes the pattern of parking provision by hotels.

From the model it is observed that on the average when X3 = 0 hotels located at the PCBD and OCBD will have 7.1583 stalls and 1.583 stalls respectively, while that of CBD is -6.4652 which indicates the level of inadequacies of parking provision as shown by the negative value. The value elisted above can be taken as the minimum values needed by service vehicles and hotel staff vehicles. These values ought to be provided, even when no patrons are served.

The model shows that the intercept of the CBD line has a negative value of -6.4652. It means that hotels with less than 22 rooms have no parking stalls provisions, while those within the PCBD and OCBD have 13 and 8.5 stalls as the thresholds for parking stalls provision, respectively. This result shows that hotels within the PCBD have more generous parking provisions in terms of number of stalls than those within the CBD. This phenomenon can be attributed to the non-availability of land and even where available the expensive nature of land within the CBD would make purchase of land for parking provision by hotel owners more difficult. The indication is that hotels must reach a certain level of capacity before it becomes worthwhile for them to devote resources to provision of parking facilities. The implication is that patrons of such hotels result to on street parking which is not healthy enough for the free flow of traffic. On the average, a ratio of 0.32 stalls is provided per room in all hotels, irrespective of location.

5.3 Peak Parking Demand / Total Number Of Rooms Model

This model describes the relationship between the peak parking demand and the total number of rooms in the hotels studied, using Fig 4.9 and model no 4 Table 4.1 given as:

$Y_p = 4.01693 - 1.67461X1 + 2.21547X_2 + 0.19920X_3$ .... 5.5)

Y_p = peak parking demand, X_1, X_2 = dummy variables, X_3 = Total number of rooms.

Making use of dummy variables the models will be given as below:

For hotels located in the CBD

$Y_p = 4.01693 - 1.67461 + 0.19920X_3$

$Y_pCBD = 2.3423 + 0.19920X_3$ ------------------------------- (5.6)

For hotels located PCBD

$Y_p = 4.01693 + 2.215470 + 0.19920X_3$

$Y_pPCBD = 6.2324 + 0.19920X_3$ ------------------------------ (5.7)

For hotels located OCBD

$$Y_pOCBD = 4.011693 + 0.19920X_3 \text{ ---------------------------- } (5.8)$$

Fig 4.9 shows that the peak parking demand for hotels increases as expected with increase in the total number of rooms in the hotel. The model shows that the peak parking demand generated by hotels per room is 0.19920 irrespective of the location of the hotel.

From the model it will be observe that the PCBD and OCBD will have a peak parking demand of 6.2324 and 4.01693 vehicles respectively while that of CBD is 2.3423 vehicles. These values are the minimum peak parking demand values that will be generated by hotel staff vehicles and service vehicles. These peak parking demand values are generated even when no patrons are served.

The peak parking demand of hotels within the PCBD is higher than those located within the CBD and OCBD, however hotels located OCBD have higher peak parking demand than those within the CBD.

Using a peak parking demand of 20 vehicles, a hotel with 72 rooms located within the PCBD will generate that peak parking demand, while those located within CBD and OCBD will require 90 and 84 rooms respectively to generate that peak parking demand value. This means that the number of parking spaces per room required by patrons of hotels within the PCBD is higher than OCBD and CBD, that outside the CBD is far higher. This result shows that patrons of hotels in these different zones exhibit slightly different parking demand characteristics. The different parking demand characteristic exhibited by patrons is due to adequacy of parking facilities, and ease of accessibility, as hotels located within the CBD are not easily reached, due to the traffic congestion experienced within the CBD, especially at the 'Bata' area of Kano, while those OCBD are slightly far from the CBD.

5.4 Supply And Demand Aspects Of Parking

Using the number of parking stalls / Total number of rooms model as the supply model, and that of peak parking demand / Total number of rooms model as the Demand side, the following comparison can be made.

5.4.1 Hotels Within The CBD.

$$Y_sCBD(S) = -6.4652 + 0.32044X_3 \quad (5.2)$$

$$Y_pCBD(D) = 2.3423 + 0.19920X_3 \text{ ---------------------------- } (5.6)$$

A comparison of this two models shows that the number of parking stalls per room of 0.32044 provided by hotels in CBD is greater than the peak parking demand value of 0.19920 vehicles. This shows that the peak parking demand value per room is taken care of by the number of stalls supply for the parking. However, the provision for service and staff vehicles is not adequate as shown by the negative value of –6.4652 stalls from the supply side while the provisions required from the Demand side is 2.3432 vehicles.

Fig 4.4 shows that the number of stalls provided by the supply model is not enough for the peak parking demand generated by the demand model at lower number of rooms (i.e. less than 72 rooms) but above 72 rooms, the supply takes care of the Demand. This implies that at less than 72 rooms, it is safer to use the Demand model in the provision of the number of parking stalls, but above 72 rooms it is safer to use the supply model in the provision of parking stalls. This indicates that small hotels with about 72 rooms or less, currently under-provide for parking. A desired situation would be one where provision is made for 3 vehicles for services and staff in addition to an average of 0.32 stalls per room. Beyond

72 rooms, the same rule would be appropriate but the general standard currently in place appears adequate.

5.4.2 Hotels Located At The Periphery of CBD

For hotels located at the PCBD,

$$Y_s PCBD\,(S) = 7.1583 + 0.32044X_3 \text{ -------------------- } (5.3)$$

$$Y_p PCBD\,(D) = 6.2324 + 0.19920X_3 \text{ -------------------- } (5.7)$$

A comparison of the two models shows that the number of parking stalls per room of 0.32044 provided by hotels at the PCBD is greater than the peak parking demand value of 0.19920 vehicles. This shows that the peak parking demand value per room is taken care of by the number of parking stalls supplied for the parking of vehicles.

The number of stalls provided for service and staff vehicles of 7.1583 takes care of the peak parking demand required for service and staff vehicles of 6.2324 vehicles. This shows that the supply aspect adequately takes care of the demand aspect in the case of hotels located at PCBD. This can also be seen from Fig 4.4 as there is no intercept between the supply and demand curve.

5.4.3 Hotels Located Outside The CBD

For hotels located OCBD

$$Ys\ OCBD(S) = 1.5833 + 0.32044X3 \text{ ---------------------------- } (5.4)$$

$$Y_p\ OCBD(D) = 4.01693 + 0.19920X_3 \text{ ------------------------- } (5.8)$$

A comparison of these two models shows that the number of parking stalls per room of 0.32044 provided by hotels OCBD is greater than the peak parking demand value of 0.19920 vehicles. This shows that the peak parking demand value, per room is taken care of by the number of stalls supplied for the parking. However, the provision for service and staff vehicles is not adequate as shown by the value of 1.5833 stalls from the supply side while the provision required from the Demand side is 4.01693 vehicles.

Fig 4.4 shows that the number of stalls provided by the supply model is not enough for the peak parking demand generated by the demand model at lower number of rooms (i.e less than 20 rooms) but above 20 rooms, the supply takes care of the Demand. This implies that at less than 20 rooms it is safer to use the Demand model in the provision of the number of parking stalls, but above 20 rooms it is safer to use the supply model in the provision of parking stalls. This indicates that small hotels with about 20 rooms or less, currently under – provide for parking. A desired situation would be one where provision is made for 5 vehicles for services and staff in addition to an average of 0.32 stalls per room. Beyond 20 rooms the same rule would be appropriate but the general standard currently in place appears adequate.

General Discussions : The supply model for hotels at PCBD adequately takes care of the Demand. In making choice among the formulated models on which to use in the provision of parking stalls for hotels at PCBD, it is what noting the following:

Model (5.3) has an R^2 value of 0.94754 and a standard error of 5.18773, while that of model (5.7) is 0.93920 and a standard error of 3.11212. Using the R^2 value, model 5.3 will be chosen, but on the basis of standard error, model 5.6 will be used, since our interest is in the choice of the model that best describes the situation on ground or on the field, model 5.3 will be recommended for use in the provision of parking stalls for hotels within the PCBD.

For CBD hotels and OCBD hotels since the supply models did not take care of the Demand at all levels of number of rooms, the following modifications are suggested.

Since the supply model is adequate in terms of the number of parking stalls per room and inadequate in terms of provisions for staff and service vehicles, using the models for hotels at PCBD as a guide, since those hotels have adequate parking facilities, and higher level of patronage compared to those of CBD and OCBD. The difference between the service staff vehicles for models of hotels at the PCBD will be used [i.e. 7.1583 – 6.2342) = 0.9259)]. Neglecting the negative value of –6.4652 for models of CBD hotels at the supply side, the modified models below will be obtained.

For hotels at CBD;

$Y_s CBD (S) = 3.2682 + 0.32044X_3$ ------------------------(5.2^I)

$Yp CBD (D) = 2.3423 + 0.19920X_3$ ------------------------(5.6).

For hotels OCBD;

$Y_s OCBD (S) = 4.94283 + 0.32044X_3$ ----------------------(5.4^1)

$Y_s CBD (D) = 4.01693 + 0.19920X_3$ ----------------------(5.8).

The use of the modified models will adequately take care of parking at all levels on number of rooms.

5.5 Peak Parking Demand / Number Of Parking Stalls Model

This is an important model that explains the relationship between the peak parking demand and number of parking stalls in the hotels studied. It shows how observed parking demand appears to have been constrained by the facilities supplied in the hotels studied. The model describing this relationship is model No. 9 Table 4.1 given as

$$Y_p = 3.76266 + 2.78991X_1 - 0.77687X_2 + 0.59605X_3 \text{ -------} \quad (5.9)$$

Y_p = peak parking demand, X_1, X_2, = dummy variables

X_3 = Number of parking stalls.

Introducing the use of dummy variables that accounts for the location of the hotels, the models will be as given below:

$$Y_p = 3.76266 + 2.78991 - 0.77687X_2 + 0.59605X_3$$

$$Y_pCBD = 6.55257 + 0.59605X_3 \text{ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_} (5.10)$$

For hotels located at the PCBD

$$Y_p = 3.7627 - 0.7768 + 0.59605\ X_3$$

$$Y_p\,PCBD = 2.9859 + 0.59605\ X_3 \text{ ---------------------------} (5.11)$$

$Y_p = 6.04132 - 0.13874 + 0.20644X_3$

$Y_p\,CBD = 5.9026 + 0.20644X_3$ ---------------------------- (5.14)

For hotels located at the PCBD;

$Y_p = 6.04132 + 9.61348 + 0.20644X_3$

$Y_p\,PCBD = 15.6548 + 0.20644\ X_3$---------------------------(5.15)

For hotels located OCBD

$Y_p OCBD = 6.04132 + 0.20644\ X_3$------------------------- (5.16)

The model and Fig 4.7 shows that peak parking demand increases with increase in the number of double rooms in a hotel. It is also observed that hotels located within the PCBD have more double rooms than those located within the CBD and OCBD.

The model and Fig 4.7 shows that Peak parking demand increase with increase in the number of double rooms in a hotel. It is also observed that hotels located within the PCBD have more double rooms than those located within the CBD and OCBD.

The model showed that the peak parking demand generated by a hotel having the same number of double rooms located within the PCBD is higher than those of hotels located OCBD and within the CBD. The higher peak parking demand values for hotels within the PCBD could be attributed to more number of double rooms possessed by these hotels. As patronizers of double rooms tends to have more cars than the users of the single rooms. Thus we can conclude that the number of double rooms a hotel possesses affects the peak parking demand it generates.

5.7 Peak Parking Demand/Total Area Covered By Hotels Model

This model describes the relationship between the peak parking demand and the total area covered by hotels, the model is model number 6 Table 4.1 given as

$$Y_p = 11.58758 - 2.89528X_1 - 0.89556X_2 + 3.286967*10^{-3}\ X_3 \quad \text{--- (5.17)}$$

Y_p = Peak Parking demand, X_1, X_2 = dummy variables,

X_3 = Total area covered by hotels (in m^2)

Introducing the dummy variables that takes care of the location of the hotels, the model for hotels at different location are as below:

For hotels located at CBD

$$Y_p = 11.58758 - 2.89528 + 3.286967x10^{-3}X_3$$

$$Y_p\,CBD = 8.6923 + 3.286967x10^{-3}X_3 \text{ ---------------------- (5.18)}$$

For hotels located at PCBP

$Y_p = 11.58758 - 0.89556 + 3.286967x10^{-3}X_3$

$Y_p PCBD = 10.6921 + 3.286967\ x10^{-3}\ X_3$------------------ (5.19)

For hotels located OCBD

$Y_p OCBD = 11.58758 + 3.386967x10^{-3}\ X_3$------------------ (5.20)

Fig 4.6 Shows that the parking demand increases with the total area covered by hotels for the different locations of the hotels, the model shows that the same area of land will generate different peak parking demand going by the location of the hotels. It is observed that hotels OCBD will generate a higher peak parking, followed by those at the PCBD and CBD, this seems so because of the larger area of land occupied by hotels located OCBD. As part of the larger area covered by such hotels are used for the provision of other facilities like swimming pools, courts for games, large conference halls, etc. which are not rooms; these facilities however attract car owners and users to the premises of hotels located OCBD.

The results also seem to indicate that rate of parking generation per unit area devoted to hotel is less for CBD than other locations. This could be simply due to the poor accessibility to CBD's which deters patrons from going with their vehicles to places located within CBD's.

This model is an important model which can be used to determine the peak parking demand values of new hotels to be built, as the total area to be covered by hotels can easily be determined with the aid of building and site survey plans. Since the site plan and building plans are basic requirements for setting up of a building in Nigeria.

In using these models, the model for hotels OCBD is recommended for use in all hotels irrespective of the location of the hotel as hotels OCBD's rate of parking generation per unit area is higher. The model for hotels within CBD should not be used as those hotels gave lower values of peak parking demand.

5.8 Concluding Remarks On The Results

The results presented have clearly established that the number of rooms provided by hotels is a strong influencing factor that determines the extent of peak parking demand generated . A good case has also been established for the provision of some specific number of parking stalls (that depends on the number of rooms contained) being made a requirement in the approval of building plans for use as hotels.

If we illustrate with hotels located in the CBD, the indication is that equation 5.6 gives the parking demand characteristics while equation 5.2 gives the supply characteristics. The indication then is that on the average hotels with less than 72 rooms located within the CBD have inadequate parking provisions, thereby causing parking related problems. In view of this the building of hotels with less than 72 rooms within the CBD should be carefully checked and sanctioned if they have fewer than required parking spaces. Ihe provision of a 0.32 parking stalls per room in addition to 7 stalls is recommended for hotels in Kano metropolis irrespective of the location of the hotel. The use of model No. 5.20 given as:

$$YP\ OCBD = 11.58758 + 3.286767 \times 10^{-3} X_3$$

Where YP = peak parking demand

X_3 = total area covered by hotel. Is recommended for use in the provision of parking stalls, as the peak parking demand obtained from this model serves as a good guide in the provision of parking stalls for hotels the determination of the peak parking demand of new hotels to be built can easily be determined since the total area covered by hotels can be obtained from the site and building plans of the new hotel to be built. The choice of the model for hotels OCBD is because of the higher rate of parking generation per unit area of hotels OCBD compared to those at the PCBD and the CBD.

The models developed above remain valid for as long as the present car ownership rate is maintained. An increase in car ownership rate will require a modification in the possession of cars, as increase in car ownership will directly affect the peak parking demand. In projecting the future ownership rate actual auto ownership rates may be routinely surveyed from time to time so as to establish when substantial changes occur. Other socio – economic indicators with strong influence on auto – ownership rates could also be surveyed for same purpose.

Ultimately, when substantial changes in auto ownership are indicated, a repeat of work done herein may need to be undertaken to establish the new parking characteristics.

Chapter 6

CONCLUSIONS AND RECOMMENDATION

6.1 Conclusions

From the result of the study carried out within the scope of this work, the following conclusions can be drawn:

1. Hotels generate parking, as shown by the parking habit survey results, and the parking generated by hotels varies with the location of the hotel, with reference to the CBD. There appears to be three distinct geographical regions, i.e, the central Business district (CBD), area peripheral to the CBD (PCBD) and area outside the CBD (OCBD) which are in the surburbs.

2. The parking provisions of most hotels within the CBD was inadequate, those OCBD was fairly adequate, while those at the PCBD seems more adequate, than the above mentioned two. The change in the patronage period as the peak parking demand period for hotels within CBD was 7 – 7:30pm when compared to those OCBD and the PCBD, which is between 4:30 – 5pm as shown by the parking habit survey is an indication of accessibility problem faced by patrons of hotels at the CBD.

3: The peak parking demand generated by a hotel increases with the number of rooms in a hotel irrespective of the location of the hotel, however, the peak parking demand of hotels within the PCBD, is higher than those located within the CBD and OCBD, while hotels located OCBD have higher peak parking demand than those within the CBD. This may be due to ease of accessibility and the availability of land at PCBD and OCBD for the provision of more number of rooms and adequate parking facilities.

Peak parking demand in addition to the above mentioned factor increase with the number of double rooms in a hotel, as the patrons of most double rooms are likely to have more cars than patrons of single rooms.

4. Peak parking demand was also found to increase with the total area covered by hotels, as larger area of land covered by hotels are either used for the provisions of more rooms in the hotels and adequate parking facilities or the provision of other facilities like swimming pools, courts for games, which are not necessarily rooms, which are facilities that attracts patrons to the premises of these hotels.

5. The model relating the peak parking demand to the total number of rooms in a hotel shows that the peak parking demand generated by hotels per room is 0.19921, irrespective of the location of the hotels. In addition to this value a peak parking demand values of 2.3423 for CBD, 6.2324 for PCBD and 4.01693 for OCBD hotels are generated, these values are probably generated by service and hotel staff vehicles.

6. The model relating the number of parking stalls provided to the total number of rooms in a hotel shows that the number of parking stalls supplied per room is 0.32044 for all hotels studied. Additional supply of 7.1583 stalls, 1.583 stalls and -6.4652 stalls are supplied by hotels at PCBD OCBD and CBD respectively.

7. On the average the peak parking demand value of 0.19920 generated per hotel room is adequately taken care of by the parking supply of 0.32044 stalls per room. However, the supply provisions for service and staff vehicles for hotels located at the CBD and OCBD appear not to be sufficient to take care of the demand, that of hotels located, at the PCBD, effectively took care of the demand generated by

this hotels, with this development, an average of 0.32 stalls supplied by hotels is adequate and in addition to this, provision should be made for seven (7) stalls to take care of service and staff vehicles. The implementation of this standard as a requirement for approval of building plan used as hotels in Kano should be encouraged.

6.2 Recommendations

1. Before we can effectively tackle our parking problems, there is need for Nigerian standards as regards the number of parking stalls for the use of buildings as hotels. As hotels have been discovered to be one of the elements within the CBD that attracts parking. Since the urban and Regional Development Board in charge of the approval of building plans have no such standards and the Architects that draws these building plans have no such standards, unlike the British and Indian Government which have standards of 0.20 stalls and 0.250 stalls per room respectively. Although models developed in this work indicated that the parking demand per room is 0.19920, and the supply is 0.32 per room, the provision of 0.32 stalls per room and an additional 7 stalls for service and staff vehicles should be adopted for Kano metropolis. Further calibration of the model through similar study in other urban towns in Nigeria will enhance the application of models developed to other locations in Nigeria.

2. The location of hotels in the CBD should be regulated through the strict enforcement of the requirement of a given number of parking

stalls (possibly the value in 1 above) for the approval of building plans in Kano. However for hotel owners who will want to make provision for parking, the following off-street parking facilities are recommended based on the Economic implications

(i) The acquisition of land within the neighbourhood of the hotel, to enable them provide adequate parking,

(ii) The use of the Roof of buildings to provide Roof parks.

(iii) Private individuals should be encouraged to build multi – storey car parks, mechanical car parks or under ground car parks near hotels so that patrons of such parks can be charged.

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APPENDIX A

```
-----------------------------------------------------------------------
Page    2                               SPSS/PC+
6/13/98

DATA LIST FILE 'A:\JOEL1.DAT' FIXED / Item 1-6 (A) Sn 8-9 x1 11 x2 13
x3 15-17
 y 19-22.
-----------------------------------------------------------------------

SAVE /OUTFILE 'a:\joel.sys' /COMPRESSED.
The raw data or transformation pass is proceeding
    100 cases are written to the uncompressed active file.
The SPSS/PC+ system file is written to
    file a:\joel.sys
      9 variables (including system variables) will be saved.
      0 variables have been dropped.

The system file consists of:

         432 Characters for the header record.
         288 Characters for variable definition.
          16 Characters for labels.
        2768 Characters for data.
        3504 Total file size.

    100 out of    100 cases have been saved.

-----------------------------------------------------------------------
REGRESSION OF NUMBER OF DOUBLE ROOMS ON TOTAL NUMBER OF ROOMS.
PROCESS IF (Item EQ 'ROOMS ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

         * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

            Mean  Std Dev  Label
X1          .650     .489
X2          .150     .366
X3        63.700   51.737
Y         41.450   42.647

N of Cases =     20

Correlation:

                  X1          X2          X3           Y
X1             1.000       -.572       -.547       -.549
X2             -.572       1.000        .505        .332
X3             -.547        .505       1.000        .922
Y              -.549        .332        .922       1.000
-----------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R           .92152
R Square             .84921
```

```
Adjusted R Square     .84083
Standard Error      17.01459

Analysis of Variance
                   DF        Sum of Squares      Mean Square
Regression          1          29346.01518       29346.01518
Residual           18           5210.93482         289.49638

F =      101.36920        Signif F =  .0000
----------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B         SE B        Beta          T  Sig T
X3               .75962       .07545      .92152     10.068  .0000
(Constant)     -6.93754      6.12961                 -1.132  .2726

------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler          T  Sig T
X1          -.06475  -.13960     .70086       -.581  .5687
X2          -.17875  -.39728     .74487     -1.785  .0921

End Block Number   1    PIN =      .050 Limits reached.
----------------------------------------------------------------------

Beginning Block Number  2.  Method:  Enter
Equation Number 1     Dependent Variable..   Y

Variable(s) Entered on Step Number
   2..     X2
   3..     X1

Multiple R            .94318
R Square              .88959
Adjusted R Square     .86889
Standard Error      15.44231

Analysis of Variance
                   DF        Sum of Squares      Mean Square
Regression          3          30741.51239       10247.17080
Residual           16           3815.43761         238.46485

F =       42.97141        Signif F =  .0000
----------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B         SE B        Beta          T  Sig T
X3               .78593       .08519      .95345      9.225  .0000
X2            -28.61594     12.28460     -.24582     -2.329  .0333
X1            -14.69720      9.48088     -.16864     -1.550  .1406
(Constant)      5.23168     10.52749                   .497  .6260

End Block Number   2   All requested variables entered.
----------------------------------------------------------------------
REGRESSION OF NUMBER OF STAFF ON TOTAL NUMBER OF ROOMS.
PROCESS IF (Item EQ 'STAFF ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.
```

```
     * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

          Mean  Std Dev  Label
X1        .650     .489
X2        .150     .366
X3      63.700   51.737
Y       63.050   81.926

N of Cases =    20

Correlation:

              X1         X2         X3         Y
X1         1.000      -.572      -.547      -.710
X2         -.572      1.000       .505       .519
X3         -.547       .505      1.000       .850
Y          -.710       .519       .850      1.000
------------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R            .84968
R Square              .72196
Adjusted R Square     .70652
Standard Error      44.38253

Analysis of Variance
                     DF       Sum of Squares      Mean Square
Regression            1        92068.38309      92068.38309
Residual             18        35456.56691       1969.80927

F =      46.73974        Signif F =  .0000
------------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B          SE B        Beta          T  Sig T
X3              1.34547        .19680      .84968      6.837  .0000
(Constant)    -22.65659      15.98907                 -1.417  .1736

------------- Variables not in the Equation -------------

Variable      Beta In  Partial  Min Toler          T  Sig T
X1            -.34963  -.55510     .70086     -2.752  .0136
X2             .12032   .19694     .74487       .828  .4190
------------------------------------------------------------------------

Variable(s) Entered on Step Number
   2..    X1

Multiple R            .89869
R Square              .80764
Adjusted R Square     .78501
Standard Error      37.98692

Analysis of Variance
                     DF       Sum of Squares      Mean Square
```

```
Regression           2        102993.85288      51496.92644
Residual            17         24531.09712       1443.00571

F =      35.68726       Signif F =  .0000
------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T
X3              1.04267      .20120     .65846     5.182  .0001
X1            -58.53257    21.27216    -.34963    -2.752  .0136
(Constant)     34.67802    24.92893                1.391  .1821

------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler         T  Sig T

X2           -.02250  -.04038     .58306     -.162  .8736

End Block Number   1   PIN =     .050 Limits reached.
------------------------------------------------------------------

Beginning Block Number  2.  Method:  Enter

Variable(s) Entered on Step Number
   3..    X2

Multiple R           .89886
R Square             .80795
Adjusted R Square    .77194
Standard Error     39.12408

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           3        103033.85442      34344.61814
Residual            16         24491.09558       1530.69347

F =      22.43729       Signif F =  .0000
------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T
X3              1.05243      .21584     .66462     4.876  .0002
X1            -60.12453    24.02042    -.35914    -2.503  .0235
X2             -5.03138    31.12383    -.02250     -.162  .8736
(Constant)     35.84580    26.67206                1.344  .1977


End Block Number   2   All requested variables entered.
------------------------------------------------------------------
REGRESSION OF NUMBER OF PARKING STORES ON TOTAL NUMBER OF ROOMS.
PROCESS IF (Item EQ 'STALLS').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

            Mean  Std Dev  Label
X1          .650     .489
```

X2	.150	.366
X3	63.700	51.737
Y	17.600	20.786

N of Cases = 20

Correlation:

	X1	X2	X3	Y
X1	1.000	-.572	-.547	-.682
X2	-.572	1.000	.505	.610
X3	-.547	.505	1.000	.951
Y	-.682	.610	.951	1.000

Equation Number 1 Dependent Variable.. Y
Beginning Block Number 1. Method: Stepwise

Variable(s) Entered on Step Number
1.. X3

Multiple R	.95087
R Square	.90415
Adjusted R Square	.89883
Standard Error	6.61136

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	7422.01843	7422.01843
Residual	18	786.78157	43.71009

F = 169.80104 Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
X3	.38202	.02932	.95087	13.031	.0000
(Constant)	-6.73436	2.38178		-2.827	.0112

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
X1	-.23102	-.62471	.70086	-3.299	.0042
X2	.17363	.48403	.74487	2.281	.0357

Variable(s) Entered on Step Number
2.. X1

Multiple R	.97034
R Square	.94156
Adjusted R Square	.93468
Standard Error	5.31217

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	7729.07403	3864.53702
Residual	17	479.72597	28.21917

F = 136.94720 Signif F = .0000

```
------------------ Variables in the Equation ------------------

Variable              B          SE B       Beta          T  Sig T
X3               .33125        .02814     .82452     11.773  .0000
X1             -9.81264       2.97474    -.23102     -3.299  .0042
(Constant)      2.87745       3.48611                  .825  .4206


------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler         T  Sig T
X2            .09827   .32000     .58306     1.351  .1955

End Block Number   1    PIN =      .050 Limits reached.
--------------------------------------------------------------------

Beginning Block Number  2.  Method:  Enter

Variable(s) Entered on Step Number
   3..    X2

Multiple R           .97342
R Square             .94754
Adjusted R Square    .93771
Standard Error      5.18773

Analysis of Variance
                    DF      Sum of Squares       Mean Square
Regression           3          7778.19929        2592.73310
Residual            16           430.60071          26.91254

F =      96.33920       Signif F =  .0000
--------------------------------------------------------------------

------------------ Variables in the Equation ------------------

Variable              B          SE B       Beta          T  Sig T
X3               .32044        .02862     .79760     11.196  .0000
X1             -8.04846       3.18503    -.18949     -2.527  .0224
X2              5.57573       4.12692     .09827      1.351  .1955
(Constant)      1.58333       3.53663                  .448  .6604


End Block Number   2   All requested variables entered.
--------------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON TOTAL NUMBER OF ROOMS.
PROCESS IF (Item EQ 'PEAK  ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

            Mean  Std Dev  Label
X1          .650     .489
X2          .150     .366
X3        63.700   51.737
Y         15.950   11.583

N of Cases =     20
```

Correlation:

	X1	X2	X3	Y
X1	1.000	-.572	-.547	-.598
X2	-.572	1.000	.505	.560
X3	-.547	.505	1.000	.964
Y	-.598	.560	.964	1.000

Equation Number 1   Dependent Variable.. Y
Beginning Block Number 1. Method: Stepwise

Variable(s) Entered on Step Number
1..   X3

Multiple R	.96390
R Square	.92910
Adjusted R Square	.92516
Standard Error	3.16857

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	2368.23246	2368.23246
Residual	18	180.71754	10.03986

F =   235.88294   Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
X3	.21579	.01405	.96390	15.358	.0000
(Constant)	2.20417	1.14150		1.931	.0694

------------ Variables not in the Equation ------------

Variable	Beta In	Partial	Min Toler	T	Sig T
X1	-.10037	-.31557	.70086	-1.371	.1881
X2	.09821	.31833	.74487	1.385	.1841

End Block Number 1   PIN =   .050 Limits reached.

Beginning Block Number 2. Method: Enter
Equation Number 1   Dependent Variable..   Y

Variable(s) Entered on Step Number
2..   X2
3..   X1

Multiple R	.96913
R Square	.93920
Adjusted R Square	.92781
Standard Error	3.11212

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	2393.98496	797.99499
Residual	16	154.96504	9.68531

F =   82.39226   Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
X3	.19920	.01717	.88981	11.602	.0000
X2	2.21547	2.47574	.07007	.895	.3841
X1	-1.67461	1.91070	-.07075	-.876	.3938
(Constant)	4.01693	2.12163		1.893	.0765

End Block Number 2 All requested variables entered.

FINISH.

```
DATA LIST FILE 'JOEL.DAT' FIXED / Item 1-6 (A) Sn 8-9 x1 11 x2 13 x3
15-19 y
 21-25.
```

```
SAVE /OUTFILE 'joel.sys'.
The raw data or transformation pass is proceeding
    100 cases are written to the uncompressed active file.
The SPSS/PC+ system file is written to
    file joel.sys
      9 variables (including system variables) will be saved.
      0 variables have been dropped.

The system file consists of:

         432 Characters for the header record.
         288 Characters for variable definition.
          16 Characters for labels.
        7680 Characters for data.
        8416 Total file size.

    100 out of     100 cases have been saved.
REGRESSION OF TOTAL AREA COVERED BY HOTEL ON TOTAL NUMBER OF ROOMS.
```

```
PROCESS IF (Item EQ 'AREA  ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.
```

* * * * M U L T I P L E R E G R E S S I O N * * * *

Listwise Deletion of Missing Data

	Mean	Std Devi	Label
X1	.650	.489	
X2	.150	.366	
X3	63.700	51.737	
Y	1940.600	3204.843	

N of Cases = 20

Correlation:

	X1	X2	X3	Y
X1	1.000	-.572	-.547	-.540
X2	-.572	1.000	.505	.570
X3	-.547	.505	1.000	.941
Y	-.540	.570	.941	1.000

Equation Number 1 Dependent Variable.. Y
Beginning Block Number 1. Method: Stepwise

Variable(s) Entered on Step Number
   1.. X3

Multiple R	.94062
R Square	.88476
Adjusted R Square	.87836

```
Standard Error    1117.76348

Analysis of Variance
                     DF      Sum of Squares      Mean Square
Regression            1     172660297.30147  172660297.30147
Residual             18      22489113.49853    1249395.19436

F =      138.19510       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B          SE B       Beta         T  Sig T

X3             58.26607       4.95644     .94062    11.756  .0000
(Constant)  -1770.94886     402.68099               -4.398  .0003

------------- Variables not in the Equation -------------

Variable      Beta In  Partial  Min Toler         T  Sig T

X1           -.03692  -.09104     .70086      -.377  .7109
X2            .12726   .32354     .74487      1.410  .1766

End Block Number   1   PIN =      .050 Limits reached.
---------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  2.  Method:  Enter

Variable(s) Entered on Step Number
   2..     X2
   3..     X1

Multiple R           .94713
R Square             .89706
Adjusted R Square    .87776
Standard Error    1120.49544

Analysis of Variance
                     DF      Sum of Squares      Mean Square
Regression            3     175061250.29080   58353750.09693
Residual             16      20088160.50920    1255510.03183

F =       46.47812       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B          SE B       Beta         T  Sig T
X3             54.71895       6.18164     .88335     8.852  .0000
X2           1183.83569     891.37214     .13532     1.328  .2028
X1            132.79897     687.93354     .02028      .193  .8494
(Constant)  -1808.89179     763.87550               -2.368  .0308

End Block Number   2   All requested variables entered.
---------------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON TOTAL AREA COVERED BY HOTEL.
PROCESS IF (Item EQ 'AREA2 ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
```

```
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

              Mean  Std Devi  Label
X1            .650      .489
X2            .150      .366
X3        1940.600  3204.843
Y           15.950    11.583

N of Cases =    20

Correlation:

                X1          X2          X3          Y
X1           1.000       -.572       -.540       -.598
X2           -.572       1.000        .570        .560
X3           -.540        .570       1.000        .959
Y            -.598        .560        .959       1.000

------------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R            .95944
R Square              .92053
Adjusted R Square     .91612
Standard Error       3.35460

Analysis of Variance
                     DF      Sum of Squares      Mean Square
Regression            1          2346.39004       2346.39004
Residual             18           202.55996         11.25333

F =      208.50627       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta          T  Sig T

X3          3.467500E-03 2.40136E-04     .95944     14.440  .0000
(Constant)       9.22097      .88308                10.442  .0000

------------- Variables not in the Equation -------------

Variable      Beta In  Partial  Min Toler          T  Sig T

X1           -.11174  -.33354     .70804    -1.459  .1629
X2            .01960   .05713     .67521      .236  .8163

End Block Number   1   PIN =     .050 Limits reached.
------------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  2.  Method:  Enter
```

```
Variable(s) Entered on Step Number
   2..    X1
   3..    X2

Multiple R           .96428
R Square             .92984
Adjusted R Square    .91668
Standard Error      3.34334

Analysis of Variance
                     DF      Sum of Squares      Mean Square
Regression            3          2370.10370        790.03457
Residual             16           178.84630         11.17789

F =       70.67830         Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable                  B         SE B        Beta         T  Sig T
X3             3.286967E-03 3.07176E-04      .90949    10.701  .0000
X1                 -2.89528      2.01610    -.12233    -1.436  .1702
X2                  -.89556      2.75778    -.02833     -.325  .7496
(Constant)         11.58758      1.87820                 6.170  .0000

End Block Number   2   All requested variables entered.
------------------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON NUMBER OF DOUBLE ROOMS.
PROCESS IF (Item EQ 'ROOMS ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

         * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

            Mean  Std Dev  Label
X1          .650     .489
X2          .150     .366
X3        41.450   42.647
Y         15.950   11.583

N of Cases =     20

Correlation:

                 X1          X2          X3          Y
X1            1.000       -.572       -.549      -.598
X2            -.572       1.000        .332       .560
X3            -.549        .332       1.000       .864
Y             -.598        .560        .864      1.000

------------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R           .86438
```

```
Variable(s) Entered on Step Number
   2..    X1
   3..    X2

Multiple R           .96428
R Square             .92984
Adjusted R Square    .91668
Standard Error      3.34334

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           3          2370.10370        790.03457
Residual            16           178.84630         11.17789

F =      70.67830        Signif F =  .0000


------------------ Variables in the Equation ------------------

Variable              B        SE B        Beta          T  Sig T
X3          3.286967E-03 3.07176E-04     .90949     10.701  .0000
X1              -2.89528     2.01610    -.12233     -1.436  .1702
X2               -.89556     2.75778    -.02833      -.325  .7496
(Constant)      11.58758     1.87820                  6.170  .0000

End Block Number   2   All requested variables entered.
--------------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON NUMBER OF DOUBLE ROOMS.
PROCESS IF (Item EQ 'ROOMS ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

             Mean  Std Dev  Label
X1           .650     .489
X2           .150     .366
X3         41.450   42.647
Y          15.950   11.583

N of Cases =    20

Correlation:

               X1          X2          X3          Y
X1          1.000       -.572       -.549      -.598
X2          -.572       1.000        .332       .560
X3          -.549        .332       1.000       .864
Y           -.598        .560        .864      1.000

--------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R           .86438
```

```
R Square                .74715
Adjusted R Square       .73310
Standard Error         5.98379

Analysis of Variance
                     DF       Sum of Squares       Mean Square
Regression            1           1904.44599        1904.44599
Residual             18            644.50401          35.80578

F =       53.18823        Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable                B          SE B        Beta         T  Sig T

X3                .23476        .03219      .86438     7.293  .0000
(Constant)       6.21937       1.88957                 3.291  .0041


------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler          T  Sig T

X1          -.17567  -.29191     .69817    -1.258  .2253
X2           .30664   .57515     .88956     2.899  .0100
----------------------------------------------------------------------
Variable(s) Entered on Step Number
   2..    X2

Multiple R              .91148
R Square                .83079
Adjusted R Square       .81088
Standard Error         5.03695

Analysis of Variance
                     DF       Sum of Squares       Mean Square
Regression            2           2117.64559        1058.82280
Residual             17            431.30441          25.37085

F =       41.73384        Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable                B          SE B        Beta         T  Sig T

X3                .20708        .02873      .76248     7.208  .0000
X2               9.69471       3.34433      .30664     2.899  .0100
(Constant)       5.91231       1.59410                 3.709  .0017


------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler          T  Sig T

X1       -5.862E-03  -.01035     .52727     -.041  .9675

End Block Number   1   PIN =     .050 Limits reached.
----------------------------------------------------------------------

Equation Number 1    Dependent Variable..   Y
Beginning Block Number  2.  Method:  Enter
```

```
Variable(s) Entered on Step Number
   3..    X1

Multiple R            .91149
R Square              .83081
Adjusted R Square     .79909
Standard Error       5.19169

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           3          2117.69177        705.89726
Residual            16           431.25823         26.95364

F =      26.18931        Signif F =  .0000

----------------- Variables in the Equation -----------------

Variable              B         SE B        Beta         T  Sig T
X3              .20644       .03344      .76011     6.174  .0000
X2             9.61348      3.96656      .30407     2.424  .0276
X1             -.13874      3.35187 -5.862E-03      -.041  .9675
(Constant)     6.04132      3.52331                 1.715  .1057

End Block Number   2   All requested variables entered.
-----------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON NUMBER OF STAFF.
PROCESS IF (Item EQ 'STAFF ').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

            Mean  Std Dev  Label
X1          .650     .489
X2          .150     .366
X3        63.050   81.926
Y         15.950   11.583

N of Cases =    20

Correlation:

               X1         X2         X3          Y
X1          1.000      -.572      -.710      -.598
X2          -.572      1.000       .519       .560
X3          -.710       .519      1.000       .901
Y           -.598       .560       .901      1.000
-----------------------------------------------------------------
Equation Number 1    Dependent Variable..   Y
Beginning Block Number  1.  Method:  Stepwise

Variable(s) Entered on Step Number
   1..    X3

Multiple R            .90065
R Square              .81117
Adjusted R Square     .80068
Standard Error       5.17108
```

```
Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           1          2067.62887       2067.62887
Residual            18           481.32113         26.74006

F =       77.32326       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B          SE B        Beta          T  Sig T

X3               .12733        .01448      .90065      8.793  .0000
(Constant)      7.92170       1.47328                  5.377  .0000


------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler        T  Sig T

X1            .08406   .13627     .49624     .567  .5780
X2            .12693   .24971     .73084    1.063  .3025

End Block Number   1   PIN =      .050 Limits reached.
------------------------------------------------------------------------
Equation Number 1    Dependent Variable..  Y
Beginning Block Number  2.  Method:  Enter

Variable(s) Entered on Step Number
   2..    X2
   3..    X1

Multiple R            .91289
R Square              .83336
Adjusted R Square     .80212
Standard Error       5.15240

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           3          2124.19451        708.06484
Residual            16           424.75549         26.54722

F =       26.67190       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B          SE B        Beta          T  Sig T
X3               .13032        .02088      .92178      6.241  .0000
X2              5.37385       4.01202      .16997      1.339  .1991
X1              3.64543       3.64498      .15402      1.000  .3321
(Constant)      4.55769       3.65628                  1.247  .2305


End Block Number   2   All requested variables entered.
------------------------------------------------------------------------
REGRESSION OF PEAK PARKING DEMAND ON NUMBER OF PARKING STALLS.
PROCESS IF (Item EQ 'STALLS').
REGRESSION /VARIABLES X1 X2 X3 Y /DESCRIPTIVES DEFAULT /DEPENDENT Y
/METHOD
STEPWISE /METHOD ENTER.

        * * * *   M U L T I P L E   R E G R E S S I O N   * * * *
```

Listwise Deletion of Missing Data

	Mean	Std Dev	Label
X1	.650	.489	
X2	.150	.366	
X3	17.600	20.786	
Y	15.950	11.583	

N of Cases = 20

Correlation:

	X1	X2	X3	Y
X1	1.000	-.572	-.682	-.598
X2	-.572	1.000	.610	.560
X3	-.682	.610	1.000	.974
Y	-.598	.560	.974	1.000

Equation Number 1 Dependent Variable.. Y
Beginning Block Number 1. Method: Stepwise

Variable(s) Entered on Step Number
1.. X3

Multiple R	.97428
R Square	.94922
Adjusted R Square	.94640
Standard Error	2.68161

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	2419.51120	2419.51120
Residual	18	129.43880	7.19104

F = 336.46173 Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
X3	.54291	.02960	.97428	18.343	.0000
(Constant)	6.39487	.79430		8.051	.0000

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
X1	.12507	.40593	.53491	1.831	.0846
X2	-.05397	-.18986	.62836	-.797	.4363

End Block Number 1 PIN = .050 Limits reached.

Equation Number 1 Dependent Variable.. Y
Beginning Block Number 2. Method: Enter

Variable(s) Entered on Step Number

```
   2..     X2
   3..     X1

Multiple R           .97874
R Square             .95794
Adjusted R Square    .95005
Standard Error      2.58860

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           3         2441.73637        813.91212
Residual            16          107.21363          6.70085

F =      121.46398       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T
X3               .59605      .04197    1.06964    14.202  .0000
X2              -.77687     2.12407    -.02457     -.366  .7193
X1              2.78991     1.72346     .11787     1.619  .1250
(Constant)      3.76266     1.76236                2.135  .0486

End Block Number   2   All requested variables entered.
--------------------------------------------------------------------
FINISH.
```