THE IMPACT OF VIEW AND ACCESSIBILITY AMENITIES ON HIGH-RISE RESIDENTIAL PROPERTIES IN THE CITY OF DHAKA: A HEDONIC PRICING MODEL

A Thesis

by

FARHANA YASMIN

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Chair of Committee,	Mohammed E. Haque
Committee Members,	Zofia Rybkowski
	Geoffrey Booth
Head of Department,	Joe Horlen

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ABSTRACT

The value of residential properties apparently depends on a number of variables such as the size of the property, number of rooms, types of construction materials used, etc. However, the external attributes, for instance, value of view and accessibility amenities associated with housing, also play important roles when determining the price of real estate. This paper examines how view and accessibility amenities impact the value of high-rise residential properties in the densely inhabited city of Dhaka. The hedonic pricing method is used here to measure these external benefits. This study explores whether view and accessibility amenities are calculated into property prices. It also investigates all the main variables in order to explain the benefits of view and accessibility amenities in hedonic pricing studies. Four residential areas (Dhanmondi, Gulshan, Mirpur, and Uttara) have been selected for the study. The data on consumer's preferred areas for purchasing flats is collected by Real Estate and Housing Association of Bangladesh. Sales data for all of the one hundred and seventy-five (175) apartments were collected from four case study zones (approx. 40 apartments per zone) through property sale advertisements published on real estate websites. Apartment characteristics, view amenities and location variables were used as independent variables. Validity of data (location verification) was verified by using geo-browsers such as Google Map, Google Earth and Street-view. Walking distance was used to measure the travel distance as traffic is unpredictable in the city due to heavy congestion.

Findings revealed that view and accessibility amenities are usually an appreciated environmental attribute and property prices also reflect their benefits. Price of apartments increases due to the proximity of park, green areas, water bodies or open spaces. Similarly, there is a positive relationship between apartment price and accessibility to location variables such as reputed school, market and central business district. However, the data analysis shows that there are negligible impacts of those

amenities on property price in the newly developed area, Uttara. The findings can be effortlessly utilized by developers as well as clients to determine the value of property before any investment.

DEDICATION

To my sister,
Antora Mehrukh Azad

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All work for the thesis was completed by the student, under the advisement of Dr. Mohammed E. Haque of the Department of Construction Science.

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NOMENCLATURE

CBD	Central Business District
HPM	Hedonic Pricing Method
SFT	Square Foot
UNDESA	United Nations Department for Economic and Social Affairs
approx.	Approximately

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1. INTRODUCTION

As in many developing nations, the annual urban population growth rate in Bangladesh is greater than its national population growth rate. The annual average urbanization rate is 3.6, which is greater than the annual average population growth rate 1.2 (UN data, 2016). However, the population growth rate in urban areas is not uniform among all the cities. Mohammad A. Mabud, in a Seminar on Bangladesh Population Prospects and Problems at North South University, Dhaka in 2008, estimated the present growth rate of Dhaka city is 5% (Parvin, 2013). Figure 1 shows the population growth rate of Bangladesh, its urban areas and Dhaka city from 1951 to 2011.

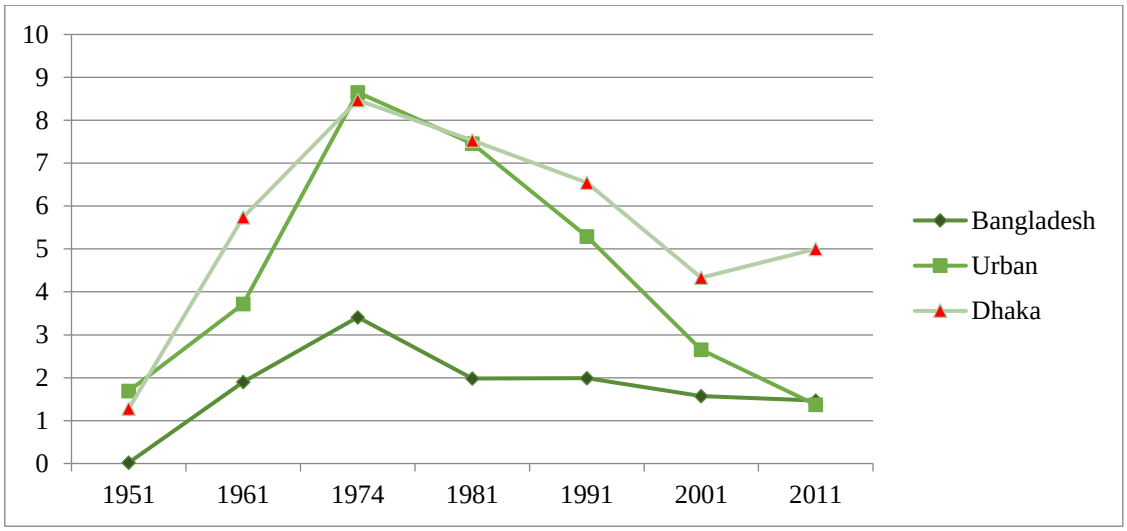


Figure 1: Population growth rate from 1951-2011. (Source: Statistics, 2011; Statistics, 2015; Parvin, 2013)

The highlights of UNDESA (2014) stated that some cities have high average population densities (for example, Dhaka, in Bangladesh) while others are spread out over a broad territory or around multiple disparate hubs. Again, the revision report of UNDESA (2014) projected that Dhaka would become the sixth most crowded city in the world by 2030 with a population of over 27.4 million. According to Dewan & Yamaguchi (2009), it is going to be the world's third largest city by 2020. Therefore, the growing urban

population is creating an increasing demand for space. As stated by Choudhury et al. (1993), in a fast-growing metropolis like Dhaka where, land is scarce and land value is high, there is no other obvious option than to go for tall structures. As a result, the city clearly needs to grow faster vertically than horizontally because of land scarcity on the city area. This observation supported by Ahamed (2014), who claims the real estate market is especially concentrated in apartment projects. The trend of building single-family homes in Dhaka is disappearing; currently the most common domicile is a unit in a high-rise apartment (Figure 2).

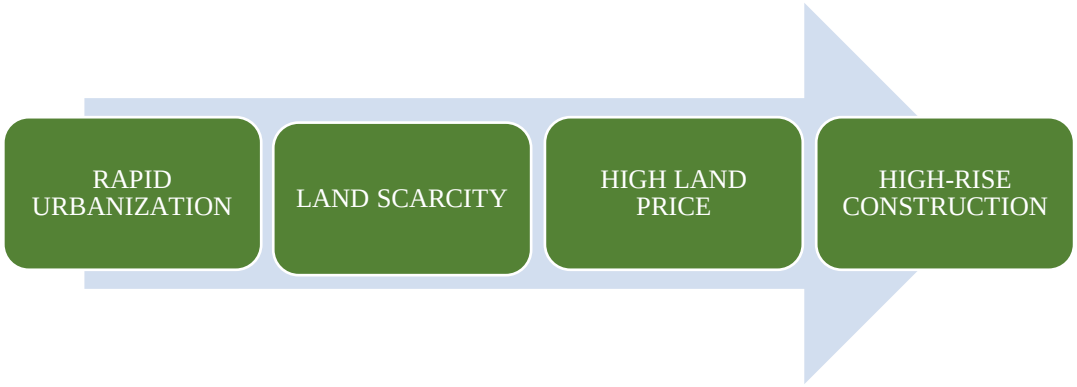


Figure 2: Diagram showing cause of current housing situation in Dhaka

Dhaka is presently experiencing a real estate boom where demand for high-rise apartments is very high. The rising income level of dwellers is encouraging real-estate investment. In addition, foreign remittance has become a major source of funds to purchase any real estate property along with personal and family savings, and bank loans (Dewri et al., 2012). Due to the heightened demand for real estate, the cost to own or rent an apartment is rising.

In the real estate sector, the market structure is highly segmented, primarily based on location, price of the land and size of the apartments (Ahamed, 2014). However, apart from these three, there are other variables that indirectly impact costs of housing. These

variables need to be addressed by each of the parties involved: real estate authorities, developers and buyers.

House prices are affected by many factors: number of rooms, access to workplace, size of garden, location etc. One important factor is local environmental quality, for example, view or access to a wooded park or watercourse (Liu & Hite, 2013). The association of these "external" amenities with housing price can be determined by using the hedonic pricing method. The hedonic pricing method is based on the idea that properties are not homogenous and can differ with respect to a variety of characteristics.

The use of hedonic analysis facilitates the separation of implicit values attributable to a particular real estate variable. Hedonic analysis has been used extensively in housing market research for estimating the demand for housing attributes, constructing constant-quality housing price indices, analyzing the impact of neighborhood externalities on house prices, and estimating the benefits of public investment programs (Taibah, 2003).
A number of studies are available on estimating real estate values through the hedonic pricing model. Some of the following research articles have identified impact of specific amenities: urban forests (Tyrväinen, 1997), urban park (Kitchen, & Hendon,1967; Harnik, & Welle, 2009), gatedness, level of amenity and proximity to park (Taibah, 2003), open space (Shultz, & King, 2001), views of ocean, lake and mountain (Benson, Hansen, Schwartz, & Smersh, 1998; Lansford & Jones, 1995), proximity to primary schools (Rosiers, Lagana, & Theriault, 2001; Gibbons, & Machin, 2004) and secondary schools (Leech, & Campos, 2003; Rosenthal, 2003), distance from Central Business District or CBD (Ottensmann, Payton, & Man, 2008; Bartholomew, & Ewing, 2011), various sizes of shopping centers (Sirpal, 1994; Rosiers, Lagana, Thériault, & Beaudoin,1996), and proximity to a golf course (Owusu-Edusei, & Espey, 2003; Nicholls, & Crompton, 2007; Ladd, & Buco, 2015), etc. However, there has been insufficient research on the effect of different amenities on housing costs in Dhaka city.

2. PROBLEM AND ITS SETTING

2.1. Problem Statement

The purpose of this study is to determine the value of view amenities and accessibility based on location variables of multistoried apartments in the city of Dhaka using the hedonic pricing method (HPM).

2.2. Research Objective

The purpose of the investigation is:
(1) To identify the impact of view amenities on housing costs.
(2) To identify the impact of location variables on housing costs.
(3) To determine whether the view amenity and accessibility benefits are considered when costing multistoried apartments.

2.3. Hypotheses

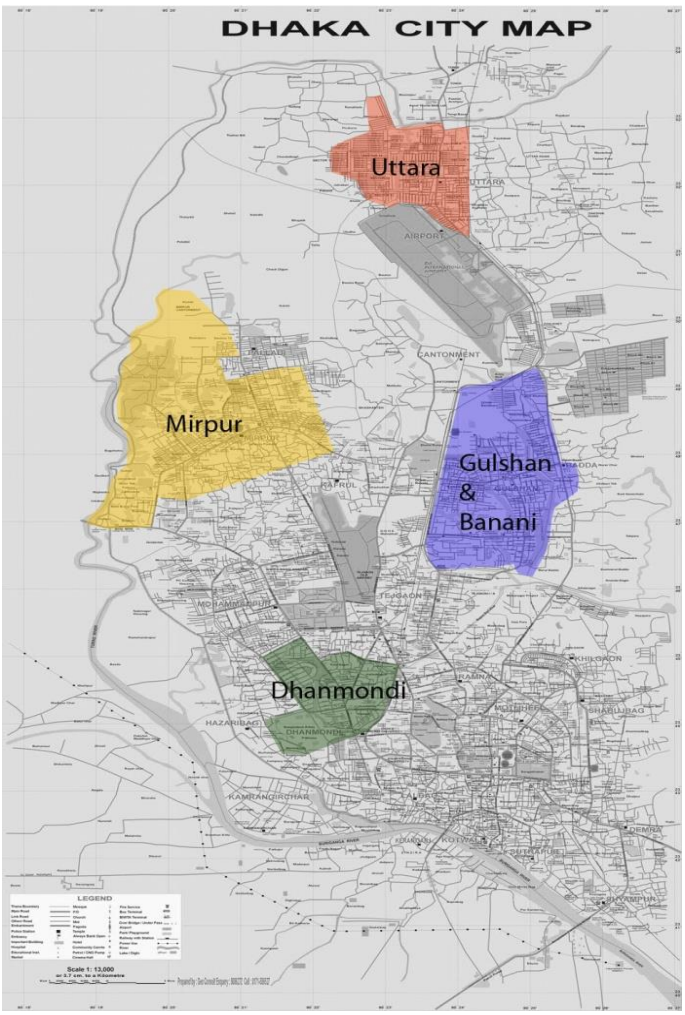
Values of residential properties increase due to the level of ease of access to amenities.

2.4. Delimitations of the Study

1. The research was confined only to four residential areas (Dhanmondi, Gulshan, Mirpur, and Uttara) of the city of Dhaka, Bangladesh.
2. The study was confined to residential apartments six to ten floors high.
3. The study was limited to cost impact of proximity to view amenities such as green areas, lakes, parks and open spaces.
4. The study was limited to cost impact of accessibility to location variables such as schools, shopping areas and CBD (i.e., banks, offices).

2.5. Area of the Study

To focus effectively on residential high-rises in Dhaka, the city was divided into four parts of distinctive real estate markets. In Figure 3, the Dhaka city map shows four case study zones in four different colors. Figures 4(A), 4(B), 4(C) and 4(D) show Dhanmondi, Gulshan, Mirpur and Uttara areas respectively. The driving principle is to select four residential areas from the four corners of the city with unique sets of residents and real estate trends.



Location	Area
North	Uttara
South	Dhanmondi
East	Gulshan & Banani
West	Mirpur

Figure 3: Study areas on the map of Dhaka city. (Source: RAJUK website)

Figure 4(A): Area map of Dhanmondi

Figure 4(B): Area map of Gulshan

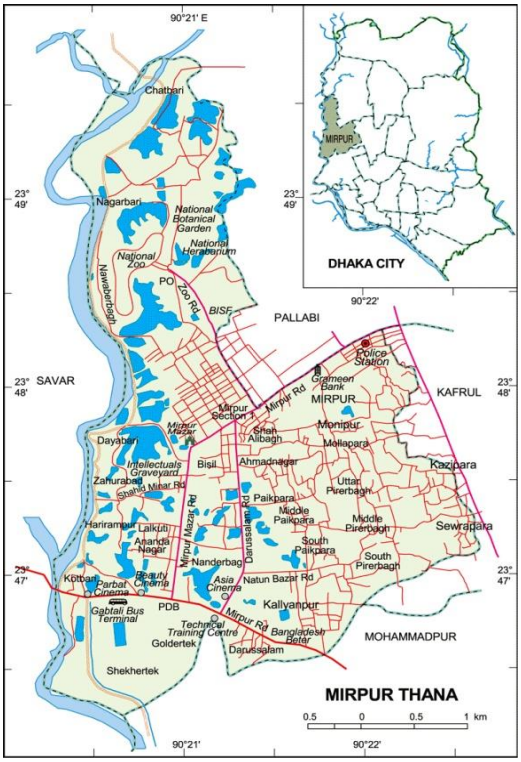


Figure 4(C): Area map of Mirpur

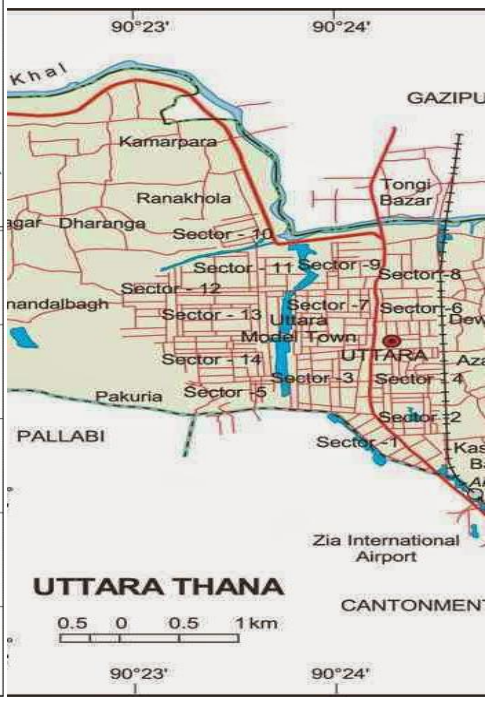


Figure 4(D): Area map of Uttara

2.6. Prototype Buildings of Study Areas

The typical buildings in the study areas are 8-10 floors high and are in locales of various population density (see Figure 5). Some buildings are located in crowded areas (see Figure 6), while other buildings are not so cramped together (see Figure 7). Some buildings have adjacent open spaces offering lake-view (see Figure 8), park-view (see Figure 9), or open areas (see Figure 10) while others do not get any view amenities (see Figure 11). Similarly, access to reputed schools, CBD, hospital, transportation service, etc. is easier in only a handful of residential areas.

Figure 5: Aerial views of study areas. (Source: personal photograph)

Figure 6: View of congested setup. (Source: personal photograph)

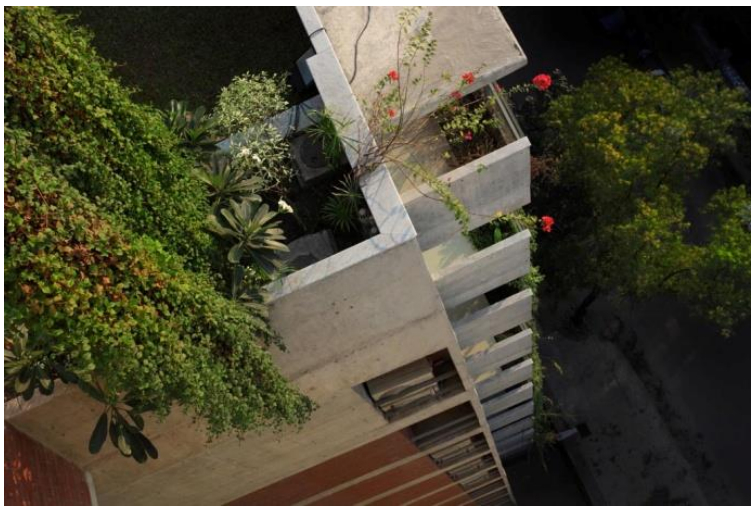


Figure 7: View of moderate distance from the next building, (Source: personal photograph)

Figure 8 : Buildings with lake-view. (Source: personal photograph)

Figure 9: Buildings with park-view. (Source: personal photograph)

Figure 10: Buildings with open space. (Source: personal photograph)

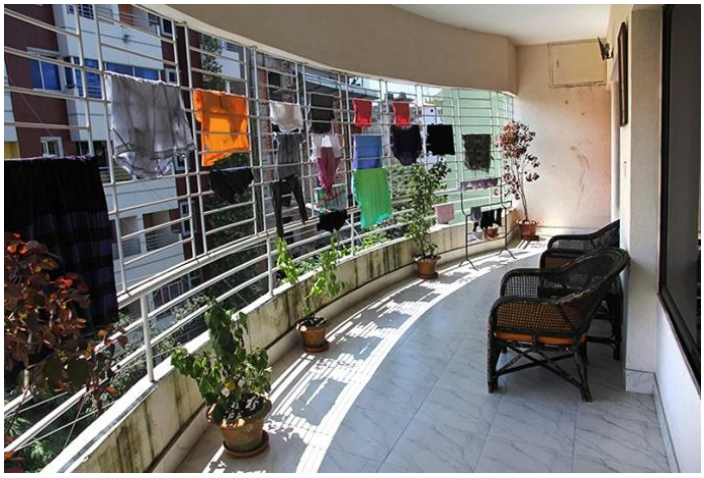


Figure 11: Buildings with no pleasant view.
(Source: personal photograph)

2.7. Definitions

The following terms are used throughout this research are defined below:

Dhaka city: This region includes Dhaka City Corporation area declared by the Ministry of Local Government.

View amenity: Environment amenities such as aesthetic view, proximity to green area, proximity to bodies of water.

Location variable: Distance from adjacent structures, school, market. daily grocery, transportation and hospital.

Hedonic Pricing Method (HPM): As per King and Mazzotta (2000), the hedonic pricing method is used to estimate economic values for ecosystem or environmental services that directly affect market prices. It is most commonly applied to variations in housing prices that reflect the value of local environmental attributes. It can be used to estimate economic benefits or costs associated with:

- Environmental negatives including air pollution, water pollution, or noise

- Environmental amenities such as pleasing views or proximity to recreational sites.

The basic idea of the hedonic pricing method is that the price of a marketed good is related to its characteristics, quality, or the services it provides. The method is most often used to value environmental amenities that affect the price of residential properties.

Property characteristics: Number or size of bedrooms, number of bathrooms

Taka: The Bangladeshi taka (BDT) is the official currency of the People's Republic of Bangladesh. 1 Taka = 80 US Dollars approx.

Crore: Crore is a unit in the Indian numbering system equal to ten million (10,000,000). It is widely used in India, Bangladesh, Pakistan, Sri Lanka and Nepal.

Thana: County/ Thana mean the area controlled by a police station.

Rickshaw: A three-wheeled hooded vehicle similar to a three-wheeled bicycle, having a seat for passengers behind the driver.

3. LITERATURE REVIEW

According to a highlights report, over the coming decades, the level of urbanization is expected to increase in all major areas of the developing world, with Africa and Asia urbanizing more rapidly than the rest (UNDESA, 2014). In addition, the revision report of UNDESA (2011) stated that Dhaka is among few cities where very high rates of growth are expected (growth rates well above 2% per year).

Bangladesh has experienced rapid urbanization in recent decades; the urban population numbered 14.1 million in 1981, 22.5 million in 1991, 31.1 million in 2001 (Statistics, 2001), 35 million in 2005 (CUS, NIPORT, & MEASURE, 2006) and 53 million in 2014 (World Bank, 2015). The pattern of urbanization confirms primacy of the capital city – Dhaka. It accommodates 15.4 million urban dwellers, about 37% of total urban population of country (Ahmad, 2015). As the growth of population in Dhaka has been exceptionally high since the 1970s, it has become one of the most populous megacities in the world (Ahmed, & Ahmed, 2012). Table 1 compared the current population in 2014 and the projected population in 2030 of cities with 5 million inhabitants or more.

2014			**2030**	
Urban agglomeration	Population (thousand)	Rank	Urban agglomeration	Population (thousand)
Tokyo	37,833	1	Tokyo	37,190
Delhi	24,953	2	Delhi	36,060
Shanghai	22,991	3	Shanghai	30,751
Mexico City	20,843	4	Mumbai	27,797
Sao Paulo	20,831	5	Beijing	27,706
Mumbai	20,741	6	Dhaka	27,374
Osaka	20,123	7	Karachi	24,838
Beijing	19,520	8	Al-Qahirah(Cairo)	24,502
New York-Newark	18,591	9	Lagos	24,239
Al-Qahirah (Cairo)	18,419	10	Mexico City	23,865
Dhaka	16,982	11	Sao Paulo	23,444

Table 1: Urban agglomerations with 5 million inhabitants or more, 2014 and 2030. (Source: World Urbanization Prospects: The 2014 Revision, UNDESA, 2014)

As a result, Dhaka, the capital city of Bangladesh, is in a continuous process of urban expansion. Figure 12 shows the historical expansion of Dhaka city over time.

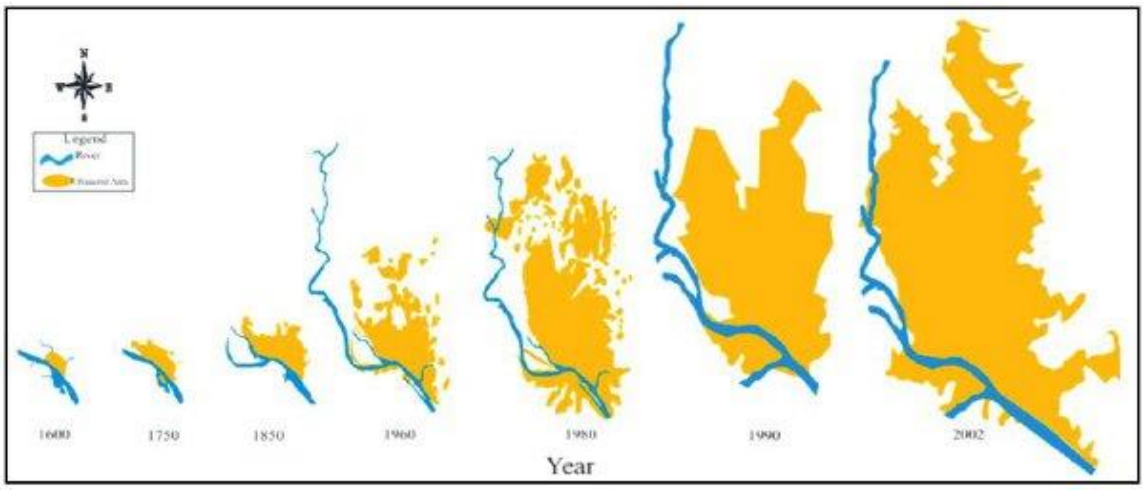


Figure 12: Historical growth of Dhaka [not to scale]. Source: Urban Planning Department, Dhaka City Corporation, 2004)

Figure 13 shows the population growth of Dhaka city over time.

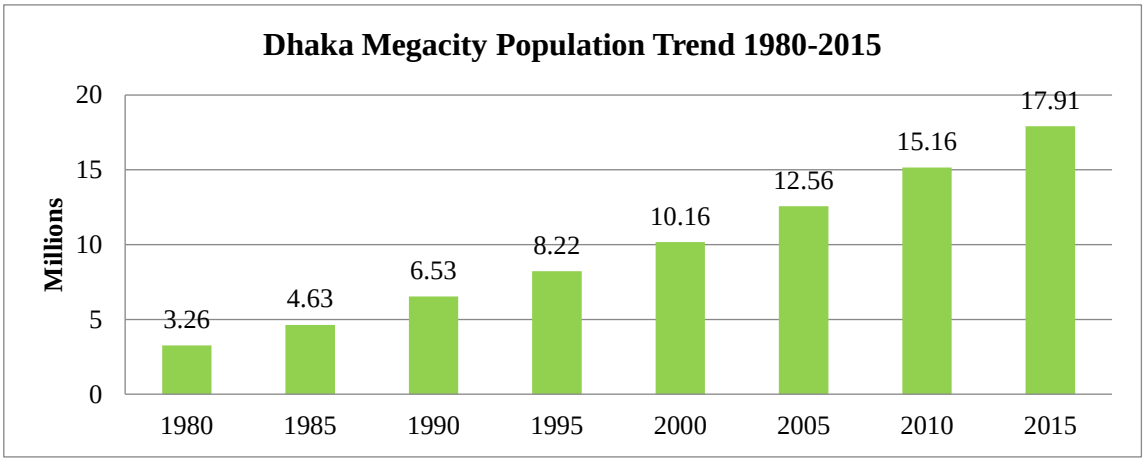


Figure 13: Dhaka Megacity population trend. (Source: World Urbanization Prospects: The 2003 Revision, UN).

To satisfy the housing of this growing population, Dhaka has attempted to expand vertically. The real estate sector has been playing a very important role in providing housing regardless of high, middle and low-income people since the past two decades.

The quick growth of population of Dhaka has been caused by a high rate of immigration, territorial expansion and natural growth. It increases the demand of accommodation of people and due to this demand the rental cost of residential units has been rising dramatically day by day (Ahmed, Rahman, & Islam, 2014).

Increasing rental costs along with rising income levels has encouraged real-estate investment. High-rise buildings have sprouted as there is land scarcity in Dhaka. Seraj and Alam (1991) have established that the growth of high-rise apartments is due to the influx of population into the city, and the lack of buildable land within the city center. Due to the rapid growth of the city, land values have greatly increased, and consequently raised residential prices and rents (Zaman, & Lau, 2001).

According to Zaman and Lau (2001), real-estate activities are a common secondary economic activity in the city, and take the form of major restructuring from low- and medium-density residential areas to high-density, high-rise buildings. The graph below of Figure 14 explains the trend of real estate business in the city (Seraj, 2012).

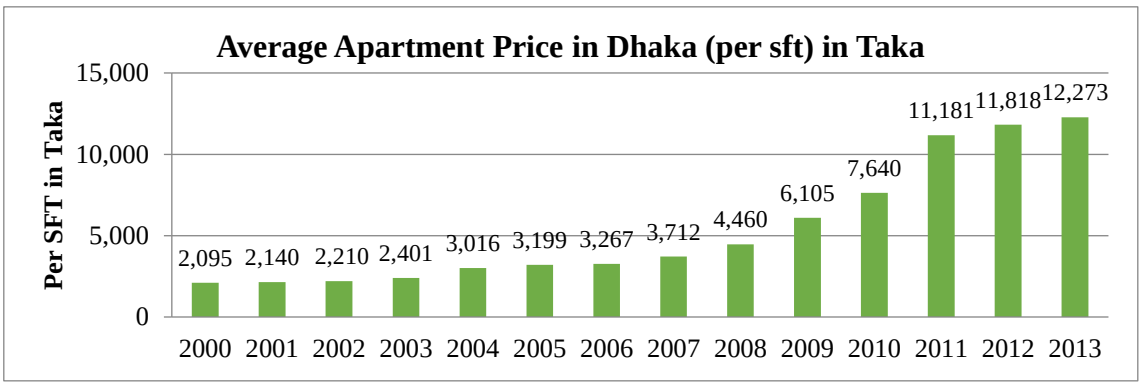


Figure 14: Average apartment price/sft in Dhaka from 2000 to 2013. (Sources: Saha 2013)

The growth, GDP contribution trend analysis & total volume of real estate business are shown by Table 2.

Year	Total volume (Crore tk)	GDP Contribution (%)	Growth (%)
2001-02	19440	8.63	-
02-03	20106	8.48	3.43
03-04	20913	8.30	4.01
04-05	21678	8.12	3.66
05-06	22404	7.87	3.35
06-07	23147	7.64	3.32
07-08	24097	7.49	4.11
08-09	24970	7.34	3.62
2009-2010	25981	7.20	4.05

Table 2: Growth, GDP contribution trend analysis & total volume of real estate business. (Source: Statistics, Y.B. 2011)

According to Mohiuddin (2014), the business of real estate is the profession of buying, selling or renting land, building or housing. He stated that three decades back the dwellers were reluctant to live in flats in Dhaka city, as mentioned earlier the main reason is economic due to increased land cost as well as construction cost and other reasons such as reluctance of individuals to spend time and energy in house construction, increased awareness of apartment living and western influence. As a result apartment-owing is becoming increasingly popular. The main reasons (Mohiuddin, 2014) for the development of real estate business in Dhaka city are:

- Rapid increase of population within the city;
- Scarcity of unoccupied land in important parts of the city;
- Very high price of land;
- Hazards (fraudulent or forgery) involving purchase of land;
- Profit motives of land owners;

- Increase of remittance inflows that finance purchases of flats or apartments;
- Restructuring of households into single family units; and
- Increased of security standards and other services in apartments.

In these days, the trend of buying property in homeland among the non-resident Bangladeshi is increasing due to its price. Because the high price gets smaller when it is converted into the US dollars (as 1 USD = approx. 80 BDT). As per the District Register office, the purchasing fees are comparatively lower, such as the registration fee is 2%, local government tax is 1%, capital gains tax 2% (applicable to land cost above 100,000 Takas, irrespective of when the transfer was made) and a VAT of 1.5% (applicable only for municipal corporation area payable by private housing and flat developers and commercial businesses).

In line with the demand the price of real estate properties is also rising rapidly. Price hike of land and construction materials also add to the overall price hike (Dewri et al., 2012). Compared to the price increase of the earlier decade, price rise is almost exponential in this decade (see Figure 15).

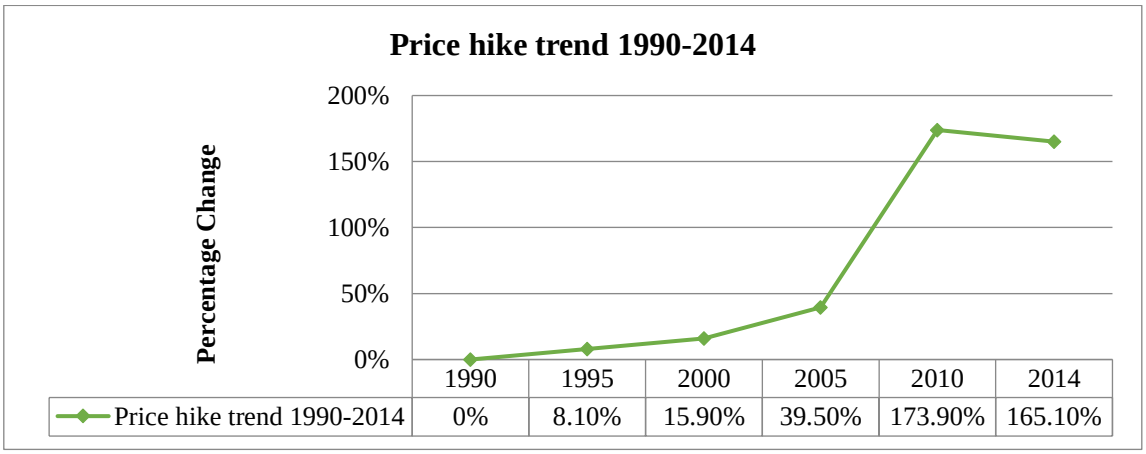


Figure 15: Price increase trend of apartments in Dhaka from 1990 to 2014. (Source: Statistics, Y.B. 2008)

Nonetheless, sale of apartments is expected to continue to rise. There are some areas in metropolitan Dhaka that are popular among buyers to live in (see Figure 16). For purchasing flats, consumers mostly prefer Dhanmondi, Uttara, Mirpur, Mohammadpur, Gulshan-Banani, Basundhara and Malibagh-Mogbazar areas (Dewri et al, 2012).

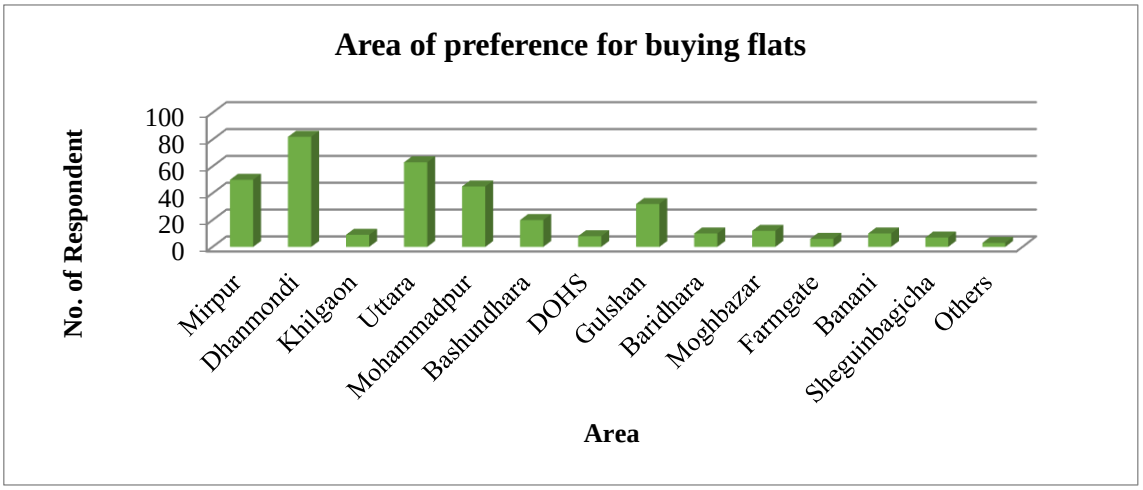


Figure 16: The area of preference for buying flats. (Source: Dewri et al, 2012)

Still, there are other factors, which we can be called amenities that directly affect market prices of these apartments. In real estate and lodging, an amenity is something considered to benefit a property and thereby increase its value (Carmichael, & Graham, 2012).

Hedonic models or Hedonic property models arise from the idea that the price of a good is really a sum of the implicit prices of each of its characteristics. For example, the price of a home depends on several groups of characteristics that determine its value: (a) physical structure, such as the number of bathrooms and bedrooms and square footage; (b) characteristics of the surrounding neighborhood, e.g., the quality of public schools, proximity to jobs and transportation networks; and (c) environmental amenities, such as air and water quality or proximity to open space. Hedonic property models collect data on the prices of home sales and housing characteristics, like those listed above, and then

estimate the marginal implicit prices of the characteristics of interest. This captures the marginal value of an environmental amenity to homeowners at the amenity's current level of provision (Mendelsohn, & Olmstead, 2009).

Hedonic models have been used primarily to estimate the economic value of air quality (Ridker, & Henning, 1967. Harrison, & Rubinfeld, 1978). Other environmental applications include proximity to wetlands and open space and dis-amenities such as hazardous waste sites and airport noise (Palmquist, & Smith, 2002).

The value of a view had its share of investigation by a number of researchers at different levels. Rodriguez and Sirmans (1994) attempted to quantify the effect of view on housing value in Fairfax County, Virginia and rejected the hypothesis that a view amenity has no effect on the market price of residential real estate in that area. Benson, Hansen, Schwartz, and Smersh (1998) evaluated the view amenity in the single-family residential real estate market of Bellingham, Washington, a city with a variety of views including ocean, lake, and mountain. This study allowed for the differentiation of the view amenity by both type and quality. Results from a hedonic model estimated for several recent years suggest that depending on the particular view, willingness to pay for this amenity is quite high (Taibah, 2003).

The hedonic pricing method is used to estimate economic values for ecosystem or environmental services that directly affect market prices. It is most commonly applied to variations in housing prices that reflect the value of local environmental attributes (King, & Mazzotta, 2000).

The hedonic pricing method is applied in this very study because:

1. The price of a property in an area is related to its nearness to open space.
2. Data on real estate transactions and open space parcels are readily available, thus making this the least expensive and least complicated approach.

According to Benson, Hansen, Schwartz, & Smersh (1998), a relatively small number of studies have examined the value of the view amenity, either as a primary or secondary focus of analysis. Because the type and quality of view are often not specified, and because results are often reported in dollar terms only, it is very difficult to make comparisons across studies.

3.1. Proximity to Parks/ Green Areas

Land which is adjacent to an urban neighborhood park, because of its unique location may be of greater value than land which is a greater distance from the park (Kitchen, & Hendon, 1967).

Urban forests are an appreciated environmental characteristic and that their benefits are reflected in the property prices. Proximity to watercourses and wooden recreation areas as well as increasing proportion of total forested area in the housing district had a positive influence on apartment price (Tyrväinen, 1997).

In this study, the first-stage hedonic price functions were calculated in order to explain the apartment prices (P) using the general formula: P=.f(A*i*,L*i*,E*i*) where A*i* is a vector of the apartment characteristics such as size, age and type of construction. L*i* is a vector of the locality attributes such as accessibility to town center, schools and shops. E*j* is a vector of the characteristics describing the environmental quality in the housing district including variables such as accessibility to watercourse, recreation areas and relative amount of green spaces. A linear hedonic function was calculated to first explain the total purchase price, a model that explained the price variation. Price per square meter was chosen to be the dependent variable in the final models. Linear and log-linear hedonic price functions were calculated with multiple regression analysis using SPSS software.

More than 30 studies have shown that parks have a positive impact on nearby residential property values. Other things being equal, most people are willing to pay more for a home close to a nice park (Harnik, & Welle, 2009). The research found that the price of all residential properties within 500' of a park is markedly valuable.

3.2. Proximity to Water Bodies

A study by Lansford & Jones (1995) shows that analysis of marginal values indicates that waterfront properties command a premium price for the private access they offer for enjoyment of public lake waters and the price falls rapidly with increasing distance.
Estimation of the value of the variety of views amenity (such as lake, ocean, mountain) in single-family residential real estate markets shows that depending on the particular view, willingness to pay for this amenity is quite high (Benson, Hansen, Schwartz, & Smersh, 1998).

3.3. Accessibility to Location Variables (Schools)

Research done in the UK by Gibbons, & Machin (2004) suggests that the higher test score based school performance is associated with increased adjacent property prices.
Houses are more expensive in the catchment areas of popular comprehensive schools (Leech, & Campos, 2003). The study assumed the price of an individual dwelling, Pi, is a stochastic function of a set of measurable attributes, A1i, A2i, ... Ari,

Pi = f(A1i, A2i, . . ., Ari, ui) ……..... (3.1)

where, ui = the random error term reflecting all other effects on price. The general statistical approach is to specify a regression model based on equation (1):

f(Pi) = Sj bj Xji + Sj gj Zji + ui (2) ..... (3.2)

where, the dependent variable is a suitable transformation of price, like most of the other studies, this paper also followed logarithmic transformation, f(Pi) = ln(Pi). The independent variables are appropriate functions of the attributes, partitioned into two

groups: measures of the characteristics of the house, X1i, X2i, . . ., Xki, and neighborhood characteristics, Z1i, Z2i, …… Zmi, including measures of the popularity or quality of schools.

There is a positive relationship between exam performance of secondary schools and dwelling prices (Rosenthal, 2003). This research estimated the following model:

(1) LPPi = Xig + bQi + mi …..... (3.3)

(2) Qi = Xip + ScqcYic + ei ..... (3.4)

LPPi= the natural log of transacted purchase price, Qi= the (log odds) quality of the nearest school to dwelling i, Xi = a vector of covariates,

Yic= exogenous dummy variables indicating whether the nearest school was inspected by Ofsted school inspection either in the current or prior school year (c=1, 2)18. If the residual in the house price equation, mi= correlated with the log odds school quality measure (Qi) because of omitted variables, OLS estimation of (1) will be biased, with resulting error in the estimate of the value of school quality.

3.4. Accessibility to Location Variables (Markets)

Studies done by Rosiers, Lagana, & Theriault (2001) and Sirpal (1994) suggest that not only size of shopping centers, but also proximity shapes the value of surrounding residential properties. There is a positive impact of shopping center size on residential values.

Addae-Dapaah and Lan (2010) extends the research further by identifying both positive and negative impacts of proximity to shopping mall on residential property-price. Shopping center, as an externality, simultaneously exerts both attractive and repulsive effects which can impact a household's location choice. It is attractive when it provides convenience to the residents (i.e. savings in travel time) in close proximity to it. It becomes a negative externality when it generates too much traffic, noise and pollution to

disturb the peace and tranquility expected by residents of nearby houses (Addae-Dapaah &Lan, 2010).

The regression equation is expressed as follows:

$$\text{Ln(Price)} = \alpha + \beta1(\text{Level}) + \beta2(\text{Type}) + \text{B3Ln(Age)} + \beta4\text{Ln(Area)} + \beta5(\text{Sch}) + \beta6(\text{Park}) + \beta7(\text{Sea}) + \beta8(\text{Worship}) + \beta9(\text{Office}) + \beta10(\text{Industrial}) + \beta11(\text{MRT}) + \beta12(\text{Bus}) + \beta13(\text{Sports}) + \beta14(\text{Library}) + \beta15(\text{CC}) + \beta16(\text{Market/FC}) + \beta17(\text{Medical}) + \beta18(\text{Police}) + \beta19\text{Ln(DistShop)} + \beta21\text{Ln(Index)} + \varepsilon i \quad \text{..... (3.5)}$$

where, α = Intercept, $\beta1\ldots\ \beta\ n$ = Regression coefficients ε = Random element that reflects the unobserved variation in the house prices.

In contrast, another study conducted by Sale (2015) reveals that the potential dis-amenities of increased traffic, noise, and localized pollution caused by a shopping mall cannot prevail over the convenience of being situated in close proximity to a shopping center. In the first stage of this paper, a hedonic price function is estimated by means of regression analysis. The hedonic price function can be specified as:

$$P = f(S, L, M) \quad \text{.....} \quad (3.6)$$

where, P= the sales price of a property, S= the on-site characteristics of the property, L= the location and surrounding neighborhood characteristics, and M= the market characteristics. The first-stage hedonic price estimates used to calculate the implicit prices of housing attributes.

3.5. Accessibility to Location Variables (CBDs)

A travel time to the CBD has a negative relationship with house sales price. Travel times to the CBD had a much larger effect, with 10 minute increases in travel times being associated with 3.3 and 6.4 percent declines in sales price for the free-flow and congested travel time models respectively (Ottensmann, Payton, & Man, 2008). In order

to evaluate the effectiveness of alter-native measures of location in predicting prices, hedonic housing price models of the following form are estimated:

$P = \beta_0 + \beta_H H + \beta_N N + \beta_L L + \varepsilon$ ……..... (3.7)

where P is a vector of house prices, H is a matrix of house characteristics, N is a matrix of neighborhood characteristics, and L is a matrix of one or more location characteristics. The β_0 is the constant term vector, β_H, β_N, and β_L are matrices of the corresponding parameters, and ε is a vector of error terms. Ordinary Least Squares (OLS) is used to estimate the model.

The shorter the distance to the CBD the higher the land values, and vice versa. The reason for this effect is sourced in transportation and convenience costs associated with accessing various locations. Because central locations are highly accessible, the transportation and convenience costs of getting to and from those locations are lower compared to other locations in a region (Bartholomew, & Ewing, 2011).

The literature review revealed that the hedonic price model (HPM) is the most commonly applied property value technique and many studies relating to real estate value analysis are concerned with hedonic price model. Though a number of studies are available on estimating real estates' economic values through HPM, there have been insufficient studies on housing prices in Dhaka city based on HPM.

Research on HPM based on Dhaka city is necessary because of the current housing trend of the city and in order to get the highest economic return.

4. RESEARCH METHODOLOGY

This paper is developed to address clients' preferences for pleasant views and public amenities by estimating market prices of high rise apartments. Therefore, the research is designed to identify the level of buyers' willingness to pay for these amenities.

4.1 Sampling and Sample Size

This study has been conducted in Dhaka, a city of around 17 million inhabitants. Four residential areas have been selected based on data collected by Real Estate and Housing Association of Bangladesh (REHAB). These four residential areas were selected because they are the most coveted and are also located in four corners of the metropolis. Property prices, structural attributes and addresses are collected from several online real estate marketplaces that advertise apartments for sale. All relevant data for a total of 175 properties have been collected from four residential areas: Dhanmondi, Gulshan, Mirpur and Uttara (approx. 40 from each zone). Apartments, both with and without pleasant views and public amenities were considered in order to reduce bias. Data have been coded in such a manner that the nearer the location to amenities, the greater the coding value.

4.2 Data Collection

The analyses concentrate on crucial amenity variables such as lakes, parks, schools, hospitals or markets. Google Maps and Earth have been extensively used for data collection purposes. All distances from a given house to the above variables have been measured using Google Earth. Walking distance has constantly been used as travel distance, as traffic congestion in the city makes commutes by other modes of transportation unpredictable. Google Street view has been used in order to verify the distance to adjacent structure.

4.3 Study Variables

Table 3 shows the research variables used in the analysis.

VARIABLES	DEFINITIONS
	DEPENDENT VARIABLES
Y	Sales price per square foot
	STRUCTURAL ATTRIBUTES
S1	No. of bedroom
S2	No. of bathroom
S3	No. of balcony
	VIEW AMENITIES
V1	Proximity to water body (lake)
V2	Proximity to green area/park
	LOCATION VARIABLES
L1	Distance from adjacent structure
L2	Accessibility to reputable school
L3	Distance to market/ shopping mall
L4	Distance to daily grocery
L5	Distance to hospital
L6	Distance to transportation service

Table 3: Variable definitions

4.4 Results of Hedonic Procedure

The hedonic pricing method is used to analysis the data in order to determine the relationship between a real estate value and the impact of external attributes associated with the real estate. In this study, the association between the asking price for apartments listed for sale and the amenities around these apartments is explained by hedonic pricing

procedure. Data analysis has been done using multiple linear regression equation and based on the results of the analysis, the hedonic equation can be written as follows:

$Y = c + bx$ …..... (4.1)

or,

*Y (Price) = c + b1*S1(Bedroom) + b2*S2(Bathroom) + b3*S3(Balcony) + b4*V1(Lake) + b5*V2(Park) + b6*L1(Openness) + b7*L2(School) + b8*L3(Shopping mall) + b9*L4(Grocery) + b10*L5(Hospital) + b11*L6(Bus)+e* ..... (4.2)

In the equation, ***Y*** = house prices (dollar/sft)

c = the intercept,

b (*b1, b2, b3,* ….) = the coefficients,

S = a matrix of house structural characteristics,

V = a matrix of neighborhood characteristics,

L = a matrix of one or more location characteristics and

e = a vector of error terms.

Data Analysis for Dhanmondi:

The following equation is derived from the data analysis of Dhanmondi:

Y = 32.028 + 3.522 *S1+ 6.300 * S2 + 0.636 * S3 + 17.564 * V1 - 1.947 * V2 + 23.125 * L1 - 0.161 * L2 + 17.865 * L3 -12.141 * L4 - 8.615 * L5 -1.687 * L6 + e ..... (4.3)

The purpose of a significance test is to provide evidence against the null hypothesis through the probability value. The probability value of this model is statistically significant with 0.00002. If the probability is less than 0.01, the data provide strong evidence that the null hypothesis is false. The coefficient of determination (R^2) of this model is 0.723. It indicates that the model explains approximately 72% variability of the response data around its mean. The result of this data analysis indicates that the view of lake, openness and location variables, particularly distance to market or shopping malls,

are important attributes those have a significant effect on apartment's market value.

Data Analysis for Gulshan:

The following equation is derived from the data analysis of Gulshan:

$$Y= - 457.360 + 20.159 * S1 + 3.944 * S2 + 4.625 * S3 + 37.923 * V1 +3.040 * V2 -1.189 * L1 + 29.868 * L2 +10.745 * L3 + 39.608 * L4 + 37.217 * L5 + 35.197 * L6 + e \quad (4.4)$$

The effect of this model is statistically significant as the p-value is 1.27E-08 which is very low. The explained variation of this model is good because the coefficient of determination (R^2) is 0.80. This describes that there is a high correlation (80%) between the premium of property and external attributes. The data analysis of Gulshan area shows that the view of lake has a greater impact on the property value. Moreover, the price of apartments has a negative relationship with the distance to reputable schools, daily grocery, hospitals and transportation service.

Data Analysis for Mirpur:

The following equation is derived from the data analysis of Mirpur:

$$Y= 5.078 + 3.944 * S1 + 6.079 * S2 + 3.106 * S3 + 1.868 * V1 + 9.010 * V2 - 0.786 * L1 + 4.650 * L2 -0.329 * L3 - 3.986 * L4 - 1.881 * L5 + 5.538 * L6 + e \quad (4.5)$$

The p-value of the model is at 2.1E-12 level, which is very small and hence it can be said statistically significant. The estimation efficacy of the model is good with a coefficient of determination (R^2) of 0.85. This describes that the model is able to explain approximately 85% of the total variation in the property’s market value. In Mirpur area,

the data analysis revealed that proximity to green or parks is the most desirable amenity which increases the price of the property.

Data Analysis for Uttara:

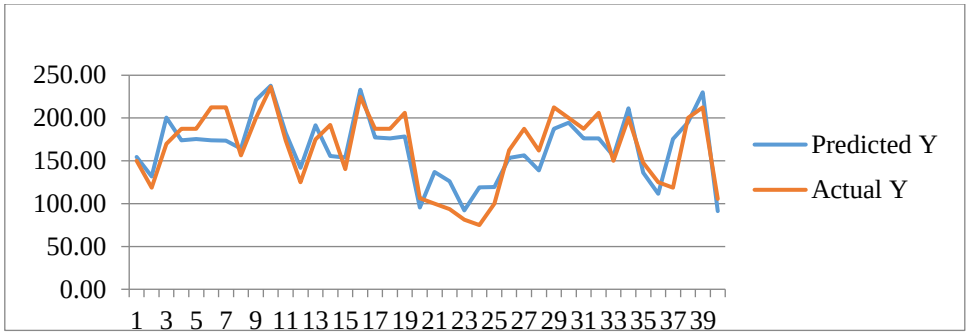
The following equation is derived from the data analysis of Uttara:

$$Y = 11.671 + 4.917 * S1 + 15.742 * S2 + 4.825 * S3 - 3.993 * V1 + 5.081 * V2 - 2.594 * L1 + 3.809 * L2 + 5.528 * L3 - 4.415 * L4 - 5.096 * L5 + 4.031 * L6 + e \quad ..... \quad (4.6)$$

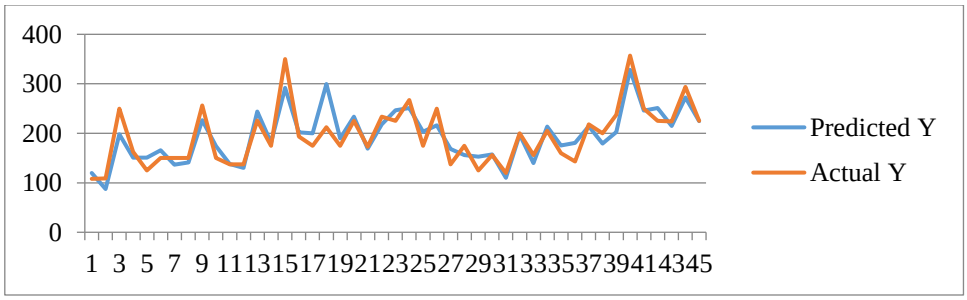
In this model, the probability value is statistically significant with 0.0004 which is below 0.01 and so the null hypothesis is rejected. The R^2 value is 0.65 here, which means the model explains about 65% of the variation in dependent variables. Unlike the data analysis of previous three areas, the analysis shows that no particular amenity has visible impact on the apartment value.

4.5 Actual Value versus Predicted Value (Dollar/sft)

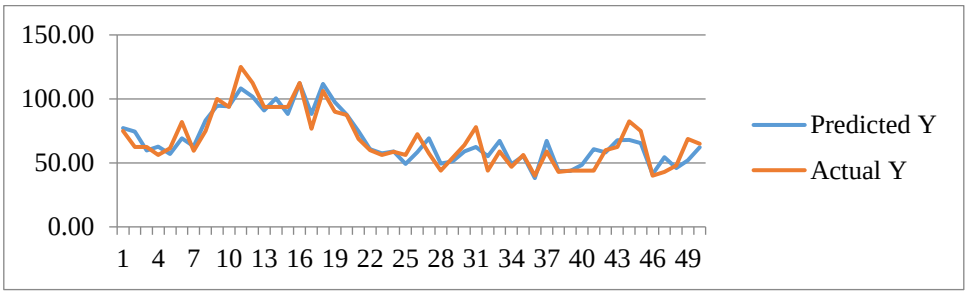
The comparison between actual value and predicted value of the four study areas show (see Figure 17) that there are some discrepancies between the two types of values in those areas. However, the values in Gulshan areas show least difference while the differences of values in Uttara are the highest. All the graphs show good agreements between the actual and predicted values (price in dollar/sft).



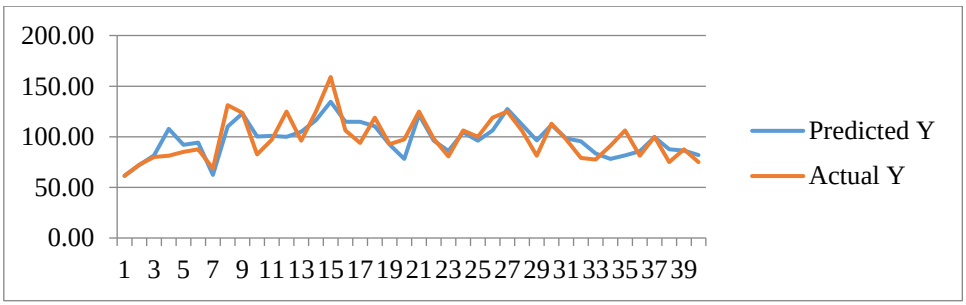
Dhanmmondi



Gulshan



Mirpur



Uttara

Figure 17: The comparison between actual value and predicted value of the four study areas

5. SIGNIFICANCE OF THE STUDY

This study attempts to utilize the hedonic pricing method to develop equations to predict high-rise apartment prices which reflects view and accessibility amenities. The equations that are formulated by utilizing the hedonic pricing function can be used by developers as well as clients to determine an appropriate cost before any investment. It will help the client to forecast the value of an apartment based on the apartment's characteristics. The client can then estimate the value and negotiate a price. It will also help the builder or seller to tailor their advertisements and be able to attract more buyers.

6. SUMMARY AND CONCLUSION

This paper explores the impact of view and accessibility amenities on price of high-rise residential properties in Dhaka. The analyses have led to several significant findings. First, any apartment that is adjacent to park, water body or open or green space usually has a greater value than properties farther away from those amenities. Proximity to view amenities has consistently been shown to increase apartment price. Second, in terms of location variables, buyers are willing to pay more for apartments located in the vicinity of reputable schools. In addition, residential units cost more when they are adjacent to large shopping malls. Distance to work is also a major factor when potential buyers consider purchasing an apartment.

Notable exceptions, however, are found in Uttara where the effects of above-mentioned amenities are negligible on a property's value.

This paper confirms that a better understanding of location optimizing concepts can help both residential developers and homebuyers to obtain substantial benefits. Moreover, the findings of this study can help all parties to minimize the risk in their investments.

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APPENDIX A

Statistical Data Analysis

Legend for Coding:

5= Direct view or adjacent to the amenity

4=Walking distance 1-5 minutes

3= Waking distance 6-15 minutes

2= Walking distance 16-30 minutes

1=Walking distance more than 30 minutes.

Y= Dollar value

S1= Number of bedroom

S2= Number of bathroom

S3= Number of balcony

V1= Proximity of water body (lake)

V2= Proximity of park/green space

L1= Openness/ distance from adjacent structure

L2= Accessibility to reputable school

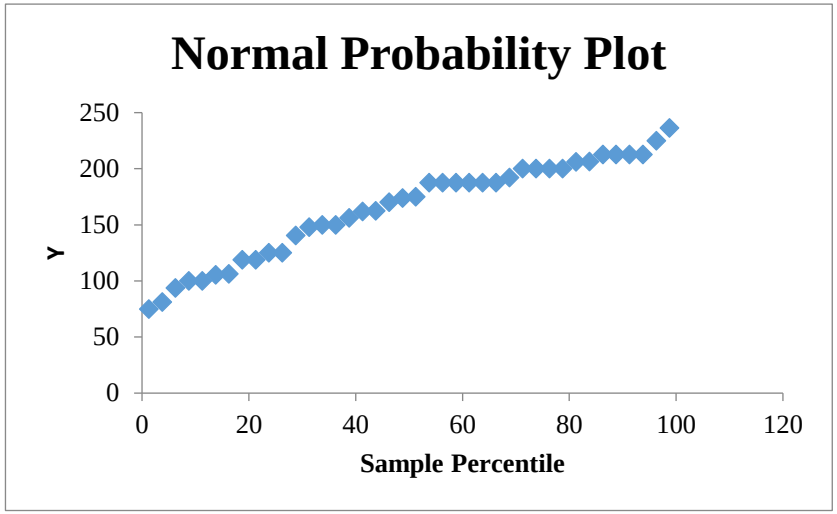
L3= Distance to market/ shopping malls

L4= Distance to daily grocery

L5= Distance to hospital

L6= Distance to transportation service

DHANMONDI DATA ANALYSIS



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8504611
R Square	0.7232841
Adjusted R Square	0.6145743
Standard Error	27.130767
Observations	40

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	53871.24	4897.385	6.653346	2E-05
Residual	28	20610.2	736.0785		
Total	39	74481.44			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	32.028	97.56629	0.328272	0.745149	-167.83	231.8837	-167.827	231.8837
X Variable 1	3.522	13.37784	0.263292	0.794253	-23.881	30.92555	-23.881	30.92555
X Variable 2	6.300	7.737257	0.814209	0.422396	-9.5493	22.1488	-9.54931	22.1488
X Variable 3	0.636	4.150301	0.153167	0.879365	-7.8658	9.137195	-7.86582	9.137195
X Variable 4	17.564	11.19855	1.568391	0.128023	-5.3755	40.50289	-5.37548	40.50289
X Variable 5	-1.947	8.353058	-0.23305	0.81742	-19.057	15.1638	-19.0571	15.1638
X Variable 6	23.125	11.12699	2.078244	0.046969	0.332	45.91722	0.331997	45.91722
X Variable 7	-0.161	8.695007	-0.01846	0.985401	-17.971	17.65039	-17.9714	17.65039
X Variable 8	17.865	10.15304	1.759548	0.089408	-2.9328	38.6623	-2.9328	38.6623
X Variable 9	-12.141	14.35387	-0.84582	0.404823	-41.543	17.26177	-41.5434	17.26177
X Variable 10	-8.615	12.57517	-0.68508	0.498928	-34.374	17.14411	-34.374	17.14411
X Variable 11	-1.687	10.19018	-0.16558	0.869679	-22.561	19.18636	-22.5609	19.18636

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	154.71559	-4.71559
2	131.82248	-13.0725
3	200.66676	-30.6668
4	174.07976	13.42024
5	175.35113	12.14887
6	174.07976	38.42024
7	173.44407	39.05593
8	164.20203	-7.95203
9	221.03992	-21.0399
10	237.79738	-1.54738
11	182.70246	-8.95246
12	141.79838	-16.7984
13	191.5125	-16.5125
14	155.84645	36.15355
15	153.89979	-13.3998
16	233.1592	-8.1592

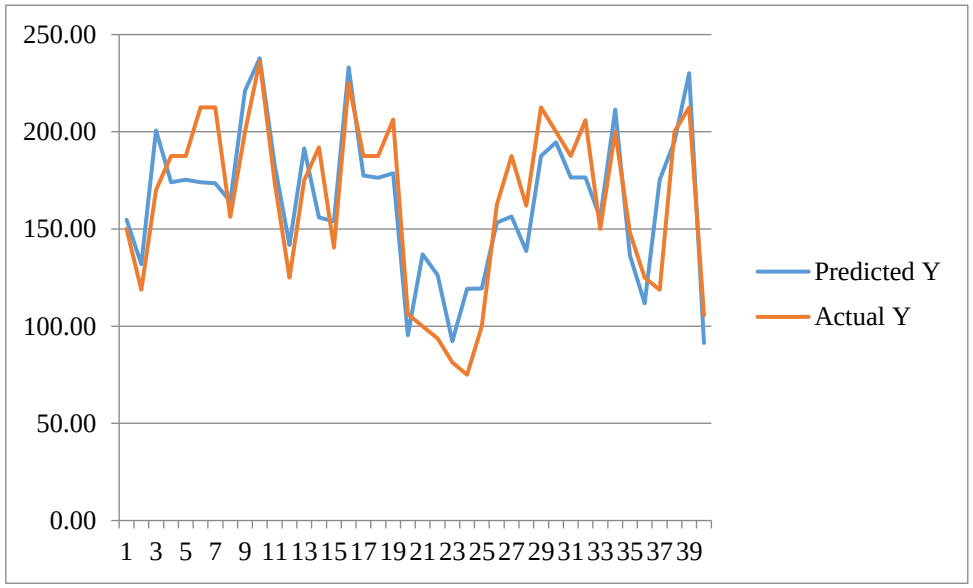
PROBABILITY OUTPUT

Percentile	*Y*
1.25	75
3.75	81.25
6.25	93.75
8.75	100
11.25	100
13.75	105.5
16.25	106.25
18.75	118.75
21.25	118.75
23.75	125
26.25	125
28.75	140.5
31.25	148
33.75	150
36.25	150
38.75	156.25

Predicted Y	*Actual Y*
154.72	150
131.82	118.75
200.67	170
174.08	187.5
175.35	187.5
174.08	212.5
173.44	212.5
164.20	156.25
221.04	200
237.80	236.25
182.70	173.75
141.80	125
191.51	175
155.85	192
153.90	140.5
233.16	225

17	177.45832	10.04168	41.25	162	177.46	187.5
18	176.35103	11.14897	43.75	162.5	176.35	187.5
19	178.60193	27.64807	46.25	170	178.60	206.25
20	95.379567	10.87043	48.75	173.75	95.38	106.25
21	136.94412	-36.9441	51.25	175	136.94	100
22	126.24799	-32.498	53.75	187.5	126.25	93.75
23	92.265649	-11.0156	56.25	187.5	92.27	81.25
24	119.16063	-44.1606	58.75	187.5	119.16	75
25	119.32116	-19.3212	61.25	187.5	119.32	100
26	153.2795	9.220499	63.75	187.5	153.28	162.5
27	156.35553	31.14447	66.25	187.5	156.36	187.5
28	138.69865	23.30135	68.75	192	138.70	162
29	187.43623	25.06377	71.25	200	187.44	212.5
30	194.54222	5.457776	73.75	200	194.54	200
31	176.40272	11.09728	76.25	200	176.40	187.5
32	176.40272	29.59728	78.75	200	176.40	206
33	155.52901	-5.52901	81.25	206	155.53	150
34	211.37947	-11.3795	83.75	206.25	211.38	200
35	136.24918	11.75082	86.25	212.5	136.25	148
36	111.75004	13.24996	88.75	212.5	111.75	125

37	175.39073	-56.6407	91.25	212.5		175.39	118.75
38	194.95666	5.043336	93.75	212.5		194.96	200
39	230.21455	-17.7146	96.25	225		230.21	212.5
40	91.314707	14.18529	98.75	236.25		91.31	105.5



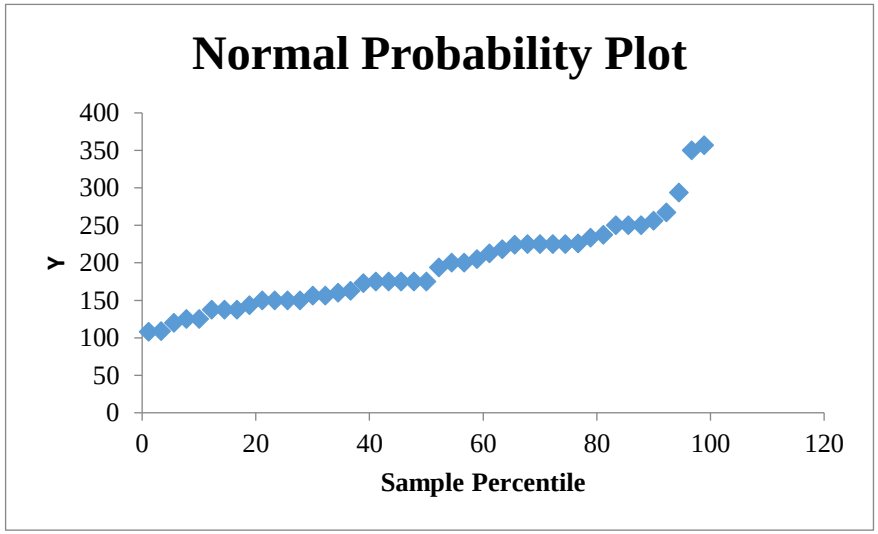
INPUT DATA (DHANMONDI):

Dollar value	No. of bedrooms	No. of bathrooms	Balcony	Proximity of water body (lake)	Proximity of green/park	Distance from adjacent structure	Accessibility to reputable school	Distance to market/ shopping malls	Distance to daily grocery	Distance to hospital	Distance to transportation service
Y	**S1**	**S2**	**S3**	**V1**	**V2**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
150	3	4	1	3	3	2	4	4	3	4	4
118.75	3	3	3	3	3	2	4	3	3	4	4
170	4	4	2	4	4	3	3	3	2	3	4
187.5	3	3	3	4	4	2	3	4	3	3	4
187.5	3	3	5	4	4	2	3	4	3	3	4
212.5	3	3	3	4	4	2	3	4	3	3	4
212.5	3	3	2	4	4	2	3	4	3	3	4
156.25	3	4	3	4	4	2	3	3	3	3	3
200	3	3	5	5	5	4	3	3	3	3	3
236.25	4	5	6	5	5	4	3	3	3	3	3

173.75	3	4	4	4	4	2	3	4	3	3	3
125	3	4	3	3	3	1	2	4	3	3	4
175	4	5	2	4	3	2	3	4	3	3	4
192	3	4	3	4	3	2	3	3	3	4	4
140.5	3	4	3	4	4	2	3	3	3	4	4
225	4	6	5	5	5	4	3	3	3	4	4
187.5	3	3	5	4	3	2	2	4	3	3	4
187.5	4	5	6	4	3	2	2	3	3	3	4
206.25	5	5	4	4	3	2	2	3	3	3	4
106.25	3	4	2	2	2	1	3	3	4	3	4
100	3	3	6	4	3	1	3	3	3	3	4
93.75	3	3	2	3	3	1	2	4	3	4	4
81.25	3	2	3	3	3	1	2	3	4	4	3
75	3	3	3	3	3	1	3	3	3	3	3
100	3	3	3	3	3	1	2	3	3	3	3
162.5	3	3	3	4	1	2	4	3	3	4	4
187.5	3	3	3	3	4	2	4	4	3	3	4
162	3	4	1	3	3	2	3	3	3	4	3
212.5	4	5	5	4	4	2	3	3	2	3	3
200	3	4	4	5	4	2	3	3	2	3	3

187.5	3	3	4	4	4	2	3	4	3	3	3
206	3	3	4	4	4	2	3	4	3	3	3
150	4	3	2	4	4	1	3	4	3	3	3
200	4	5	3	4	5	3	3	4	3	3	4
148	3	3	2	4	3	1	2	3	3	3	3
125	3	2	1	3	3	1	2	3	3	3	3
118.75	3	3	2	4	3	2	3	4	3	3	4
200	3	3	3	5	5	3	3	3	3	3	4
212.5	4	5	5	5	5	3	3	4	3	3	4
105.5	3	3	3	3	3	1	1	2	3	4	4

GULSHAN DATA ANALYSIS



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8946313
R Square	0.8003652
Adjusted R Square	0.7338203
Standard Error	29.783465
Observations	45

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	117359	10669	12.02744	1.27E-08
Residual	33	29272.81	887.0548		
Total	44	146631.8			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-457.360	91.75298	-4.98469	1.93E-05	-644.033	-270.688	-644.033	-270.688
X Variable 1	20.159	17.37241	1.160387	0.254218	-15.1857	55.50313	-15.1857	55.50313
X Variable 2	3.944	13.03088	0.302647	0.764059	-22.5678	30.45527	-22.5678	30.45527
X Variable 3	4.625	5.492068	0.842164	0.405758	-6.54847	15.79892	-6.54847	15.79892
X Variable 4	37.923	10.23565	3.704945	0.000771	17.09793	58.74708	17.09793	58.74708
X Variable 5	3.040	6.417378	0.473673	0.638852	-10.0165	16.09599	-10.0165	16.09599
X Variable 6	-1.189	5.196773	-0.22884	0.820403	-11.7622	9.38367	-11.7622	9.38367
X Variable 7	29.868	10.39907	2.872165	0.007072	8.710778	51.02491	8.710778	51.02491
X Variable 8	10.745	12.93931	0.830406	0.412277	-15.5803	37.07009	-15.5803	37.07009
X Variable 9	39.608	13.86331	2.857064	0.007346	11.40326	67.81351	11.40326	67.81351
X Variable 10	37.217	7.729566	4.81491	3.18E-05	21.49124	52.94308	21.49124	52.94308
X Variable 11	35.197	13.64641	2.579204	0.014548	7.433043	62.96068	7.433043	62.96068

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	119.57668	-11.5767
2	87.419557	21.26044
3	197.77329	52.22671
4	150.591	11.909
5	150.89618	-25.8962
6	165.44301	-15.443
7	136.71532	13.28468
8	141.34055	8.659451
9	226.3515	29.8985
10	174.24814	-24.2481
11	137.63437	-0.13437
12	129.92924	7.570759
13	243.96802	-18.268
14	181.2818	-6.2818
15	291.9958	58.0042

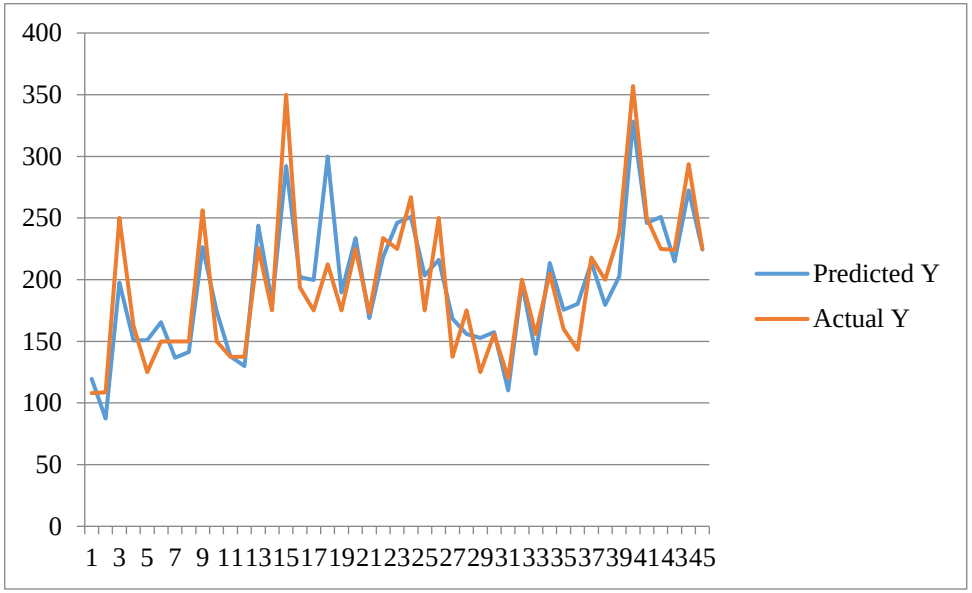
PROBABILITY OUTPUT

Percentile	*Y*
1.111111	108
3.333333	108.68
5.555556	120
7.777778	125
10	125
12.22222	137.5
14.44444	137.5
16.66667	137.5
18.88889	143.25
21.11111	150
23.33333	150
25.55556	150
27.77778	150
30	156
32.22222	156

Predicted Y	*Actual Y*
119.5767	108
87.41956	108.68
197.7733	250
150.591	162.5
150.8962	125
165.443	150
136.7153	150
141.3405	150
226.3515	256.25
174.2481	150
137.6344	137.5
129.9292	137.5
243.968	225.7
181.2818	175
291.9958	350

16	202.17627	-8.42627	34.44444	160	202.1763	193.75
17	199.69164	-24.6916	36.66667	162.5	199.6916	175
18	299.86098	-87.361	38.88889	173	299.861	212.5
19	189.65211	-14.6521	41.11111	175	189.6521	175
20	233.75609	-8.75609	43.33333	175	233.7561	225
21	168.87899	4.12101	45.55556	175	168.879	173
22	218.3798	15.2202	47.77778	175	218.3798	233.6
23	246.25885	-21.2588	50	175	246.2588	225
24	250.88407	16.11593	52.22222	193.75	250.8841	267
25	203.36552	-28.3655	54.44444	200	203.3655	175
26	216.00131	33.99869	56.66667	200	216.0013	250
27	168.43367	-30.9337	58.88889	205	168.4337	137.5
28	155.78642	19.21358	61.11111	212.5	155.7864	175
29	152.74667	-27.7467	63.33333	218	152.7467	125
30	157.53529	-1.53529	65.55556	224	157.5353	156
31	110.23437	9.765627	67.77778	225	110.2344	120
32	197.48806	2.511945	70	225	197.4881	200
33	139.75507	16.24493	72.22222	225	139.7551	156
34	213.60864	-8.60864	74.44444	225	213.6086	205
35	175.65727	-15.6573	76.66667	225.7	175.6573	160

36	180.2825	-37.0325	78.88889	233.6		180.2825	143.25
37	214.0941	3.905904	81.11111	237.5		214.0941	218
38	179.60103	20.39897	83.33333	250		179.601	200
39	202.68405	34.81595	85.55556	250		202.684	237.5
40	328.2112	28.7888	87.77778	250		328.2112	357
41	245.98723	4.012768	90	256.25		245.9872	250
42	250.97174	-25.9717	92.22222	267		250.9717	225
43	214.89473	9.105266	94.44444	293.75		214.8947	224
44	272.43225	21.31775	96.66667	350		272.4322	293.75
45	224.50564	0.494363	98.88889	357		224.5056	225



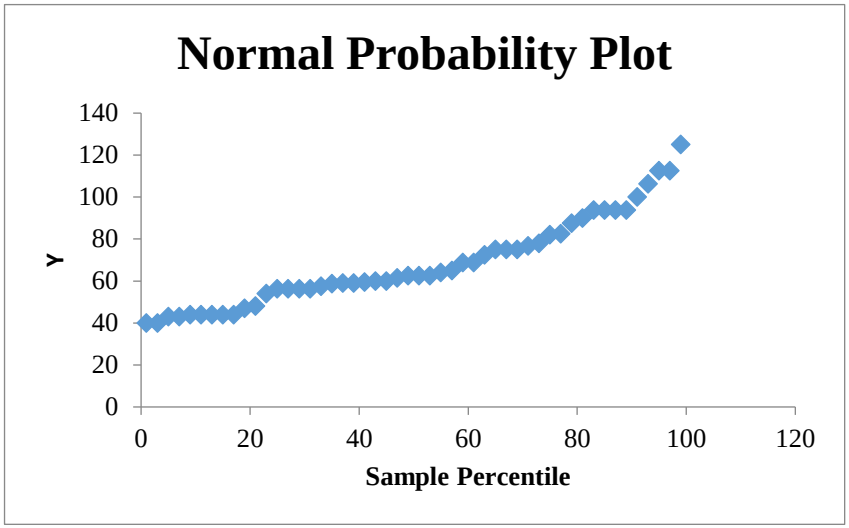
INPUT DATA (GULSHAN):

Dollar value	No. of bedrooms	No. of bathrooms	Balcony	Proximity of water body (lake)	Proximity of green/park	Distance from adjacent structure	Accessibility to reputable school	Distance to market/ shopping malls	Distance to daily grocery	Distance to hospital	Distance to transportation service
Y	**S1**	**S2**	**S3**	**V1**	**V2**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
108	3	3	3	3	2	4	2	2	2	2	4
108.68	3	3	3	3	3	4	2	2	2	2	3
250	3	3	3	3	5	1	2	4	4	2	3
162.5	3	3	5	3	3	1	2	3	3	2	3
125	3	3	3	3	3	2	2	4	3	2	3
150	4	4	3	3	3	1	2	3	3	2	3
150	3	3	2	3	3	1	2	3	3	2	3
150	3	3	3	3	3	1	2	3	3	2	3
256.25	3	3	4	4	4	2	3	4	3	2	3
150	3	3	3	3	4	1	3	3	3	2	3
137.5	3	3	3	4	3	1	2	3	2	1	4
137.5	3	3	3	4	4	1	2	2	2	1	4
225.7	4	4	2	4	4	3	1	3	3	4	3

175	3	3	2	3	3	1	1	3	3	4	3
350	4	4	4	4	4	2	1	3	4	3	4
193.75	4	4	3	4	3	2	2	3	3	2	3
175	3	3	3	3	4	1	1	4	3	4	3
212.5	4	5	6	4	4	2	2	3	4	3	3
175	3	3	3	4	4	1	1	3	3	3	3
225	3	3	3	4	3	2	1	4	4	2	4
173	4	4	4	3	3	2	2	3	3	2	3
233.6	4	4	4	4	4	1	1	3	3	3	3
225	4	4	3	5	3	3	1	3	3	3	3
267	4	4	4	5	3	3	1	3	3	3	3
175	4	4	3	4	3	1	2	3	3	2	3
250	4	4	4	4	4	3	1	3	3	3	3
137.5	3	3	2	3	4	2	3	3	3	2	3
175	3	3	3	3	5	3	2	4	3	2	3
125	3	3	3	3	4	3	2	4	3	2	3
156	4	3	2	3	4	3	2	3	3	2	3
120	2	2	2	3	3	3	2	3	3	2	3
200	3	4	3	3	4	2	2	4	4	2	3
156	3	3	2	3	4	1	2	3	3	2	3

205	3	4	2	4	4	2	2	3	3	1	5
160	3	3	2	4	4	1	2	3	3	1	4
143.25	3	3	3	4	4	1	2	3	3	1	4
218	3	4	3	4	4	1	3	3	3	1	4
200	3	4	2	4	4	1	2	3	3	1	4
237.5	4	5	2	4	3	1	2	3	3	2	3
357	4	5	5	4	3	1	2	3	3	5	3
250	4	5	4	3	5	2	3	3	3	3	3
225	4	4	3	4	4	1	1	3	3	4	3
224	3	3	2	4	4	1	2	3	3	3	3
293.75	4	4	5	4	1	2	3	3	3	3	3
225	3	3	1	4	3	2	1	4	4	2	4

MIRPUR DATA ANALYSIS



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.922163
R Square	0.850385
Adjusted R Square	0.807075
Standard Error	9.298981
Observations	50

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	18676.47	1697.861	19.63502	2.09671E-12
Residual	38	3285.9	86.47104		
Total	49	21962.37			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	5.078546	14.05084	0.361441	0.719772	-23.36589942	33.52299	-23.3659	33.52299
X Variable 1	3.944787	4.980451	0.792054	0.433246	-6.13760845	14.02718	-6.13761	14.02718
X Variable 2	6.079252	3.70322	1.641612	0.108922	-1.417525947	13.57603	-1.41753	13.57603
X Variable 3	3.10685	2.093529	1.484026	0.14605	-1.131276862	7.344977	-1.13128	7.344977
X Variable 4	1.868065	7.181966	0.260105	0.796187	-12.67106416	16.40719	-12.6711	16.40719
X Variable 5	9.010423	8.246763	1.092601	0.281448	-7.684274737	25.70512	-7.68427	25.70512
X Variable 6	-0.7862	2.296922	-0.34228	0.734023	-5.436074424	3.863676	-5.43607	3.863676
X Variable 7	4.650896	2.489232	1.868406	0.06943	-0.388291289	9.690083	-0.38829	9.690083
X Variable 8	-0.3298	2.264736	-0.14562	0.88499	-4.914513179	4.254923	-4.91451	4.254923
X Variable 9	-3.98621	2.014439	-1.97882	0.055117	-8.064232637	0.091803	-8.06423	0.091803
X Variable 10	-1.88113	3.015894	-0.62374	0.536525	-7.986489334	4.224226	-7.98649	4.224226
X Variable 11	5.538579	2.877913	1.924512	0.061802	-0.287451736	11.36461	-0.28745	11.36461

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	76.65751	-1.65751
2	74.72235	-12.2224
3	55.34136	7.15864
4	63.7939	-7.5439
5	57.57359	3.926406
6	68.97223	13.02777
7	63.10488	-3.60488
8	82.15864	-7.15864
9	94.6108	5.3892
10	94.27591	-0.52591
11	108.193	16.807
12	101.3007	11.19927
13	91.22233	2.527668
14	100.5429	-6.79288
15	88.38174	5.368255
16	112.1792	0.320783

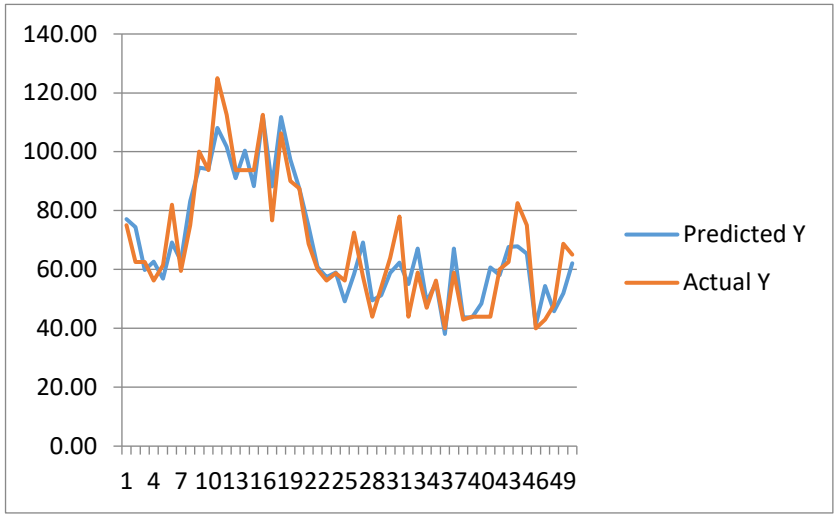
PROBABILITY OUTPUT

Percentile	*Y*
1	40
3	40
5	43
7	43
9	44
11	44
13	44
15	44
17	44
19	47
21	48
23	54
25	56.25
27	56.25
29	56.25
31	56.25

Predicted Y	*Actual Y*
76.66	75
74.72	62.5
55.34	62.5
63.79	56.25
57.57	61.5
68.97	82
63.10	59.5
82.16	75
94.61	100
94.28	93.75
108.19	125
101.30	112.5
91.22	93.75
100.54	93.75
88.38	93.75
112.18	112.5

17	87.94223	-11.2422	33	57.5	87.94	76.7
18	111.6347	-5.38474	35	58.75	111.63	106
19	97.98663	-7.98663	37	59	97.99	90
20	87.61243	-0.11243	39	59	87.61	87.5
21	73.95512	-5.20512	41	59.5	73.96	68.75
22	61.01184	-1.01184	43	60	61.01	60
23	57.89515	-1.64515	45	60	57.90	56.25
24	59.11764	-0.36764	47	61.5	59.12	58.75
25	49.08748	7.162517	49	62.5	49.09	56.25
26	58.78275	13.71725	51	62.5	58.78	72.5
27	68.97223	-11.4722	53	62.5	68.97	57.5
28	49.47513	-5.47513	55	64	49.48	44
29	50.96964	3.030358	57	65	50.97	54
30	58.06051	5.939493	59	68.75	58.06	64
31	63.11217	14.88783	61	68.75	63.11	78
32	55.46342	-11.4634	63	72.5	55.46	44
33	67.42818	-8.42818	65	75	67.43	59
34	49.08851	-2.08851	67	75	49.09	47
35	54.90553	1.344468	69	75	54.91	56.25
36	37.78843	2.211572	71	76.7	37.79	40

37	67.42818	-8.42818	73	78		67.43	59
38	44.07947	-1.07947	75	82		44.08	43
39	44.07947	-0.07947	77	82.5		44.08	44
40	48.75872	-4.75872	79	87.5		48.76	44
41	60.66389	-16.6639	81	90		60.66	44
42	58.23318	1.766816	83	93.75		58.23	60
43	67.75798	-5.25798	85	93.75		67.76	62.5
44	68.05378	14.44622	87	93.75		68.05	82.5
45	65.88194	9.118063	89	93.75		65.88	75
46	41.66565	-1.66565	91	100		41.67	40
47	54.79654	-11.7965	93	106.25		54.80	43
48	45.98166	2.01834	95	112.5		45.98	48
49	52.14569	16.60431	97	112.5		52.15	68.75
50	61.85301	3.14699	99	125		61.85	65



INPUT DATA (MIRPUR):

Dollar value	No. of bedrooms	No. of bathrooms	Balcony	Proximity of water body (lake)	Proximity of green/park	Distance from adjacent structure	Accessibility to reputable school	Distance to market/ shopping malls	Distance to daily grocery	Distance to hospital	Distance to transportation service
Y	**S1**	**S2**	**S3**	**V1**	**V2**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
75	3	2	4	2	2	1	3	2	3	2	3
62.5	3	3	2	2	2	4	2	3	3	2	4
62.5	3	3	2	2	1	1	1	4	4	4	4

56.25	3	3	2	2	2	1	2	3	4	4	3
61.5	3	3	3	1	1	1	2	4	4	3	3
82	3	3	2	1	1	1	3	3	3	3	4
59.5	3	3	2	1	1	1	3	3	4	4	4
75	3	3	2	4	3	3	3	2	3	2	2
100	3	3	3	4	4	3	4	3	4	2	2
93.75	3	3	3	4	4	3	3	2	3	2	2
125	4	4	4	4	4	2	3	2	3	2	2
112.5	4	4	4	3	3	2	3	2	2	2	2
93.75	4	4	2	3	3	1	2	2	2	2	2
93.75	4	4	5	3	3	1	2	2	2	2	2
93.75	3	4	3	3	3	2	3	2	3	3	2
112.5	4	4	4	4	4	2	3	2	2	2	2
76.7	3	4	2	3	3	1	3	2	3	2	2
106	4	4	5	4	4	2	4	3	4	2	2
90	4	4	3	3	3	1	2	2	2	3	3
87.5	3	4	2	3	3	1	3	3	3	2	2
68.75	3	3	3	1	1	1	2	1	2	2	4
60	3	2	2	1	1	1	3	3	3	4	4
56.25	3	3	2	1	1	1	1	2	4	2	4

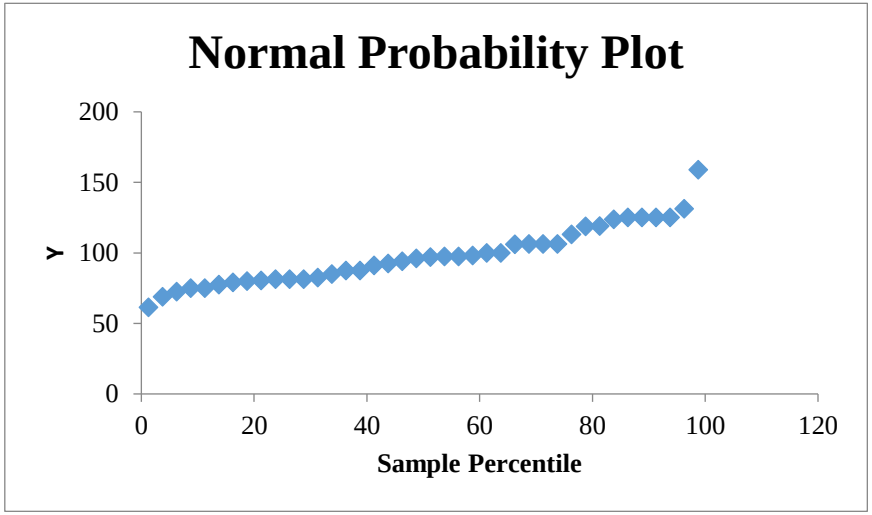
58.75	3	3	2	1	1	1	3	4	4	3	3
56.25	2	2	2	1	1	1	2	3	2	2	2
72.5	3	3	2	1	1	1	2	3	3	3	3
57.5	3	3	2	1	1	1	3	3	3	3	4
44	3	2	1	1	1	2	3	3	4	3	3
54	2	2	2	1	1	1	2	2	3	2	3
64	2	2	2	1	1	1	4	3	3	3	3
78	3	3	3	1	1	1	2	4	4	3	4
44	3	3	3	1	1	1	1	2	4	2	3
59	3	3	3	1	1	1	2	3	3	3	4
47	2	2	2	1	1	1	2	2	3	3	3
56.25	3	3	3	1	1	1	2	1	4	2	2
40	2	2	2	1	1	1	2	1	5	2	2
59	3	3	3	1	1	1	2	3	3	3	4
43	2	2	1	1	1	3	2	3	3	3	3
44	2	2	1	1	1	3	2	3	3	3	3
44	2	2	2	1	1	1	2	3	3	3	3
44	3	3	2	1	1	1	2	3	3	2	3
60	3	3	3	1	1	1	2	2	4	3	3
62.5	3	3	3	1	1	1	2	2	3	3	4

82.5	3	4	1	1	1	2	1	2	2	2	4
75	3	3	3	1	1	1	3	4	4	4	4
40	2	2	1	1	1	1	2	3	4	3	3
43	3	3	2	1	1	1	2	3	4	3	3
48	2	2	1	1	1	1	2	2	3	3	3
68.75	3	2	2	1	1	1	1	1	4	2	4
65	3	3	1	1	1	3	2	2	3	2	4

UTTRA DATA ANALYSIS

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8091
R Square	0.6547
Adjusted R Square	0.5191
Standard Error	14.339
Observations	40



ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	10916.18	992.3797	4.8265	0.000364
Residual	28	5757.097	205.6106		
Total	39	16673.27			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	11.671	36.79337	0.317191	0.753452	-63.6973	-63.6973	87.03831
X Variable 1	4.917	10.9776	0.44788	0.657686	-17.5699	-17.5699	27.40324
X Variable 2	15.742	4.982968	3.159142	0.003775	5.534755	5.534755	25.94905
X Variable 3	4.825	3.939615	1.224631	0.230918	-3.24536	-3.24536	12.89451
X Variable 4	-3.993	4.083662	-0.97791	0.336493	-12.3585	-12.3585	4.371549
X Variable 5	5.081	4.310675	1.178601	0.248476	-3.74945	-3.74945	13.91058
X Variable 6	-2.594	3.444237	-0.75307	0.457695	-9.64894	-9.64894	4.461457
X Variable 7	3.809	6.293858	0.605215	0.54991	-9.08324	-9.08324	16.70152
X Variable 8	5.528	5.621934	0.983262	0.333899	-5.98817	-5.98817	17.04384
X Variable 9	-4.415	5.243339	-0.84208	0.406877	-15.1558	-15.1558	6.325171
X Variable 10	-5.096	5.089621	-1.00124	0.325284	-15.5216	-15.5216	5.329665
X Variable 11	4.031	4.257202	0.946825	0.351828	-4.68966	-4.68966	12.75131

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	61.594	-0.34404
2	72.203	0.297385
3	81.735	-1.73504
4	107.86	-26.6145
5	92.123	-7.12259
6	94.301	-6.80066
7	62.429	6.320663
8	110.06	21.19205
9	123.12	0.631837
10	100.14	-17.6374
11	100.88	-3.87741
12	99.995	25.0048
13	105.02	-9.01576
14	116.31	8.691483
15	134.55	24.45267
16	114.68	-8.4273
17	114.74	-20.7403

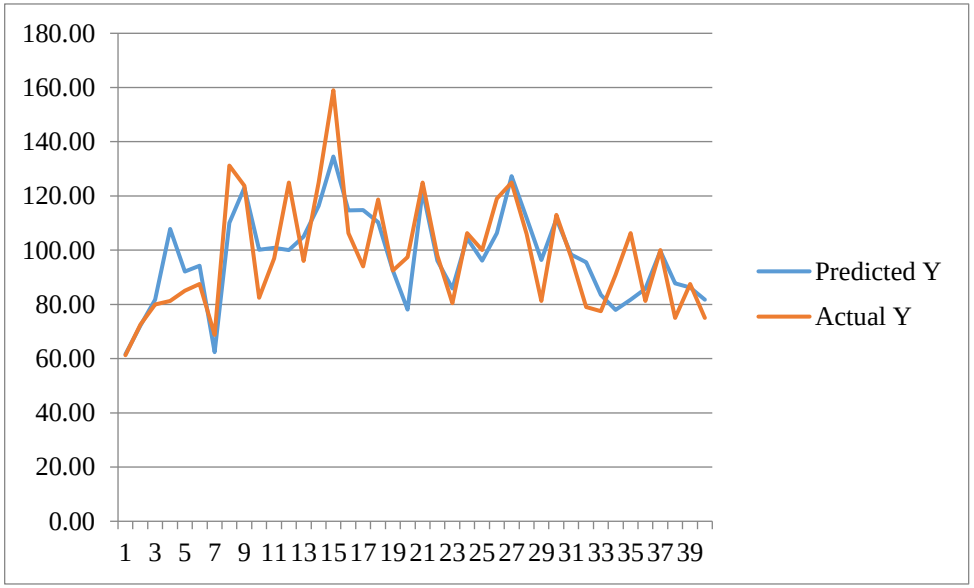
PROBABILITY OUTPUT

Percentile	*Y*
1.25	61.25
3.75	68.75
6.25	72.5
8.75	75
11.25	75
13.75	77.5
16.25	79
18.75	80
21.25	80.5
23.75	81.25
26.25	81.25
28.75	81.25
31.25	82.5
33.75	85
36.25	87.5
38.75	87.5
41.25	91

Predicted Y	*Actual Y*
61.59	61.25
72.20	72.5
81.74	80
107.86	81.25
92.12	85
94.30	87.5
62.43	68.75
110.06	131.25
123.12	123.75
100.14	82.5
100.88	97
100.00	125
105.02	96
116.31	125
134.55	159
114.68	106.25
114.74	94

18	110.26	8.487797	43.75	92.5	110.26	118.75
19	92.448	0.052447	46.25	94	92.45	92.5
20	78.127	19.37291	48.75	96	78.13	97.5
21	121.86	3.139841	51.25	97	121.86	125
22	96.198	1.802266	53.75	97.5	96.20	98
23	85.93	-5.42968	56.25	97.5	85.93	80.5
24	104.37	1.877495	58.75	98	104.37	106.25
25	96.198	3.802266	61.25	100	96.20	100
26	106.27	12.73125	63.75	100	106.27	119
27	127.27	-2.26689	66.25	106	127.27	125
28	111.8	-5.79636	68.75	106.25	111.80	106
29	96.364	-15.1136	71.25	106.25	96.36	81.25
30	111.54	1.459627	73.75	106.25	111.54	113
31	98.415	-0.91514	76.25	113	98.42	97.5
32	95.58	-16.5799	78.75	118.75	95.58	79
33	83.489	-5.98888	81.25	119	83.49	77.5
34	78.024	12.97619	83.75	123.75	78.02	91
35	81.699	24.5515	86.25	125	81.70	106.25
36	85.729	-4.47933	88.75	125	85.73	81.25
37	99.717	0.283305	91.25	125	99.72	100

38	87.73	-12.7299	93.75	125		87.73	75
39	86.233	1.26711	96.25	131.25		86.23	87.5
40	81.78	-6.78019	98.75	159		81.78	75



INPUT DATA (UTTARA):

Dollar value	No. of bedrooms	No. of bathrooms	Balcony	Proximity of water body (lake)	Proximity of green/park	Distance from adjacent structure	Accessibility to reputable school	Distance to market/ shopping malls	Distance to daily grocery	Distance to hospital	Distance to transportation service
Y	**S1**	**S2**	**S3**	**V1**	**V2**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
61.25	3	2	3	4	1	1	1	1	4	1	4
72.5	3	3	3	3	1	1	1	1	4	2	3
80	3	4	3	5	1	4	1	2	4	2	4
81.25	3	4	3	4	3	1	2	2	3	2	3
85	3	3	3	4	3	1	2	2	3	2	3
87.5	3	3	4	3	4	2	2	2	3	3	2
68.75	3	2	2	4	3	1	2	2	3	3	2
131.25	3	4	4	3	3	2	2	2	3	2	2
123.75	4	4	4	4	4	1	2	3	3	3	3
82.5	3	4	3	3	3	2	2	2	3	3	2

97	3	4	3	5	4	2	2	2	4	3	4
125	3	3	2	3	3	1	3	4	3	4	4
96	3	3	3	2	4	1	3	3	4	3	3
125	3	4	4	4	4	1	4	3	4	4	3
159	3	4	3	3	4	1	4	4	3	3	4
106.25	3	3	3	2	4	2	4	3	3	3	4
94	3	3	4	3	3	1	3	4	3	3	4
118.75	3	3	4	3	4	1	3	3	3	3	3
92.5	3	3	3	4	4	3	2	3	3	3	3
97.5	3	3	2	4	3	3	2	3	4	3	3
125	3	4	3	3	4	1	3	3	4	2	3
98	3	3	2	3	4	1	3	3	4	3	3
80.5	3	3	2	3	3	3	3	3	4	3	3
106.25	3	3	3	3	4	1	3	3	3	4	4
100	3	3	2	3	4	1	3	3	4	3	3
119	3	3	4	4	4	1	3	3	3	3	3
125	3	4	4	3	4	2	4	4	4	4	4
106	3	3	3	3	4	2	4	4	4	3	4
81.25	3	3	3	4	3	1	3	3	3	3	3
113	3	3	4	3	3	2	4	4	4	3	4

97.5	4	3	4	4	3	2	3	3	3	4	3
79	3	3	2	3	3	1	3	4	4	4	4
77.5	3	3	2	4	3	1	1	2	3	2	3
91	3	3	2	4	2	1	1	2	4	2	4
106.25	3	3	3	3	2	1	1	1	3	2	3
81.25	3	3	3	3	2	1	1	1	3	2	4
100	4	3	5	5	3	2	2	2	4	2	4
75	3	3	2	4	3	1	2	3	3	3	3
87.5	3	3	2	4	3	1	2	2	3	3	4
75	3	3	2	3	3	1	2	2	4	3	3