Analysing house prices in Potchefstroom: A microeconomic and pricing strategy approach

W Oberholzer

orcid.org/0000-0001-5290-5491

Dissertation submitted in fulfilment of the requirements for the degree Master of Commerce in Economics at the North-West University

Supervisor: Prof AM Pretorius

Co-supervisor: Mr D Dyason

Graduation May 2018

Student number: 22798196

NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
UNIBESITI YA BOKONE-BOPHIRIMA

ABSTRACT

In the absence of an existing valuation, homeowners have to determine the value of their property when they put it on the market. It is thus possible to identify a two-fold problem. One of the problems that homeowners face is determining their house's value, since homeowners and potential buyers value house characteristics, which are microeconomic factors, differently. Another problem is that, while the sellers need to determine an asking price, they also need to decide on an appropriate pricing strategy. The asking price can be defined as a suggested price for the property by the owner (the seller); the price the property would be advertised for. The selling price would be the price to transfer ownership of the property, agreed to by the buyer and seller.

Therefore the following research questions were identified: Firstly, what are the characteristic determinants of house prices in Potchefstroom (selling price as well as asking price)? Secondly, does the pricing strategy (asking price) have an impact on the time on the market (TOM), selling price and over-priced percentage?

105 observations of sold properties between 2015 and 2017 were accumulated and used as a sample containing noteworthy data. To answer the first research question, house prices and the determining house characteristics were analysed with the support of a hedonic price model. To test the theory that house prices can be explained by house characteristics, the objective was to find specific house characteristics explaining house selling and asking prices in Potchefstroom. To answer the second research question, the relationship between the pricing strategy, derived from the house asking price, and the time on the market, selling price and over-priced percentage was tested with the support of an Ordinary Least Squares (OLS) method.

The results of the hedonic price model indicated, in agreement with the literature study, that house characteristics are able to explain house prices since house characteristics indicated significance for both the asking price and the selling price. The significant characteristics for the asking price and selling price models were bedrooms, garage, plot size, a tiled roof, Baillie Park, Grimbeeck Park and Van Der Hoff Park.

Furthermore, the impact of a pricing strategy was determined by using pricing strategy, where asking prices ended on a five, as an independent variable along with control variables. The dependant variables for three separate models were time on the market, selling price and over-priced percentage. The pricing strategy indicated a statistically significant relationship with the selling price and the over-priced percentage variables. The results indicate that, if a pricing strategy is implemented, a house will sell for a price closer to the asking price.

The contribution of this study is, firstly, that house characteristics can be used to explain house prices in Potchefstroom with unique qualities such as high house price inflation, the academic town traits and the presence of the Army Support Base (ASB). Secondly, house characteristics do not only explain the selling price, but also explain the asking price in Potchefstroom. Thirdly, if a pricing strategy is implemented in Potchefstroom, a house would sell for a price closer to its asking price, especially if the house has one of the following qualities: situated in Baillie Park; more than three rooms; two bathrooms; a swimming pool; or more than one garage.

Therefore the practical implication of this study is that these findings can be used for valuing, forecasting and investment purposes.

Keywords: house prices, microeconomic, pricing strategy, over-pricing, characteristics and time on the market

OPSOMMING

In die afwesigheid van 'n bestaande waardasie moet huiseienaars die waarde van hul eiendom bepaal wanneer dit op die mark geplaas word. Dit is dus moontlik om 'n tweevoudige probleem te identifiseer. Een van die probleme wat huiseienaars in die gesig staar, is om hul huise se waarde te bepaal, aangesien huiseienaars en potensiële kopers huiseienskappe, wat mikro-ekonomiese faktore is, anders waardeer. Nog 'n probleem is dat, terwyl die verkopers 'n vraagprys moet bepaal, hulle ook moet besluit oor 'n gepaste prysstrategie. Die vraagprys kan gedefinieer word as 'n voorgestelde prys vir die eiendom deur die eienaar (die verkoper); die prys waarvoor die eiendom geadverteer sal word. Die verkoopprys sal die prys wees om eienaarskap van die eiendom oor te dra, soos ooreengekom deur die koper en verkoper.

Daarom is die volgende navorsingsvrae geïdentifiseer: Eerstens, wat is die kenmerkende determinante van huispryse in Potchefstroom (verkoopprys sowel as vraagprys)? Tweedens, beïnvloed die prysstrategie (vraagprys) die tyd op die mark, verkoopprys en oorgeprysde persentasie? 105 waarnemings van verkoopte eiendomme tussen 2015 en 2017 is ingesamel en word gebruik as 'n steekproef wat opmerklike data bevat. Om die eerste navorsingsvraag te beantwoord, is huispryse en die bepalende huiskenmerke geanaliseer met die ondersteuning van 'n hedoniese prysmodel. Om die teorie te toets dat huispryse deur huiseienskappe verklaar kan word, was die doel om spesifieke huiskenmerke te vind wat huiseverkoop en pryse in Potchefstroom verduidelik. Om die tweede navorsingsvraag te beantwoord, is die verhouding tussen die prysstrategie, afgelei van die vraagprys en die tyd op die mark, verkoopprys en oorgeprysde persentasie getoets met die ondersteuning van 'n kleinste kwadraat metode.

Die resultate van die hedoniese prysmodel is in ooreenstemming met die literatuurstudie wat aangedui het dat huiskenmerke huispryse kan verduidelik, aangesien huiskenmerke betekenis vir beide die vraagprys en die verkoopprys aandui. Die beduidende eienskappe vir die vraagprys en verkoopprysmodelle was slaapkamers, motorhuis, plotgrootte, 'n teeldak, Baillie Park, Grimbeeck Park en Van Der Hoff Park.

Verder is die impak van 'n prysbepalingstrategie bepaal deur die gebruik van prysstrategieë, waar die vraag pryse op 'n vyf geëindig het, as 'n onafhanklike veranderlike saam met beheer veranderlikes. Die afhanklike veranderlikes vir drie afsonderlike modelle was tyd op die mark, verkoopprys en oorgepryste persentasie. Die prysstrategie het 'n statisties beduidende verhouding met die verkoopprys en die te veel persentasie veranderlikes aangedui. Die resultate dui aan dat, indien 'n prysstrategie geïmplementeer word, 'n huis sal verkoop teen 'n prys wat nader aan die vraagprys is.

Die bydrae van hierdie studie is eerstens dat huiskenmerke gebruik kan word om huispryse in Potchefstroom te verklaar met unieke eienskappe soos hoë huisprysinflasie, die akademiese dorpstrekke en die teenwoordigheid van die weermagbasis. Tweedens, eienskappe van huise verduidelik nie net die verkoopprys nie, maar verduidelik ook die vraagprys in Potchefstroom. Derdens, as 'n prysstrategie in Potchefstroom geïmplementeer word, sal 'n huis verkoop teen 'n prys wat nader aan sy vraagprys is, veral as die huis een van die volgende eienskappe het: geleë in Baillie Park; meer as drie kamers; twee badkamers; n swembad; of meer as een motorhuis.

Daarom is die praktiese implikasie van hierdie studie dat hierdie bevindings gebruik kan word vir waardasie, vooruitskatting en beleggingsdoeleindes.

Sleutelwoorde: huispryse, mikro-ekonomie, prysstrategie, oorprysing, eienskappe en tyd op die mark

This dissertation is dedicated to my father and mother,

Merwe and Louise Oberholzer

ACKNOWLEDGEMENTS

This dissertation is the result of many peoples input and help over the years, whom I owe a great debt of gratitude. I would therefore like to give a special mention to the following:

- Prof. Krugell, thank you to you and your team for having faith in me and accepting me and to do my honours; it laid the foundation for my master's study.
- Prof. Kleynhans thank you for teaching me the essentials of research and to pay attention to fine detail as it came in helpful during my master's degree.
- To my language editor, Me Cornelius, thank you for assisting with editing my study. Your ability to effectively help me at last minute with noble language skills definitely added abundant value to my study.
- My sincere thanks go to my supervisors, Prof. Pretorius and Mr Dyason. Prof. Pretorius, thank you for believing in me and for your empirical inputs. Your enthusiasm is contagious and kept me motivated. Mr Dyason, thank you for sharing your knowledge in the field of properties and for your positive critique, it helped to improve my work. The two of you made an exceptional team! Thank you for always having time for me.
- A special thanks to Franki du toit properties, Hanlie and Frankie, for assisting and providing me with data throughout my data accumulation process that formed the fundamentals of my empirical chapter. I highly appreciate your time and efforts.
- My parents, mother, thank you for your emotional support. I treasure your teaching - "finish what you started" as I believe it help me to successfully conquer my master's study. Father, your guidance throughout my years of studies is appreciated. Your help, advice, guidance and assistance throughout my master's helped me to succeed and reach my full potential as a master's student. I have to thank you both for supporting me financially throughout my studies.

I honour God for the opportunity, strength and knowledge that were given to me to complete this dissertation.

Waldo Oberholzer

Potchefstroom

November 2017

TABLE OF CONTENTS

ABSTRACT i
ACKNOWLEDGEMENTS vi
ACRONYMS AND ABBREVIATIONS x
FIGURES xi
TABLES xii

CHAPTER 1 1
INTRODUCTION AND BACKGROUND 1
1.1. INTRODUCTION 1
1.1.1. Background and study area 2
1.2. PROBLEM STATEMENT 5
1.3. RESEARCH QUESTIONS 5
1.4. RESEARCH OBJECTIVES 5
1.4.1. General objective 5
1.4.2. Specific objectives 5
1.5. LITERATURE STUDY 6
1.5.1. Macroeconomic factors 6
1.5.2. Microeconomic-factors 6
1.5.3. Empirical models 8
1.5.4. Pricing strategies 9
1.5.5. Synthesis 9
1.6. METHODOLOGY 9
1.6.1. Research design 10
1.7. SIGNIFICANCE AND PRACTICAL IMPLICATIONS OF THE RESEARCH 11
1.8. CHAPTER OUTLINE 11

CHAPTER 2 13
LITERATURE STUDY 13
2.1. INTRODUCTION 13
2.2. SOUTH AFRICAN STUDIES ON HOUSE PRICES 13
2.3. MACROECONOMIC FACTORS AND THEORIES 15
2.4. MICROECONOMIC FACTORS AND THEORIES 18

2.4.1. Structural characteristics 18
2.4.2. Locational characteristics 26
2.4.3. Synthesis 29
2.5. ESTIMATION TECHNIQUES 31
2.5.1. Hedonic model 32
2.5.2. Other estimations 36
2.5.3. Synthesis 37
2.6. PRICING STRATEGY 38
2.6.1. Over-pricing and under-pricing 38
2.6.2. Price endings 41
2.7. CONCLUSION 44

CHAPTER 3 46
RESEARCH METHODOLOGY & DATA ANALYSIS 46
3.1. INTRODUCTION 46
3.2. RESEARCH PARADIGM 47
3.3. RESEARCH APPROACH 47
3.4. RESEARCH QUESTIONS 47
3.4.1. The determinants of house prices in Potchefstroom 47
3.4.2. The pricing strategy impact on the selling price 48
3.5. STRATEGY AND RESEARCH DESIGN 48
3.5.1. Method 48
3.5.2. Empirical validity 51
3.5.3. Case study research 52
3.6. DATA COLLECTION 56
3.6.1. Variables 57
3.6.2. Data description 58
3.7. HOUSE PRICE TRENDS 59
3.7.1. House prices per suburb 61
3.7.2. House characteristics per suburb 64
3.8. ETHICS 69
3.9. VALIDITY 69
3.10. RELIABILITY 70

3.11. CONCLUSION 70

CHAPTER 4 72
RESULTS AND FINDINGS 72
4.1. INTRODUCTION 72
4.2. MODEL SPECIFICATION 72
4.3. VALIDITY TESTS 72
4.4. EMPIRICAL ANALYSIS 73
4.4.1. The determinants of house prices in Potchefstroom 73
4.4.2. The impact of the pricing strategy 79
4.6. CONCLUSION 94

CHAPTER 5 95
SUMMERY AND CONCLUSION 95
5.1. INTRODUCTION 95
5.2. PROBLEM STATEMENT AND OBJECTIVES 95
5.3. METHODOLOGY 96
5.3.1. Research area 96
5.4. SUMMERY OF FINDINGS 97
5.4.1. Literature review 97
5.4.2. Empirical study 99
5.5. LIMITATIONS 100
5.6. DISCUSSION AND CONCLUSION 100
5.7. RECOMMENDATIONS 102
5.8. FUTURE RESEARCH 102
5.9. FINAL CONCLUSION 103

REFERENCE LIST 104
ADDENDUM A 110

ACRONYMS AND ABBREVIATIONS

ASB	Army Support Base
ANN	Artificial neural network
ANOVA	Analysis of variance
BLUE	Best Linear Unbiased Estimator
CBD	Central business district
CC&R	Covenants, Conditions and Restrictions
CEE	Central and Eastern Europe
CLRM	Classical Linear Regression Model
GDP	Gross Domestic Product
GIS	Geographic information system
HKD	Hong Kong Dollar
HOA	Home Owners' Association
NE	North East
NW	North West
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Square
QR	Quantile regression
RESET	Regression Equation Specification Error Test
SANDF	South African National Defence Force
SAR	Simultaneous autoregressive
SE	South East
SW	South West
TOM	Time on the market
USA	United States of America
VC	Varying coefficient

FIGURES

Figure 1	Average house selling prices	3
Figure 2	Map of Potchefstroom	4
Figure 3	Impact of economic activities on housing market	17
Figure 4	Original means-end chain mode	19
Figure 5	Pricing strategies summary	44
Figure 6	Potchefstroom settlement types	53
Figure 7	Potchefstroom tenure status	53
Figure 8	Map of Potchefstroom	55
Figure 9	Asking price kernel density estimate	59
Figure 10	Selling prices kernel density estimate	60
Figure 11	Average house prices per suburb	61
Figure 12	Roof type per suburb: tiled or metal	67
Figure 13	Roof type per suburb: pitched or flat	67
Figure 14	Presence of pools per suburb	68
Figure 15	Pricing strategies summary	99

TABLES

Table 1	Top twenty house characteristics in hedonic pricing model studies	20
Table 2	House characteristics summary	31
Table 3	Variable summary	58
Table 4	Baillie Park house price statistics	62
Table 5	Central and Suid Dorp house price statistics	62
Table 6	Van der Hoff Park house price statistics	63
Table 7	Grimbeeck Park house price statistics	63
Table 8	Miederpark house price statistics	64
Table 9	Baillie Park house characteristic statistics	64
Table 10	Central and Suid Dorp house characteristic statistics	65
Table 11	Van der Hoff Park house characteristic statistics	65
Table 12	Grimbeeck Park house characteristic statistics	66
Table 13	Miederpark house characteristic statistics	66
Table 14	Correlation matrix	71
Table 15	Price models results	72
Table 16	Squared explanatory variable model – plot size	76
Table 17	Logarithmic selling price models	78
Table 18	TOM regression results	79
Table 19	Selling price regression results	80
Table 20	Selling price regression results with house characteristics	81
Table 21	Over-priced percentage regression results	82
Table 22	Squared explanatory variable – distance	83
Table 23	Houses with more than three bedrooms	84
Table 24	Houses with two bathrooms	85
Table 25	Houses with a pool present	86
Table 26	Houses with more than one garage	87
Table 27	Suburb effect	88
Table 28	Suburb effect with TOM	89
Table 29	Whole sample excluding suburbs	90
Table 30	Baillie Park	91
Table 31	Miederpark, Central and Suid Dorp	92

Table 32	House characteristics summary	97
Table 33	Price model result – asking price	110
Table 34	Heteroscedasticity test: Price model results – asking price	110
Table 35	Adjusted price model results – asking price	110
Table 36	Price model result – selling price	111
Table 37	Heteroscedasticity test: Price model results – selling price	112
Table 38	Adjusted price model results – selling price	112
Table 39	Squared explanatory variable model – plot size	112
Table 40	Heteroscedasticity test: Squared explanatory variable model – plot size	113
Table 41	Adjusted squared explanatory variable model – plot size	113
Table 42	Logarithmic model 1 – selling price	114
Table 43	Heteroscedasticity test: Logarithmic model 1 – selling price	114
Table 44	Adjusted logarithmic model 1 – selling price	115
Table 45	Logarithmic model 2 – selling price	115
Table 46	Heteroscedasticity test: Logarithmic model 2 – selling price	116
Table 47	Adjusted logarithmic model 2 – selling price	116
Table 48	TOM regression results	117
Table 49	Heteroscedasticity test : TOM regression results	117
Table 50	Adjusted TOM regression results	117
Table 51	Selling price regression results	118
Table 52	Heteroscedasticity test: Selling price regression results	118
Table 53	Adjusted selling price regression results	119
Table 54	Selling price regression results with house characteristics	119
Table 55	Heteroscedasticity test: Selling price regression results with house characteristics	120
Table 56	Adjusted selling price regression results with house characteristics	120
Table 57	Over-priced percentage regression results	121
Table 58	Heteroscedasticity Test: Over-priced percentage regression results	121
Table 59	Adjusted over-priced percentage regression results	121
Table 60	Squared explanatory variable – distance	122

Table 61	Heteroscedasticity test: Squared explanatory variable – distance	122
Table 62	Adjusted squared explanatory variable – distance	122
Table 63	Houses with more than three bedrooms	123
Table 64	Heteroscedasticity test :Houses with more than three bedrooms	123
Table 65	Adjusted houses with more than three bedrooms	124
Table 66	Houses with less than four bedrooms	124
Table 67	Heteroscedasticity test: Houses with less than four bedrooms	124
Table 68	Adjusted houses with less than four bedrooms	125
Table 69	Houses with two bathrooms	125
Table 70	Heteroscedasticity test: Houses with two bathrooms	126
Table 71	Adjusted houses with two bathrooms	126
Table 72	Houses with more than two bathrooms	126
Table 73	Heteroscedasticity test: Houses with more than two bathrooms	127
Table 74	Adjusted houses with more than two bathrooms	127
Table 75	Houses with a pool	127
Table 76	Heteroscedasticity test: Houses with a pool	128
Table 77	Adjusted houses with a pool	128
Table 78	Houses without a pool	129
Table 79	Heteroscedasticity test: Houses without a pool	129
Table 80	Adjusted houses without a pool	129
Table 81	Houses with more than one garage	130
Table 82	Heteroscedasticity test: Houses with more than one garage	130
Table 83	Adjusted houses with more than one garage	131
Table 84	Houses with only one garage	131
Table 85	Heteroscedasticity test: Houses with only one garage	131
Table 86	Adjusted houses with only one garage	132
Table 87	Suburb effect	132
Table 88	Heteroscedasticity test: Suburb effect	133
Table 89	Adjusted suburb effect	133
Table 90	Suburb effect with TOM	134
Table 91	Heteroscedasticity test: suburb effect with TOM	134
Table 92	Adjusted model: suburb effect with TOM	134
Table 93	Whole sample excluding suburbs	135

Table 94	Heteroscedasticity test: whole sample excluding suburbs	136
Table 95	Adjusted model: whole sample excluding suburbs	136
Table 96	Baillie Park	136
Table 97	Heteroscedasticity test: Baillie Park	137
Table 98	Adjusted model: Baillie park	137
Table 99	Miederpark, Central and Suid	138
Table 100	Heteroscedasticity test: Miederpark, Central and Suid	138
Table 101	Adjusted model: Miederpark, Central and Suid	139
Table 102	Grimbeeck Park	139
Table 103	Heteroscedasticity test: Grimbeeck Park	140
Table 104	Adjusted model: Grimbeeck Park	140
Table 105	Van Der Hoff Park	141
Table 106	Heteroscedasticity test: Van Der Hoff Park	141
Table 107	Adjusted model: Van Der Hoff Park	141

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1. INTRODUCTION

One feature of the real estate market is that there is constant variation in house prices and the number of houses for sale on the market (Genesove & Mayer, 1994:255). This is driven by movement and customer satisfaction preferences within the economy. The value of house prices is affected by macroeconomic factors, such as house price inflation and economic cycles (Adams & Füss, 2010:3), and microeconomic factors, such as house characteristics (Kim, Hung & Park, 2015:272; Zietz, Zietz & Sirmans, 2008:318). These circumstances are a determinant of the property's equity and a large component of a household's wealth (Merlo *et al.*, 2015: 457). A household's wealth is influenced by the price received when selling the property (Merlo *et al.,* 2015: 457). For this reason, the role of the above-mentioned micro- and macroeconomic factors in determining the value of a property is important. Sellers have strong incentives to gain as high a yield as possible on their houses. Consequently, sellers need to strategically set the asking price of the houses (Merlo *et al.,* 2015: 457; Beracha & Seiler, 2014:2).

The asking price serves as an indicator of how much the seller would like to receive as an initial value; at the same time, buyers use it as a screening mechanism when searching for houses within their budget (Allen & Dare, 2004:695). Therefore, the asking price can be defined as a suggested price for the property by its seller; the price the property will be advertised for. On the other hand, the selling price is defined as the agreed value of a property, usually a price (based on the seller's asking price) offered by the buyer and accepted by the seller. The selling price is fixed by a sales contract and the property ownership will transfer based on this amount. In addition, the seller, assisted by the real estate agent, wants to sell the house at a maximum price and as quickly as possible. The asking price has a significant effect on the time on the market (TOM) factor of a house (Genesove & Meyer, 1994:259)

Since houses have characteristics that differ from each other, according to Steynberg (2017:1), it is not preferable to align one's asking price with the asking prices of houses in one’s street or area that are listed on property portals. Furthermore, when setting an asking price for one’s house, it is important to keep in mind that it will only sell for the amount that the market is prepared to pay. Therefore, an important factor would be to price one’s house properly with the correct pricing strategy. Pricing strategy is the strategy the seller or real estate agent will use to sell the house; pricing strategies include over-pricing, under-pricing and price endings. Price ending strategies include the following: “just below” – this refers to an asking price of, for example, R219 999; “round price” – this refers to an asking price of, for example, R220 000; or a precise pricing strategy – this refers to an asking price of, for example, R221 455 (Beracha & Seiler, 2014:4).

The challenge to sellers when setting the asking price lies in the general problem of valuing houses with the focus on microeconomic factors representing house characteristic features; however, these characteristics can be quantified (Malpezzi *et al.*, 1980:1; Sirmans *et al.*, 2005:3). Malpezzi *et al.* (1980:2) further state that quantifying the value of properties is compounded by their characteristics. Consequently, whatever the basis of property valuations, it is important to value accurately (South African Property Valuations, 2017).

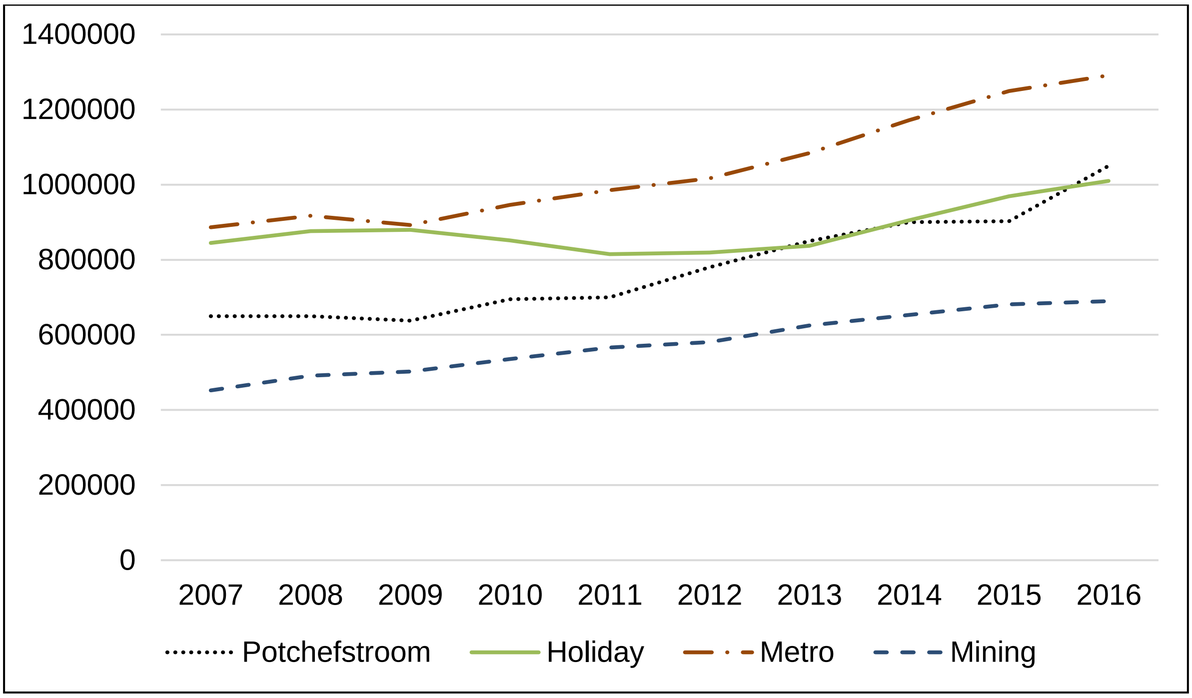
For sellers to accurately value their houses and use the correct pricing strategy, the aim of this dissertation is to explain the characteristic that best determines the asking and selling prices for houses as well as explain the potential impact of the pricing strategy on the selling price. The real estate market in Potchefstroom, North West, is used to determine these aspects.

1.1.1. Background and study area

The economy consists of a network of geographical areas, each with their own individual characteristics. In Gauteng, the house price differences between asking and selling prices are narrower than those in Cape Town (Steynberg, 2017:1). For this reason, each area, rural and urban, driven by geographical differences, tends to have some degree of separate house price trends. Since house prices change over time, it is important to consider all pricing suggestions; Steynberg (2017:1) acknowledges this by suggesting that sellers should “think like a buyer”.

Potchefstroom experienced unexpectedly high house price inflation compared to holiday destinations, metro areas and mining towns in the past decade (Property24®, 2017; Quantec, 2017). Figure 1 indicates the comparative growth of house purchase prices in Potchefstroom in comparison to other areas between 2007 and 2016. Potchefstroom's house purchase prices have continuously increased since 2007, catching up with holiday destination house prices. In 2016, the average house price in Potchefstroom was higher than that of holiday destinations and mining areas. The house prices of metro areas and Potchefstroom, however, display a similar growing curve.

Figure 1. Average house selling prices



Source: Compiled by author with Property24® (2017) and Quantec (2017) data

The contributing factors in the house price growth in Potchefstroom are not the focus of this study. However, the uniqueness of this trend has resulted in Potchefstroom being chosen as a case study. The reasons contributing to the growth in house prices could be driven by the growth of the university, the military and other business activities. To minimise the impact of student residential demand in Potchefstroom, which is influenced by flats and townhouses, this study will only consider freestanding residential properties and suburbs not surrounding the university. Figure 2 illustrates a satellite view of the study area, Potchefstroom and its suburbs.

Figure 2. Map of Potchefstroom

Source: Google Maps (2017)

1.2. PROBLEM STATEMENT

Based on the above discussion, it is evident that the valuation of residential property is a multifaceted process. Valuations could be based on several characteristics and circumstances, all of which should be considered. In the absence of an existing valuation, homeowners have to determine the value of their property when they put it on the market. It is thus possible to identify a two-fold problem that will serve as a point of departure for the present investigation. One of the problems that homeowners face is determining their house's value, since homeowners and potential buyers value physical characteristics differently. Another problem is that, while the sellers need to determine an asking price, they also need to decide on an appropriate pricing strategy. For example, in the case of over-pricing, it can cause the house to prolong its TOM as the asking price could be too high.

1.3. RESEARCH QUESTIONS

The research questions that will be investigated by this study can be summarised as follows:

- What are the characteristic determinants of house prices in Potchefstroom (selling price as well as asking price)?
- Does the pricing strategy (asking price) have an impact on the TOM, selling price and over-priced percentage?

1.4. RESEARCH OBJECTIVES

1.4.1. General objective

The general objective of the study is to find the determinants of house prices in Potchefstroom based on the specific characteristics of houses and to determine if there is a relationship between a pricing strategy and the TOM, selling price and over-priced percentage.

1.4.2. Specific objectives

The first research question will be supported by the following specific objectives:

- From a micro perspective, to determine the specific characteristics of a house in explaining the selling and asking prices.

- Calculate the price difference between the asking price and the selling price of houses, thus determining the over-priced factor.

The second research question will be supported by the following specific objectives:

- To determine if a relationship exists between the pricing strategy and time on the market.
- To determine if the pricing strategy would influence the selling price.
- To determine if there is a relationship between the pricing strategy and the over-pricing of a house.

1.5. LITERATURE STUDY

1.5.1. Macroeconomic factors

House prices are influenced by macroeconomic factors (Adam & Füss, 2010:39). Firstly, when economic growth takes place, an opportunity for development to take place is presented. An indicator of economic activities and, more specifically, economic development is the Gross Domestic Product (GDP) per capita. When there is economic growth, the GDP per capita will increase and new employment opportunities will be created (Taltavull De La Paz, 2003:111; Holmes, 2007:9). More employment opportunities will increase the demand for goods and services, which includes the need for housing and house building (Taltavull De La Paz, 2003:111). Secondly, interest rate changes affect house prices since, if the mortgage rates increase, this affects property level costs and customer spending; as a result, house values are affected (Adams & Füss, 2010:39). In addition, business cycle changes also affect the demand for housing and new house building; as a result, changes in house prices will occur (Hort, 1998:93; Muller, 2010:1).

1.5.2. Microeconomic-factors

House prices are influenced by house characteristics, which are microeconomic factors (Kim, Hung, *et al.,* 2015:279). House prices can further be influenced by different characteristics according to house segments (Kim, Hung, *et al.,* 2015:279). Different income and area buyers are, therefore, looking for different characteristics to fulfil their various needs. House segments play a role when house prices are determined due to the existence of economic growth and socio-economic imbalances amongst provinces and within areas and between households' income (Naudé & Krugell, 2006:445; Simo-Kengne *et al.,* 2012:102). Since homebuyers do not value characteristics equally, it is important to identify the most important house characteristics and their corresponding value.

House characteristics can be divided into two sections: the physical structure of a house and its immediate surroundings (Goodman, 1977:475) – termed structural characteristics; and the location of a house that is unique to each house – termed locational characteristics. House characteristics can be used as variables to explain house prices. Sirmans *et al.* (2005:8) summarised the top twenty characteristics that mostly appeared in 125 studies. Seventeen of the top twenty variables represented structural characteristics. The top five construction and structural characteristics represented the following: plot size; the age of the house; the number of bedrooms; square feet (square meter); and the number of bathrooms. These findings correlate with South African studies that illustrate the most important house characteristics. These top structural characteristics corresponded with the significant characteristics of South African studies. Van Der Walt (2010:38) found pool, attached garage and building style to be significant in Hout Bay, South Africa. Du Preez and Sale (2013:460) found significant results for the number of stories, lot size, a pool and an electric fence. Arimah (1992:366), an African study, discovered that homeowner's demand for structural characteristics was the highest for rooms, house size, number of stories and bathrooms. Not only are the characteristics important, but they also affect the selling price. Furthermore, the following structural characteristics had a positive effect on house selling prices: square feet (square meter); number of bedrooms; number of bathrooms; number of garages; the presence of a fireplace; the presence of a pool; and if the house had been remodelled (Konecny, 2012:32). Liao and Wang (2012:16) found square feet and number of bedrooms to be significant throughout quantiles. Kim, Hung, *et al.* (2015:278) indicated that a rooftop terrace would have a positive effect on the selling price.

The location of a house is another consideration for the selling price. House characteristics are mostly valued differently in different locations (Sirmans *et al.,* 2005:3). Therefore, it is important to incorporate locational characteristics to explain house prices, such as various suburbs and distances from amenities. Dumm *et al.* (2016:1) indicated that waterfront properties had a larger premium percentage than non-waterfront properties, implying that the location of a property influences a property's price. Accordingly, Du Preez and Sale (2014:464) identified that the distance from social housing developments has a significant relationship with formal house prices in South Africa. The distance to shops, trains, hospitals and public schools was considered as a locational characteristic by De Angelo and Fávero (2003:10). Arimah (1992:375) found that, in terms of locational characteristic needs, the distance from schools and hospitals was the highest demand for tenants. In addition, Kim, Park, *et al.* (2015:96) stated that owners of lower priced houses also preferred to stay closer to schools. Locational characteristics, which include the distance to various parks and a greening environment rate, were investigated by Liao and Wang (2012:19). Liu and Hite (2013:1) concurred and suggested that houses closer to larger green spaces would have higher selling prices. Another locational characteristic, more specifically with regard to scenery, is the view, since a house can face various settings such as rivers or mountains. Kim, Park, *et al.* (2015:96) identified view as a characteristic if a house faced a river or a mountain, as well as the distance to a station. Choy *et al.* (2009:7) found that homebuyers prefer properties where the view is not obstructed, in other words, properties with an open view, a green view or a sea view.

1.5.3. Empirical models

The previous section details how house prices can be explained by various structural and locational characteristics. The hedonic price function is mostly used as a method to empirically explain house prices (Kim, Hung, *et al.,* 2015:273). As a result, the hedonic price function determines the demand and supply for house characteristics as well as how these characteristics vary in value from area to area (Rosen, 1974:42; Epple, 1987:59).

The following other econometric models could be found in similar studies: OLS regression; quantiles by using a varying coefficient (VC) approach; Box-Cox quantile regression; Rosen's two-step model; artificial neural network (ANN); and a geographic information system (GIS). This will be discussed in the literature study.

1.5.4. Pricing strategies

House sellers want to sell their properties within a minimum time on the market at a maximum price (Genesove & Mayer, 1994:259; Beracha *et al.,* 2013:293). The house asking price sends out a signal to buyers (Benjamin & Chinloy, 2000:61); it is, therefore, important to strategically set the asking price as it is an attempt to affect the perception of the buyer. Some argue that over-pricing and under-pricing could be used as pricing strategies (Hui *et al.*, 2012:375; Asabere *et al.,* 1993:149). Over-pricing as a strategy can be seen as an implementation of a broker to incorporate more marketing costs and, as a result, market the property for much more (Benjamin & Chinloy*,* 2000:63). However, over-pricing of houses has been found to prolong the time on the market (Hui *et al.,* 2012:395). Furthermore, price endings are considered as pricing strategies; these are categorised into a round number, a "just below" number or an exact number. Usually when houses are advertised, a round number or "just below" pricing strategy is followed (Palmon *et al.,* 2004:115). Studies have found that when the "just below" pricing strategy is used, the house will sell for a price closer to the asking price (Palmon *et al.,* 2004:115).

1.5.5. Synthesis

The difference in house prices can be explained by structural and locational house characteristics with most studies making use of the selling price, while others incorporated the municipal valuation as dependent variables. Few studies considered the asking price as a dependent variable. The incorporation of the asking price can further be used to analyse the effectiveness of pricing strategies, since pricing strategies have a significant impact on both the time on the market factor and the selling price.

1.6. METHODOLOGY

The study will follow a quantitative deductive approach, as the stated theories are tested. In addition, the study follows a positivistic epistemological paradigm since the data analysis is quantitative in nature. The ontological assumption deals with the nature of reality and will be objective. The rhetorical language of the study comprises the impersonal voice using scientific facts. The methodological process of research will be deductive reasoning.

The objectives of this study are answered by both a literature study and an empirical study. Firstly, the literature study inspects the difference which exists between asking and selling prices and, secondly, investigates macroeconomic factors that impact the housing sector as well as microeconomic characteristics of house price estimates. The aim of the literature study with regard to house prices was to focus on the microeconomic, macroeconomic and pricing strategy impact in order to see what variables, methodological approaches and theories were used by previous authors and to detect the gap in those studies.

An empirical study was conducted in order to determine the significance of house characteristics so as to explain house prices as well as to determine if there is a relationship between house prices (asking and selling), pricing strategy, over-pricing and time on the market in Potchefstroom.

1.6.1. Research design

The study specifically focuses on freestanding low-density residential houses registered in Potchefstroom for the period 2015 to 2017.

In particular, cross-sectional data for this study was accumulated by the author from real estate agencies in Potchefstroom and the South African property portal, Property24® (2017). In addition, Lightstone Property® (2017), Windeed and the Tlokwe City Council valuation roll also contributed to the collection of data. Approximately 100 observations were collected for this study.

A hedonic regression approach was used to establish the impact of house characteristics on selling and asking prices. This was done by developing models with the selling price and the asking price as dependent variables and different structural and locational characteristics as independent variables.

The following Ordinary Least Square (OLS) regressions were done in order to identify the interrelationships between pricing strategy, over-pricing and time on the market; the over-priced variable describe and explains the difference between the asking price and the actual selling price:

- Time on the market = f(Pricing strategy, control variables)
- Selling price = f(Pricing strategy, control variables)

- Over-priced = f(Pricing strategy, control variables)

1.7. SIGNIFICANCE AND PRACTICAL IMPLICATIONS OF THE RESEARCH

The originality of this study can be explained as follows: firstly, the study is the first to investigate, not only selling prices, but also asking prices; and, secondly, to the best knowledge of the author, this is the first study in South Africa to consider both characteristics and pricing strategy.

The contribution of this study is that it analyses and explains house prices in Potchefstroom with a microeconomic and pricing strategy approach. Therefore, the practical implication of the study would be that it could be used for selling, valuing, forecasting and investing purposes (Marcato & Nanda, 2016:166). The models can be used as a basis for similar studies in other towns or regions. Consequently, sellers, buyers, investors, estate agencies, developers and financial institutions would have a more informed understanding of current house prices and the appropriate price strategies to use.

1.8. CHAPTER OUTLINE

Chapter one introduces the study with a discussion of the background and the study area. This is followed by the problem statement, the research questions and the underlying objectives of the study. A brief literature study is included to ensure a deeper understanding of the study's research problem. The methodology, which includes a research design, then follows which states how the study was conducted. Lastly, the significance and the practical implications of the study are discussed.

Chapter two serves as a literature discussion to assist in obtaining theoretical and empirical understandings of the identified research problem. The literature study includes a discussion of relevant South African studies on house prices, macroeconomic factors influencing house prices and which housing characteristics – microeconomic factors – influence house prices. In addition, house price estimation techniques and different pricing strategies are discussed, after which a conclusion is made.

Chapter three describe and explains the research methodology and data analysis. This chapter provides a background to the empirical study, explaining the research paradigm, research approach and the research questions. A discussion of the research strategy and the research design follows. The data collection process is then discussed with the identified variables for empirical purposes. This is followed by an explanation of the data in the form of house price trends and variable comparisons. The chapter ends with the validity and reliability of the study.

Chapter four explains the empirical results and findings. The chapter begins with the model specification and the tests used for validity. The empirical analysis then follows together with the results of the models and a conclusion of the findings.

Chapter five serves as a conclusion and summary of the study. The problem statement, objectives and methodology are revisited with the goal of ensuring that the objectives of the study have been reached. This is followed by the findings in the literature study and the empirical study that are summarised in order to reach a conclusion. Lastly, recommendations are made together with a final conclusion.

CHAPTER 2

LITERATURE STUDY

2.1. INTRODUCTION

The literature study serves as a critical discussion of relevant theories and empirical studies in support of the research questions. Furthermore, the literature study will highlight the relevant studies in order to establish a theoretical framework and methodological focus.

The chapter is structured as follows: firstly, South African studies regarding house prices are discussed; secondly, macroeconomic and microeconomic factors (resembling house characteristics) that influence house prices are investigated; thirdly, the hedonic pricing model and other different estimation techniques are discussed; and, lastly, pricing strategies of selling prices are investigated. The conceptual framework of this study is demarcated to the broader microeconomic and pricing strategy theories.

2.2. SOUTH AFRICAN STUDIES ON HOUSE PRICES

Only a few studies have been done in South Africa with regard to house prices and the determining factors. Accordingly, a discussion of these studies will follow.

Du Preez and Sale (2013:451) investigated the price changes of properties situated near social housing developments in Nelson Mandela Bay, South Africa. Social housing developments might seem like a negative concept for surrounding property owners; however, these structures include the capacity to connect residents to city-related resources and to stabilise crime within some environments since some international studies have found that such structures might have a positive effect on house prices (Du Preez & Sale, 2013:451). In order to investigate this phenomenon, a neighbourhood in Nelson Mandela Bay, The Walmer Township, was considered and used as a proxy for other social housing developments. The Walmer Township includes formal housing as well as “shack dwellings” that are situated at the back of the township (Du Preez & Sale, 2013:465). The hedonic function indicated that the distance from the township had a significant effect on house prices, as the distance from the Walmer Township was valued at R234.49 per metre indicating that, for every metre from the township, house prices would increase. This indicates that social housing developments will have a negative impact on areas near such developments in Nelson Mandela Bay (Du Preez & Sale, 2013:464).

Another South African study examined municipal assessments versus the actual selling price of properties regarding hedonic price models in Nelson Mandela Bay, South Africa (Du Preez & Sale, 2014:1). In terms of hedonic modelling, actual house selling prices were mostly used as the dependent variable. However, the selling price is not the only price to be considered since assessed municipal property valuations can be used as an alternative and are more readily available. The study made use of assessed prices and selling prices in order to compare them in two separate hedonic models. The selling prices were lower than the assessed property values in the Nelson Mandela Bay area (Du Preez & Sale, 2014:6). The results indicated that the influence of structural and locational characteristics on assessed municipal prices and selling prices was different. Supplementary to this, selling prices presented a more accurate market condition than the assessed values. For this reason, it was suggested that researchers should use the selling price as the dependent variable rather than the assessed value in a hedonic pricing model (Du Preez & Sale, 2014:8).

Van Der Walt (2010:5) established the determinants of house prices in Hout Bay. The study acknowledges the basis that houses cannot be disconnected from their surrounding environment. Therefore, the aim was to find which factors affect house prices, to assess how much the different characteristics influence house prices and to determine the role characteristics play as a group in determining house prices. The study implemented a quantitative and qualitative approach through interviewing estate agents. The findings show that homebuyers desire privacy and a large lot size; consequently, for a house to be situated close to a noisy road was undesirable. The variables that were considered as reliable indicators proved to be poor predictors when using the statistical analysis of variance (ANOVA) approach. Furthermore, informal settlements had a negative effect on price and desirability, which supports Du Preez and Sale’s (2013:465) results on social housing developments and informal settlements.

Other South African studies include Burger and Janse van Rensburg (2008:291) who investigated whether or not differences in house prices cause the various metropolitan areas to each constitute a separate housing market and, whether or not, in spite of these differences, there still exists a single South African housing market. Gupta and Das (2008:1) examined spatial Bayesian models of forecasting house prices in six metropolitan areas of South Africa and added that literature on the micro determinants of house prices in South Africa was scarce.

2.3. MACROECONOMIC FACTORS AND THEORIES

The property market is sensitive to changes within the economy, especially the macroeconomic environment. Since this study will focus largely on microeconomic determinants of house prices, it is worthy to acknowledge the macroeconomic environment influencing house prices. External factors are influencing house prices either positively or negatively. In this study, external factors are viewed as macroeconomic factors. This section further exploits macroeconomic factors and theories to identify the effects of these on house prices.

Numerous studies have studied and analysed macroeconomic determinants of house prices (Adams & Füss, 2010:38; Merlo *et al.,* 2015:457; Beracha & Seiler, 2013:2), especially in developed countries (Simo-Kengne *et al.*, 2012:79).

Adams and Füss (2010:39) examined the short-term dynamics of international house prices and the long-term macroeconomic impact thereof. The study found that an increase in economic activity resulted in an increase in employment, which increases the demand for accommodation. Employment is the largest macroeconomic factor to influence the time on the market factor of a house (Kalra & Chan, 1994:260). Housing inventory cannot change in the short-term and, therefore, if an increase in employment takes place, property rental will increase leading to higher house prices in the short-term (Adams & Füss, 2010:41; Wang & Zhou, 2006:4). An upsurge in the long-term interest rate does not change the demand for housing directly. However, it changes the demand from ownership to rentals. This is also reflected in higher mortgage rates and a decrease in the demand for houses and in house prices (Adams & Füss, 2010:41). The difference between other capital market assets and real estate prices is that real estate prices show less price fluctuations and do not change directly after economic news has been released. However, the change is more evident in the long-term where house prices were significantly impacted by macroeconomic variables − nine out of the fifteen countries examined indicated a similar long-term response with regard to macroeconomic changes. These findings suggest that it is useful to predict long-term tendencies of the overall housing market in the case of macroeconomic shocks (Adams & Füss, 2010:48).

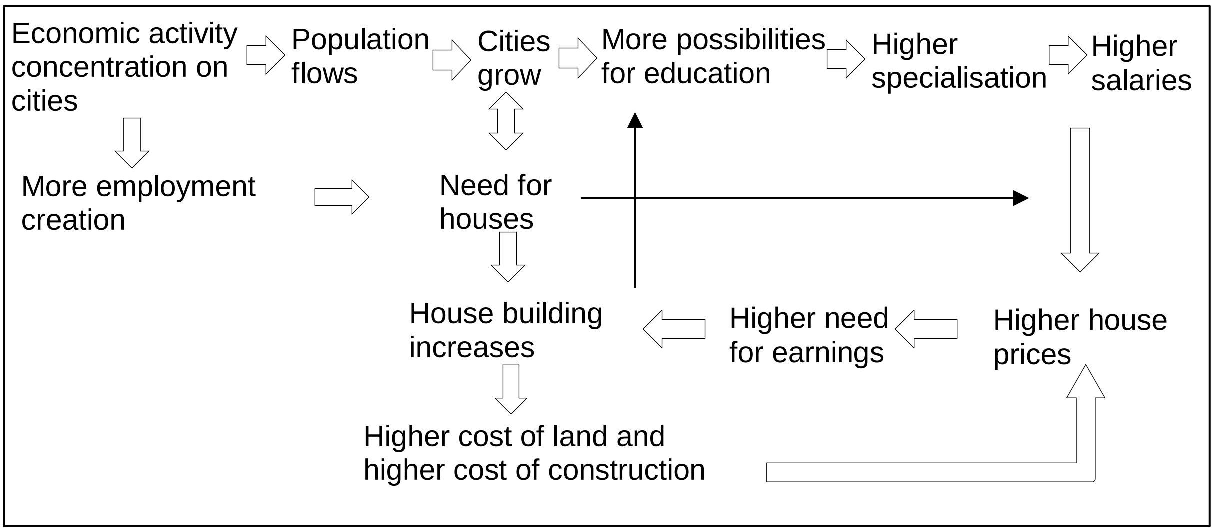
The demand for housing typology or various house prices tends to react differently when macroeconomic changes occur. Muller (2010:1) found that middle-income suburbs in South Africa, where houses sell for approximately R1 million, show more market price fluctuations − these fluctuations indicate real estate cycles. In 2010, middle-income suburb house prices started to rise again for the first time since 2008, although the housing market was not fortified fully in all areas. It was identified that price recovery is not the same in all areas and areas have, therefore, different cycles and recovery periods (Muller, 2010:1).

Furthermore, in terms of house price cycles, Hort (1998:93) conducted a study to establish the determinants of urban house prices in Sweden by analysing 20 urban areas in Sweden from 1967 to 1994. The data was used to formulate a restricted error correction model of house price changes. Real house price fluctuations were a result of demand circumstances in certain periods. The real house prices in Sweden have shown a tendency by following cycles that indicate economic expansion and declines. Nicodemo and Raya (2012:761) detected economic expansion and declines in Spain between 2004 and 2007; it was evident that 2007 had a lower kurtosis in comparison to 2004, which further indicated, by the use of quantile regressions, a quick increase in higher priced houses. Following this, when Seoul went through a financial crisis in 2008, house prices before and after 2008 were compared in order to determine the impact of this financial crisis on house prices. As a result, the impact of variables on house prices was lower after the crisis, an indication that economic conditions were depressed at the time (Kim, Park, *et al.*, 2015:111). Hort (1998:117) further stated that the long-term equation showed the following significant impacts: movements in income; construction costs; and user costs. The short-term equation explained approximately 80 per cent of the total variation in real house price changes and captures their troughs and peaks.

Égert and Mihaljek (2007:2) studied the determinants of house prices in member countries of The Organisation for Economic Cooperation and Development (OECD) and included Central and Eastern Europe (CEE). Their investigation focused on whether conventional fundamental determinants of house prices drive house prices in CEE. These determinants included GDP per capita, housing finance, demographic factors and real interest rates. The researchers found that house prices in CEE are generally determined by these conventional fundamentals, especially housing finance and other quality effects (Égert & Mihaljek, 2007:17-18).

As a summary, Taltavull De La Paz (2003:111) illustrated how house prices are influenced by economic activities within cities and the consequences thereof (see Figure 3).

Figure 3. Impact of economic activities on housing market



*Source: A*dapted from Taltavull De La Paz (2003:111)

To conclude, the level of house prices are determined by macroeconomic factors (Adams & Füss, 2010:39), which include the following: market structures, buyer preferences and the job market (Holmes, 2007:11); real estate price cycles (Muller, 2010:1); Gross Domestic Product (GDP) per capita, housing finance, demographic factors and real interest rates (Égert & Mihaljek, 2007:14); and movements in income, construction costs and user costs (Hort, 1998:93). Furthermore, house price fluctuations are a result of demand circumstances in certain periods and house prices followed cycles that indicate economic expansion and declines (Hort, 1998:93). These different house price cycles have different recovery periods (Muller, 2010:1).

2.4. MICROECONOMIC FACTORS AND THEORIES

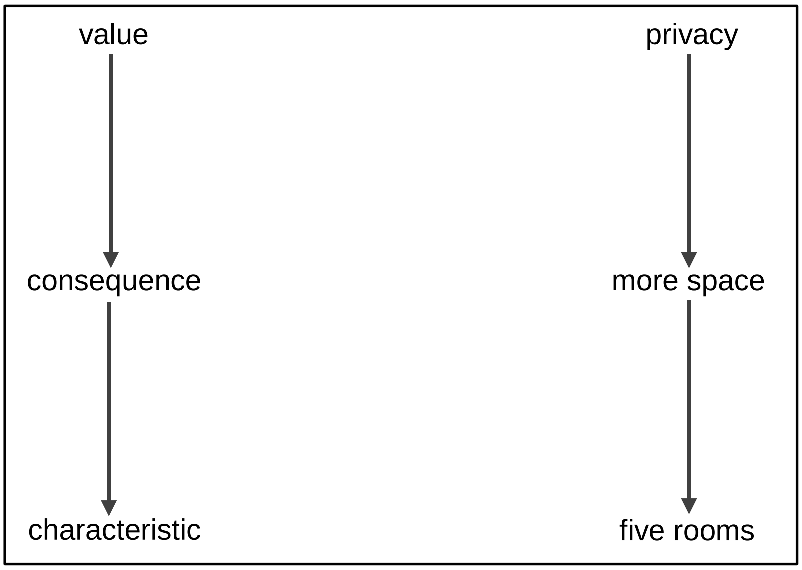
Along with the macroeconomic factors discussed above, characteristics, specific to each property, exist. Therefore, characteristics can determine house prices − in this study, these characteristics are referred to as microeconomic factors. These microeconomic factors regarding house characteristics can be divided into eight sub-components, namely, construction and structure, internal house features, external house amenities, natural environment, neighbourhood and location environment, public service environment, marketing occupancy and selling and financial issues (Sirmans *et al.,* 2005:11-12). Although, there are eight sub-components, for the purposes of this study, these are divided into two main sub-component categories. Firstly, structural characteristics that refer to house attributes describing the physical structure of a house and the immediate surroundings (Goodman, 1977:475), which include the following: square feet (square meter), bedrooms, bathrooms, other areas within the house and garage (Adair *et al.*, 1996:71; Gyourko & Tracy, 1999:66); swimming pool (Sirmans *et al.,* 2005:33); and a garden (Kim, Hung, *et al.,* 2015:275). Secondly, locational characteristics that are unique to each property and include, to name a few, the presence of shops, the quality of schools, pollution level, distance from work and distance or time to travel to the central business district (CBD) (Goodman, 1977:475; Arimah, 1992:372; Adair *et al.*, 1996:78; Thériault *et al.*, 2003:31). These two sub-components are investigated accordingly, with the specific focus on the variables that have been used by other studies. Consequently, the hedonic pricing model will be discussed together with other implemented econometric methods and the results found by the relevant studies.

2.4.1. Structural characteristics

In order to indicate the relative importance of each structural characteristic, Collen and Hoekstra (2001:285) researched the values of buyers as determinants of preferences for house characteristics in the Netherlands. The study specifically focussed on micro-level motivational factors as determinants of stated preferences for housing. The choice behaviour of homebuyers can be explained by value-oriented and goal-directed factors. A means-end theory forms the basis of the study;

it explains the relationship between consumers and goods. Goods are a collection of characteristics and these characteristics produce consequences when they are used. These consequences are important since it have the ability to satisfy a person's values and goals. In terms of the satisfaction of personal values and goals, see Figure 4 that explains how a value can influence the house preferences of a homebuyer. Figure 4 explains that a homebuyer's value of privacy can influence the buyer to search for houses with five rooms. The values of homebuyers differ and they, therefore, do not price characteristics equally. Homebuyers' values influence their need for house characteristics. In addition, a discussion of structural characteristics as determinants of house prices will follow below.

Figure 4. Original means-end chain model



Source: Collen and Hoekstra (2001:291)

Sirmans *et al.* (2005:8) examined approximately 125 studies that implemented hedonic modelling regarding house prices. As a result, the top twenty characteristics that most often appeared in these studies were constructed and summarised as illustrated in Table 1.

Table 1. Top twenty house characteristics in hedonic pricing model studies

Variable	Appearances	Number of times positive	Number of times negative	Number of times not significant
Lot Size	52	45	0	7
Ln Lot Size	12	9	0	3
Square Feet	69	62	4	3
Ln Square Feet	12	12	0	0
Brick	13	9	0	4
Age	78	7	63	8
# Stories	13	4	7	2
# Bathrooms	40	34	1	5
# Rooms	14	10	1	3
Bedrooms	40	21	9	10
Full Baths	37	31	1	5
Fireplace	57	43	3	11
Air-Conditioning	37	34	1	2
Basement	21	15	1	5
Garage Spaces	61	48	0	13
Deck	12	10	0	2
Pool	31	27	0	4
Distance	15	5	5	5
Time on the market	18	1	8	9
Time Trend	13	2	3	8

Source: Sirmans *et al.* (2005:10)

Seventeen of the top twenty variables represent structural characteristics. Table 1 included the top twenty variables, the number of times they appeared within the study sample, the number of times the variable coefficients were positive and negative as well as the number of times the variables were not significant. The top five variables that appeared most often in the study sample were age, square feet, garage spaces, fireplace and lot size. However, of the characteristics that were regarded as "not significant", garage spaces along with fireplaces were the most insignificant. The variables, age and time on the market, had a significant negative effect on house prices. Supplementary to this, the top five construction and structural characteristics were determined and these characteristics were lot size, the age of the house, number of bedrooms, square feet and number of bathrooms. The top five internal features included full bathrooms, half bathrooms, fireplace, air-conditioning, hardwood floors and a basement. The top five external amenities included garage spaces, deck, pool, porch, carport and garage (Sirmans *et al.,* 2005:11).

Accordingly, the following conclusions were made. Firstly, the effect of the variables together with the lot size and square feet (square meter) of houses had the same influence on entire house selling prices in the study. Secondly, the variable age of houses had an expected negative effect on selling prices. Thirdly, the variable number of bedrooms had a bigger impact on some of the regions, creating a positive effect. Fourthly, the variable number of bathrooms affected selling prices between 10 and 12 per cent in most of the regions. In addition, a garage had a consistent effect on all of the regions, affecting selling prices between 6 and 12 per cent. Swimming pools were determined as a significant characteristic and had a greater impact on selling prices in some of the hotter temperature regions. Furthermore, the findings conclude that houses without an attic space had a negative effect on house prices. Another structural characteristic, a separate shower stall, had a positive effect on house prices (Sirmans *et al.,* 2005:34-35).

These top structural characteristics corresponded with the characteristics of the previously discussed South African studies. Van Der Walt (2010:38) investigated more than twenty structural characteristics determining house prices; however, only pool, attached garage and building style were found to be significant in Hout Bay, South Africa. Du Preez and Sale (2013:460) considered the following characteristics: square feet (square meter); number of stories; number of full bathrooms; number of half bathrooms; number of garages; number of bedrooms; number of living rooms; a dining room; an additional flat; staff quarters; a boundary wall; air-conditioning; house age; a security system; electronic fence; electric access gate; a borehole; the presence of a pool; irrigation system; and a tennis court. From these characteristics, the study indicated significant positive results for the following structural characteristics: number of stories; lot size; a pool; and an electric fence. Du Preez and Sale (2014:6) identified and used similar characteristics, namely, number of bedrooms, number of bathrooms, number of stories, house age, lot size, a garage, air-conditioner, a pool and an electric fence. All of these variables, with the exception of the number of bedrooms, were found to have a positive effect on house selling prices as well as assessed municipal values. The coefficient signs were as expected, with the exception of age and the number of bedrooms, since it is expected that the age of a house will have a negative effect and the number of bedrooms will have a positive effect on house prices. To explain these unexpected coefficient signs, Du Preez and Sale (2014:7) stated that older, more traditional houses might be more desirable by buyers in Nelson Mandela Bay, thus explaining the positive coefficient for age.

Moreover, Arimah (1992:366) studied another African, third-world country, Nigeria; he, therefore, had to take into account that not all residents could afford to purchase a house. Consequently, due to the poor environment, homeowners let their rooms out to tenants for extra money indicating that more than one household could reside in a house. The following structural characteristics were implemented by Arimah (1992:369): the number of rooms occupied in the house; average room size; lot size; square feet; number of stories; bathrooms; the presence of a fence; roof type; the presence of a balcony; and the age of the house. The results indicated that tenants' demand for structural characteristics were the highest for the number of rooms, average room size and lot size. Homeowners' demand for structural characteristics was the highest for the number of rooms, average room size, number of stories and bathrooms.

Goodman (1978:471) investigated the metropolitan city, New Haven, in Connecticut in the United States of America (USA). Accordingly, fifteen submarkets (five areas in New Haven) are described in this study, conducted over three years, in a short-term equilibrium model. The following structural characteristics were considered: lot size; number of garages; number of bedrooms; number of full bathrooms; number of lavatories; number of rooms without en suite bathrooms; house size; the age of the house; number of fireplaces; and if the exterior of the house is face brick (Goodman, 1977:480). The results showed that the intra-submarket analysis indicated that improvements in structural characteristics lead to higher premiums. Furthermore, the variables are significant across submarkets and bathrooms and garage space appeared to be moderately constant across the submarket areas. On the other hand, lot size, the age of the house, living space and the number of rooms were not constant (Goodman, 1977:477). It was stated that price structures change over time within a submarket and submarkets may differ from year to year since they are related to the supply of characteristics of available house inventory. Therefore, the supply of characteristics contributed to the inconstancy of the four last-named variables and might differ from other studies.

In agreement with Goodman (1977:480), Gyourko and Tracy (1999:66) also identified the following structural characteristics in order to explain house prices in the USA: bathrooms; bedrooms; square feet; lot size; and the presence of a garage and other rooms, thereby corresponding with the structural characteristics employed by Adair *et al.* (1996:71). The results were expressed in five price distribution percentiles (10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th}) and indicated that bathrooms increased from one bathroom in the 10^{th} and 25^{th} percentile to two bathrooms in the 75^{th} and 90^{th} percentile. The age of the property decreased significantly from 31 years in the 10^{th} percentile to 16 years in the 90^{th} percentile. The variable bedrooms were three throughout all the percentiles. Other rooms were three up to the 90^{th} percentile which comprised four other rooms (Gyourko & Tracy 1999:74). Gyourko and Tracy (1999:66) further added the following variables to their study: the presence of a basement; air-conditioning; and a heating system. The 10^{th} percentile did not have a basement; however, all the other percentiles had a basement present. None of the percentiles had air-conditioning and all the percentiles indicated the presence of a heating system.

Konecny (2012:32) studied house prices in California, USA, and correspondingly identified the following structural characteristic variables: number of bedrooms; number of bathrooms; lot size, floor size; number of garages; the existence of a pool; the existence of a fireplace; and the age of the house. In addition to previous studies, the following characteristics were also considered: days on the market; if the house had been remodelled from 2000 to 2010; and declaration of Covenants, Conditions and Restrictions (CC&R) regulations set by the Home Owners' Association (HOA). The study predicted that the majority of the house characteristic variables would have a positive effect on a house’s value, except for the age of the house, since this is expected to have a negative effect on a house’s value. The following variables had a positive effect on house prices: floor size; number of bedrooms; number of bathrooms; number of garages; the presence of a fireplace; the presence of a pool; and if the house had been remodelled. Liu *et al.* (2013:19) established that the remodelling of a house and the number of bathrooms were highly spatial dependent. On the other hand, the following variables had a negative effect on house prices: the age of the house; the presence of a Covenants, Conditions and Restrictions (CC&R) regulation; and the number of days on the market. All the house characteristic variables were significant at a 90% confidence level or greater, except for the pool variable (Konecny, 2012:53). The variables moved in the expected direction and the results of these findings corresponded with other studies.

Zietz *et al.* (2008:317) studied the determinants of house prices for different quantiles in the USA, where the following variables were used: number of rooms; number of bathrooms; lot size; square feet; number of garages; the presence of a pool; if bricks were used; the presence of a basement; and the presence of air-conditioning. The results from this study indicated that, in terms of quantiles, higher priced houses had positive significant characteristics such as square meter and number of bathrooms, while lower priced homes did not have similar characteristics, an indication that buyers have different characteristic needs throughout quantiles.

Wan *et al.* (2017: 1988) supported the above-identified structural characteristics for the estimation of hedonic house price functions in quantiles in Hong Kong. For the reason that Hong Kong has tall residential buildings, the following characteristics were added: the direction of the building (facing south or north); the presence of a garden; and the floor level. Findings include that not all structural characteristics are significant at the different floor levels. Furthermore, the direction of the property is more important for the highest floor levels as well as the lowest floor levels. In addition, age affects property prices negatively especially at lower quantiles (Wan *et al.,* 2017: 1984).

The structural characteristics that Kim, Hung, *et al.* (2015:272) identified for house prices in Hong Kong are: square feet (square meter); floor level; sea view; age of building; and the direction of the property. This is supported by a similar study done in Seoul by Kim, Park, *et al.* (2015:96). Structural characteristics supplementary to the previously stated studies are: the presence of a balcony; a roof top; and a swimming pool. Corresponding with Wan *et al.* (2017: 1985), the reaction of house prices to the characteristics fluctuated across quantiles. For example, the square feet (square meter) were priced higher at higher quantiles. However, the square feet (square meter) had an overall positive effect on house prices. Conversely, Choy *et al.* (2009:8) found that, up to 1 257 square feet, the square feet increased house prices; thereafter, it tended to decrease house prices. The floor level up to the 24th level had a positive effect on house prices and, for floor levels above the 24th level, house prices decreased (Choy *et al.*, 2009:8; Kim, Hung, *et al.,* 2015:278). On the other hand, Choy *et al.* (2012:359) argued that a higher floor level provided a better view. Similarly Kim, Park, *et al.* (2015:110) stated that higher floor levels receive more sunshine and have less noise. As a result, the Seoul study supported the finding that floor level has a positive effect on house prices. Moreover, in agreement with Choy *et al.* (2012:362) and Kim, Park, *et al.* (2015:105), Kim, Hung, *et al.* (2015:278) indicated that a higher building age is associated with a lower house price, since an increase of one year reduced the house price by 61 940 Hong Kong Dollar (HKD) (R112 165). A rooftop terrace had a positive effect on house prices; however, a balcony and a swimming pool had a negative effect (Kim, Hung, *et al.*, 2015:278). The latter variables were not significant at a 5 per cent level and clarify the negative results, since it is expected that a balcony and a swimming pool should have a positive effect on house prices (Kim, Hung, *et al.,* 2015:279).

Liao and Wang (2012:16) investigated house prices in a Chinese city, with similar structural characteristics as the Hong Kong studies discussed above, namely, square feet, bedrooms, floor level and lot size. The results of this study indicated that implicit prices of structural characteristics could differ through house price distribution. Yet, the variables relating to square feet and the number of bedrooms indicated a positive impact on house prices throughout the quantiles.

Nicodemo and Raya (2012:747) investigated the change of house price distribution in Spain by using the following structural characteristics: age; square feet (square meter); the availability of a lift; separate kitchen; bedrooms; and floor level. The variables relating to bedrooms and floor level were insignificant. However, having a separate kitchen had a positive effect on house prices in lower percentiles. Conversely, the effect changed to negative at higher percentiles, indicating an open-plan kitchen is favoured at higher percentiles. The availability of a lift showed an increase in house prices, but, a higher age of the house and square feet caused a decrease in house prices (Nicodemo & Raya 2012:750). It is expected for age to have a negative effect on house prices; however, it is not expected for square feet to have a negative effect and Nicodemo and Raya (2012:750) stated no reason for the abnormality.

Correspondingly, Mimis *et al.* (2013:128), who conducted another house price study in Europe, similarly implemented the variables house age, floor level and square feet as structural characteristics. However, additional variables included year of valuation, land value and mean income – the mean income was considered to take the socio-economic influence on house prices into account. All the structural characteristic variables were significant. The results indicated a negative impact on house prices for age and year of valuation. However, floor space, floor level and land value had a positive impact on house prices as expected, which is supported by the above studies. The results found that there is a non-linear relationship between the value of a property and the square feet and age. The floor size indicates an increasing non-linear relationship with house prices as expected, while house prices decreased rapidly within the first few years, after which age had a linear decreasing relationship.

Similar to the structural characteristics, the location is a significant contributor in determining house prices and is discussed next. A synthesis of structural and locational characteristics will follow after the discussion of the locational characteristics section.

2.4.2. Locational characteristics

Various studies were conducted on the location of properties as a determinant of house prices (Goodman, 1977:475; Arimah, 1992:372; Adair *et al.,* 1996:78; Thériault *et al.*, 2003:31; Du Preez & Sale 2014:1; Dumm *et al.*, 2016:1). The most significant factors that influenced buyers' choice of property were structural characteristics, the property's price and locational characteristics (Adair *et al.*, 1996:78). Since structural characteristics are discussed in the previous section, this section focuses on locational characteristics that influence house prices. Some characteristics that have been identified as neighbourhood characteristics will be included in this section as locational characteristics.

Dumm *et al.* (2016:1) stated that, by studying price variations of waterfront properties, the multi-dimensional feature of properties had a significant influence on the price of properties. The location of the properties in this study was examined with regard to the following two aspects: waterfront and non-waterfront properties. In addition, this study examined the price changes of properties through boom and bust phases of real estate cycles with reference to the comparison between non-waterfront properties and waterfront properties. The study found that waterfront properties had a 7.2 per cent price premium over non-waterfront properties. Moreover, this premium was higher than during the last boom phase. The waterfront properties did not experience the same level of a price decrease as non-waterfront properties. The house prices in some locations can, therefore, fluctuate more than others.

In terms of the location of properties indicated by Dumm *et al.* (2016:2), house characteristics are mostly valued differently in different locations (Sirmans *et al.,* 2005:3). Sirmans *et al.* (2005:3) used the example of a house with a garage situated in a cold climate area that will be valued more than others in a similar area, while, in contrast, a house with a swimming pool situated in a warmer area will have greater value than those without pools. In addition, Sirmans *et al.* (2005:13) stated that houses in a gated community had a positive effect on house prices. Du Preez and Sale (2013:464), furthermore, indicated a significant relationship between the distance of nearby formal housing and social housing developments with formal house prices, an indication that the price of a house is affected by its location. De Angelo and Fávero (2003:10) analysed the real estate market with a focus on the structural and locational characteristics of each property in order to identify which characteristics present larger utility to homebuyers. The locational characteristics included the distance to shops, trains, hospitals and public schools for the formation of prices. Similar to the study by Mimis *et al.* (2013:131), De Angelo and Fávero (2003:9) incorporated socio-economic variables, categorised in three different social classes, namely, low-income, middle-income and high-income categories. Consequently, results show that, in low-income districts, the distances to public schools and hospitals were more important than the number of rooms. Moreover, Arimah (1992:369) included the following locational characteristics: the presence of shops; the quality of schools; pollution level; and distance from the workplace, schools, hospitals and the airport. The study found that tenants' demand for locational characteristics was the highest for distance from school and distance from hospital (Arimah, 1992:375).

From a green location point of view, Liao and Wang (2012:19) identified the following locational characteristics: greening rate; distance from the CBD; distance from urban parks; and distance from natural parks. The results indicated that a greening rate for lower quantiles had a positive impact on the property price in China. On the other hand, the greening rate for higher quantiles and the distance from parks had a negative impact on the property price. This suggests that a site with larger greenery would result in lower house prices and, since private backyards in Chinese cities are rare, it is beneficial to stay as close as possible to parks (Liao & Wang, 2012:22). Liu and Hite (2013:1) noted that the impact of different green space characteristics on house prices could change through the conditional distribution of house prices. The study suggested that houses closer to larger green spaces would sell for more and is significant for the high quantile. Areas with green settings are known as the place for the rich since those who can afford it, choose to have attractive green settings. For this reason, buyers in greener areas are willing to pay more for a house with an attractive environmental setting. The results indicated that green areas are only significant for middle- and high-priced houses and are not significant for bottom-level house prices (Liu & Hite, 2013:20).

Konecny (2012:1) aimed to discover if the urban form is valuable to homebuyers in the USA. The new urbanism movement represents a more attractive environment with smaller blocks and better access to job centres and commercial services. If it is true that homebuyers are valuing the new urbanism movement, homebuyers will pay a higher premium for homes in neighbourhoods with urbanised qualities. The study hypothesised that urban form and locational characteristics would influence house prices. Based on these findings, new urban form positively influenced house prices (Konecny, 2012:78).

Kim, Hung, *et al.,* (2015:273) employed the following locational characteristics: the distance from the metro; and the distance from a shopping mall. Whether a house had a sea view was also considered. The results show that sea views and the distance from the metro had a positive effect on house prices; on the other hand, the distance from the shopping mall had a negative effect on house prices. This variable was, however, insignificant. Kim, Park, *et al.* (2015:96) also employed the view as a characteristic: whether the house faced a river or a mountain; and the distance from the metro station. In addition, the distance from school was also considered. The empirical study indicated that the distance from school had the largest effect on the house prices and that the effect was larger in the lower quantiles, which indicated that owners of lower priced houses preferred to stay closer to schools. Accordingly, Mimis *et al.*, (2013:134) included the distance from the metro station as a locational characteristic since it was argued that it was an important method of transport in Spain.

The characteristic view is regarded by Choy *et al.* (2009:7) as being more than merely a sea view (Kim, Hung, *et al.,* 2015:273) or a scenic view (Kim, Park, *et al.,* 2015:96). They categorised it into a building view, an obstructive view and an open view. The direction that the property was facing was categorised into North East (NE), South East (SE), South West (SW) and North West (NW). Regarding the view of the property, most homebuyers favour properties where the view is not obstructed, preferring properties with an open view, a green view or a sea view. According to empirical results, it was found that homebuyers of higher priced properties were more concerned about having an open view unless a larger discount was offered to them. Additionally, Choy *et al.* (2012:364) stated that the variable view could be divided into the following categories: hill view; garden view; greenery view; open view; and street view. The results showed that hill view, garden view, greenery view and open view would result in a higher transaction price, while the street view was associated with a lower transaction price.

2.4.3. Synthesis

To conclude, the behaviour of homebuyers can be explained by value-oriented and goal-directed factors. Homebuyers do not value characteristics equally. Therefore, to understand and identify the most common and most important characteristics, it is necessary to econometrically determine the value of each characteristic pertaining to house prices. The above section focussed on the structural and locational characteristics of a house. These house characteristics were used as independent variables in the above studies and house price was used as the dependent variable.

Findings included that the following variables were significant in explaining house prices and had a positive impact on house prices: square footage (square metre), number of bedrooms, number of bathrooms, number of garages, presence of a fireplace and a pool and if the house had been remodelled (Konecny, 2012:32; Liu & Hite, 2013:19); floor level and land value (Mimis *et al.,* 2013:128); waterfront properties (Dumm *et al.,* 2016:1); distance from schools and hospitals (Arimah, 1992:372 ; Kim, Hung, *et al.,* 2015:273; Kim, Park, *et al.,* 2015:96); greening rate (Liao & Wang, 2012:19: Liu & Hite, 2013:1); and open views (Choy *et al.,* 2009:7; Choy *et al.*, 2012:364). The following variables had a negative impact on house prices: the age of the house; the presence of a Covenants, Conditions and Restrictions (CC&R) regulation; the number of days on the market; greening rate for higher quantiles; and distance from parks (Konecny, 2012:53). Table 2 below entails a summary of the house characteristic variables within the subcomponents, namely, structural and locational characteristics.

Table 2. House characteristics summary

House characteristics	
Structural characteristics	**Locational characteristics**
Lot size	Gated community
Square feet (square meter)	Presence of shops
Number of bedrooms	Quality of schools
Number of bathrooms	Pollution level
Number of garages	Distance from work
Age of property	Distance from school
Sprinkler system	Distance from airport
Number of stories (floor level)	Distance from hospital
Attic space	Distance from metro station
Room size	View (obstructive/open)
Electric Fencing	View (street view/no street view)
Roof type	Greening rate
Rooftop terrace	Distance from park (natural/urban)
Balcony	Distance from CBD
Property type	Presence of a cemetery
Exterior condition	Area (or Suburb)
On-site parking	
Direction of building	
CC&R regulations	
Age	
Fireplace	
Pool	
Remodelling of house	
Lift	
Separate kitchen	

2.5. ESTIMATION TECHNIQUES

The characteristics identified above can be qualified by making use of various empirical estimation techniques; the following section will discuss different techniques. Firstly, a brief background regarding hedonic modelling will be provided, along with studies that implemented the technique. Secondly, other estimation techniques will follow.

2.5.1. Hedonic model

2.5.1.1. Background

Housing has been defined as a long-lasting durable and a heterogeneous good – a bundle of individual characteristics (Witte *et al.,* 1979:1151), which could be categorised into structural and environmental (Adair *et al.,* 1996:77) and locational and neighbourhood characteristics (Sirmans *et al.,* 2005:11). Sirmans *et al.* (2005:11) further announced eight categories: construction and structure; internal house features; external house amenities; natural environment; locational and neighbourhood environment; public service environment; marketing, occupancy and selling; and financial issues.

The term "hedonics" comes from the Greek word *hēdonikos* – translated as pleasure – representing the "pleasure" or utility each individual characteristic will provide the homebuyer (Nguyen, 2012:7). Similarly to utility, the hedonic price function increases at a diminishing rate (Rosen, 1974:34). Consequently, hedonic prices represent the implicit prices of individual characteristics congregated from the observed prices (Rosen, 1974:34). However, the individual characteristics could not be independently utilised, therefore, all the characteristics of a house should be utilised together as a set (Day, 2001:174). To explain house prices in terms of the characteristics of a house, the hedonic price function is commonly considered (Kim, Hung, *et al.,* 2015:273). There are two reasons for implementing the empirical hedonic price function. Firstly, to identify how the set characteristics possessed by a house vary in explaining different house prices. Secondly, to determine the demand and supply for house characteristics (Rosen, 1974:42; Epple, 1987:59).

The following equation represents a hedonic function:

$$p(z) \qquad (1)$$

Where p represents the house price and z represents the different house characteristics representing the house price (Rosen, 1974:37).

The hedonic price function:

$$p = \alpha + \sum x\beta + \varepsilon \qquad (2)$$

Where p represents the house price and x represents the vector of characteristics; basically, any utility variable which influences buyers could be applied to the hedonic function (Oczkowski, 1994:95). ε represents the error term and β represents the coefficient estimates to be estimated (Kim, Hung, *et al.,* 2015:273). The coefficients are usually estimated by making use of an Ordinary Least Square (OLS) method (Zietz *et al.,* 2008:322). The coefficients could be interpreted as the reflection streams of returns from house characteristics (Goodman, 1977:472). However, the OLS method addresses the average effect of independent variables (house characteristics) on the dependent variable (house price) (Goodman, 1977:472; Kim, Hung, *et al*., 2015:273).

2.5.1.2. Hedonic model applied

Goodman (1977:471) considered the hedonic regression analysis in order to investigate and extend the hedonic price analysis to form house price catalogues, so that the variation within metropolitan areas could be measured. Since the OLS equation addresses the average effect of the hedonic price function, it can be applied to measure house prices in different areas of a market separately and, as a result, the price differences could be calculated. In addition, these separate equations could offer a better understanding of short-term behaviour in the market as well as estimate welfare effects (Brasington & Hite, 2005:64).

Similar to Goodman (1977:471), Adair *et al.* (1996:67) also used a hedonic modelling approach by investigating housing submarkets and residential valuations in Northern Ireland. The focus of the study was to solve the problem of valuation, as the valuator might have difficulties in estimating structural characteristics. The empirical analysis aimed to utilise multiple regressions in order to examine the existence of housing submarkets. The findings supported the theoretical considerations. The findings stated further that traditional valuation approaches are not as sufficient as the hedonic pricing method, since they do not identify with variation or objectively measure the influence of variables.

Thériault *et al.* (2003:25) investigated the modelling interactions of location with the specific value of house attributes in Quebec. The study considered a hedonic model to find the interaction of locational characteristics and structural characteristics. These interactions included geographical factors and a contribution of each property characteristic. Simulation procedures were implemented where GIS and spatial statistics were used to define accessibility and socio-economic factors related to house prices. The first stage of the spatial hedonic model was to obtain market price approximates which, in return, were used to compare with property tax amounts. These amounts were added to the second stage of the model incorporating fiscal effects on house values. De Angelo and Fávero (2003:5) also implemented a hedonic model in order to analyse the importance of each individual characteristic in relation to diverse social-economic factors.

A mixed conclusion was drawn, which resulted from the calculation of house price determinants (Zietz *et al.,* 2008:318) and the economic impact of these determinants (Simo-Kengne *et al.,* 2012:101). Zietz *et al.* (2008:332) stated that buyers of high-priced houses placed a different value on different characteristics in comparison to buyers of low-priced houses. Zietz *et al.* (2008:317) examined the issue that the difference in house prices was not influenced by house characteristics by a quantile regression that took autocorrelation into account in order to determine whether coefficients over a large set of varied variables across diverse quantities differed. Zietz *et al.* (2008:325) suggested that a difference in house prices was due to the fact that these characteristics were not linked to house prices in the same way. It is, therefore, important to take house price quantiles into account.

In agreement with Zietz *et al*., (2008:317), Liao and Wang (2012:16) investigated hedonic house prices and stated that the incorporation of spatial econometrics and quantile regressions could be helpful for the determination of structural characteristics since estimated spatial dependence varies across quantiles. This is supported by Liu and Hite (2013:5). The purpose of the study was to examine how implicit prices of structural characteristics could differ through the conditional distribution of house prices. The estimates of this study indicated that implicit prices of structural characteristics can differ through distribution and the authors suggested using conditional quantile functions in addition to the conditional mean.

Furthermore, Wan *et al.* (2017:1979) estimated hedonic house price functions and additionally incorporated quantiles by using a varying coefficient (VC) approach in Hong Kong. The VC model is an addition to the ordinary regression model because confidents are permitted to vary differently from the regressors. Many characteristics are not priced equally across floor levels. For example, two properties on the same floor could have largely different characteristics to offer, contributing to high price differences. The VC model assumes that a house characteristic will have an equivalent effect on house prices for any given floor level. To address this heterogeneity problem, the VC approach was applied to the quantile regression (QR). The VC model has a unique structure with the reason that it reduces biasness and avoids a dimension problem.

Kim, Hung, *et al.* (2015:271) also made use of a hedonic pricing model in order to perform an empirical analysis and stated that the reaction of house prices to structural characteristics differs across quantiles. This is also supported by McMillen (2008:573). Therefore, a Box-Cox quantile regression method was used to estimate the model. The study also addressed non-linear relationships between the characteristics and house prices by using the Box-Cox method. Transaction data were used from a real estate company in Hong Kong. The determinants of house prices in Hong Kong and the results showed that the method used provided a broad explanation of house price determinants. Although the Box-Cox regression model was implemented in this study in contrast to the VC model used by Wan *et al.* (2017:1979), there was found that the Box-Cox regression cannot address heterogeneous effects. Therefore, structural characteristics will fluctuate according to house prices.

Similarly, Choy *et al.* (2009:1) estimated Hong Kong real estate prices by making use of a quantile regression approach. The quantile regression approach supports the least squares regression by recognising the different responses of real estate for a change in one unit of a structural characteristic at different quantiles. This approach estimates the implicit price for characteristics through the distribution of property prices. It also acknowledges that higher priced properties and lower priced properties will behave differently even though they may be in the same area. Therefore, this approach offers a better explanation of property prices and provides a better picture of the relationship between structural characteristics and property prices.

Choy *et al.* (2012:359) studied real estate prices and structural characteristics in Hong Kong by making use of a quantile regression analysis. The study stated that a hedonic price model projected by Ordinary Least Squares (OLS) can be used to model the relationship between structural characteristics and house prices. The study made use of the following hypothesis: the influence of house attributes on real estate prices is the same at the conditional mean and specific quantiles. It was put to the test to determine whether homeowners placed the same value on the same structural characteristics.

Kim, Park, *et al.* (2015:91) and Nicodemo and Raya (2012:739) investigated the determinants of house prices by using a quantile regression approach. The purpose of these studies was to determine estimates for house characteristics in the Korean and Spanish housing markets. The quantile regression approach was used to determine how the prices of structural characteristics vary for each quantile of the house prices.

2.5.2. Other estimations

Although hedonic models are found to explain house prices effectively, Follain and Jimenez (1985:421) intended to take stock of the existing literature regarding structural characteristics and the demand for these characteristics. In addition, the econometric procedures used by various studies were analysed. The hedonic approach is where demand parameters are directly inferred from coefficients resulting from the hedonic function. The marginal price resulting from this approach does not measure the price the household is willing to pay for additional structural characteristics. Instead, the results indicated the valuation of the demand and supply relationships of the market. However, other econometric approaches like the two-step and index approaches are considerably more complicated. The two-step approach found by Rosen (1974:34) estimated the compensated demand curve. This approach is derived from the hedonic regression with respect to each characteristic as it is estimated at a particular bundle. It is, therefore, used as a price vector within a demand and supply system. Firstly, the problem with the two-step approach is simultaneity, since error terms are correlated with the right-side variables of the equation in supply or demand equations, as price and quantity are simultaneously concluded. Secondly, problems may occur when micro-level data are being used. Thirdly, simultaneity can be corrected by econometric treatment; however, it will result in non-linearity in terms of the price. The index approach uses the hedonic regression by conducting weighted sums of subsections of the characteristics, where the internal structural characteristics coefficient is multiplied by the amount of space occupied by the household within the house; the result constitutes an index of a variable space. The indexes are measurements of the dependent variable on categories of characteristics in order to conduct a demand analysis. The problem with this approach is that the calculated indexes are not systematic and dependent upon available data. Subsequently, the price indexes will not be able to be defined since weighted averages from the hedonic regression results are the same for all households (Follain & Jimenez, 1985:421). The study concluded that the most suitable econometric approach to use will largely depend on the issues being addressed in a particular study, the objectives of the researcher and the data available.

Mimis *et al.* (2013:128) researched property valuations with the artificial neural network (ANN) in Athens, Greece. The aim of this study was to examine the application of an ANN approach in terms of property valuation. The approach has been improved by the geographic information system (GIS) to improve explanatory variables and to model the spatial occurrence problem. Various structural characteristic data are available in Athens. This study employed the multilayer perception network and the results thereof were compared to the spatial lag model. After the fitting of the models, 87 per cent of the data was explained by the ANN model and 76 per cent by the simultaneous autoregressive (SAR) model. To conclude, the ANN demonstrated more consistent predictions in comparison to other approaches.

2.5.3. Synthesis

The following econometric models were used by the above studies: hedonic regression; OLS regression; quantiles by using a VC approach; Box-Cox quantile regression; Rosen's two-step model; artificial neural network (ANN); and a geographic information system (GIS). Hedonic models were mainly implemented by the studies as they can be used to explain house prices with characteristic variables accordingly. On the other hand, econometric approaches like the two-step approach are considerably more complicated.

Consequently, a hedonic function will be implemented for this study with the support of an Ordinary Least Square (OLS) regression approach to establish the impact of house characteristics on house selling and asking prices.

2.6. PRICING STRATEGY

The literature indicates that price fluctuations are a result of macroeconomic and microeconomic factors. On the other hand, from a cognitive perspective, Black and Diaz (1996:287) examined house asking prices and the negotiation process. The negotiation process is influenced by the asking price even if the asking price is mismatched in terms of house characteristics and market information. The dispensation capacity of the human mind recommends that critical information will be devalued in favour of cognitive shortcuts. As a result, the asking price can be seen as one of these cognitive shortcuts influencing selling price results, thus emphasising the importance of correctly setting the asking price.

Sellers have the objective of selling their houses as soon as possible at a maximum price; consequently, the price should be strategically set (Genesove & Mayer, 1994:259; Beracha & Seiler, 2013:239). A house price strategy is followed (either purposefully or unintentionally) as a measure to value the property by the owner. The effect of house price strategies was studied and it was found that the pricing strategy used correlates with the selling price (Miller & Sklarz, 1987:31; Knight *et al.*, 1994:177; Allen & Dare, 2004:695; Beracha & Seiler, 2013:239). To achieve the objectives of this study, over-pricing and under-pricing as well as price endings as price strategies will be discussed.

2.6.1. Over-pricing and under-pricing

Kang and Gardner (1989:21) studied the relationship between the asking price, selling price, house characteristics, market conditions and the time on the market factor. Key findings indicated that the marketing time of houses of equal quality depends on the level of mortgage contract rates. On the other hand, over-pricing the house is not a successful strategy, although under uniform market conditions, houses generally sell quickly. It was found that new houses have a shorter time on the market, especially in the medium and higher price ranges.

Sellers set the asking price (sometimes unknowingly) as a signal of their willingness to sell their property (Benjamin & Chinloy, 2000:61). Their study identified two strategies regarding the pricing of a property. The first strategy is a pricing strategy where a property is priced under or at market value. The mentioned value can be determined by the quality of the property and its house characteristics. The second strategy is an exposure strategy that refers to pricing the property above market value with an increase in marketing activities mainly through brokers in order to attract offers that are more favourable. Results from the study indicated that there is a positive relationship between the usage of a broker and an increased asking price. The two competitive strategies are trade-offs of each other. The results indicated that brokers would prefer to focus on sellers using the pricing strategy rather than the exposure strategy (Benjamin & Chinloy*,* 2000:63), as it would be easier for a broker to sell a property with a lower asking price in comparison to the market value. Furthermore, the exposure strategy expects the broker to have more marketing material and a longer time on the market since the property will be priced above market value. Additionally, sellers who make use of brokers in order to increase market exposure might be exposed to risky brokerage contracts. The contracts might include commission splits across brokers and, as a result, this reduces the net sales price of the seller and the commission of the listing broker. This problem can be avoided by making use of the pricing strategy.

Correspondingly, Hui *et al.* (2012:375) studied pricing strategies in terms of the over-pricing of a property. The study investigated if the over-pricing of a property would be profitable. The study showed that the over-pricing strategy would influence the time on the market factor. Similarly, Asabere *et al.* (1993:149) examined the relationship between house pricing and the optimal time on the market. The results indicated that over-pricing and under-pricing would impact the optimal time on the market and optimal selling prices. Sellers' returns on investment were higher when they implemented the over-pricing strategy instead of listing their property at a moderately low market price. However, when buyers become aware that properties were over-priced, they became more sensitive towards over-priced properties and, consequently, the time on the market lengthened (Hui *et al.,* 2012:395). Sirmans *et* *al.* (2005:38) found that the time houses spend on the market has a negative effect on the selling price of houses – selling prices are lower the longer houses are listed on the market.

Horowitz (1992:115) stated that houses are rarely sold above the asking price as they mostly sell for prices below or at the asking price. For this reason, the asking price can be seen as a price ceiling preventing sales at higher prices. To prevent this problem, the sellers' behavioural theory shows that sellers usually set an asking price above their reservation price (the lowest price they would like to receive). This theory has formed the basis of this study's econometric model, discussed henceforth.

$$w \leq P_R < P_A \quad (3)$$

The w represents the alternative opportunity value, P_R is the reservation price and P_A is the asking price. Sellers maximise their return on investment if they set an asking price higher than their reservation price. This theory does not allow sellers to set fixed house prices; however, it is optional if sellers' asking and reservation prices are the same. The model further indicates why sellers might not want to reduce their asking price even if the house has been on the market for a long time. Even if a house is optimally priced, it can still be on the market for a long time. This statement supports the fact that a seller will not increase his utility by reducing the asking price further.

The Knight *et al.* (1994:177) study inspected the practicality of asking prices as indicators of house values and housing markets. The asking price is an initial signal of the house value and influences the buyer's and the seller's perspectives regarding market functions. The asking price is the starting point of the house selling process and, in agreement with Horowitz (1992:115), the asking price can be seen as a ceiling for expected offers and the selling price a ceiling for sellers. The asking price signals to a buyer what the seller's reservation price is. When setting the asking price within the existing macroeconomic and microeconomic environment, it is important to reach the objectives of selling a house at a maximum price and as quickly as possible (Genesove & Mayer, 1994:259; Beracha & Seiler, 2014:239). Belkin *et al.* (1976:57) recognised the conflict of maximising return on investment and minimising the time on the market. The relationship between these factors varies and, therefore, three arguments were made regarding these factors: firstly, there is no lagging or leading relationship between the asking price and the listing price; secondly, the asking price influences the selling price; and, thirdly, the selling price influences the asking price. The study made use of hedonic regressions by using both selling and asking prices as dependent variables, after which, the housing market was geographically categorised by using the Granger causality test. The results indicated that market segments performed differently over time. The study supports previous studies as it also found that listing prices deliver important information about selling prices. To conclude, the study stated that the collection and usage of listing data is a worthwhile effort to determine the selling price.

Miller and Sklarz (1987:31) stated that different pricing strategies influence the buyer's perception of a good's quality. The study investigated real estate pricing strategies to establish if these strategies influence the selling prices of properties. The main hypothesis of this study was that there exists an optimal pricing strategy for real estate selling prices if the appropriate asking price is chosen. Furthermore, three specific hypotheses were identified: firstly, if the asking price is too high, buyers will be discouraged; secondly, a higher asking price compared to the relative market value will facilitate a sale; and thirdly, a lower asking price will result in a short time on the market. As a result, the study stated that it would be much easier to assert an optimal pricing strategy than to prove it statistically. Furthermore, the study suggested that the asking price should be set equal to the asking price of similar properties in order to reach optimality.

Northcraft and Neale (1987:84) studied the price singularity within real estate markets. They made use of experimental techniques and consulted college students, considered to be amateurs, and real estate agents, considered to be experts. The two groups were given houses with asking prices and other information regarding the houses, after which they had to estimate values for these houses. The results indicated that the asking price impacted the valuation of a house by both groups.

2.6.2. Price endings

Palmon *et al.* (2004:115) stated that real estate prices can exhibit two pricing strategies regarding price endings, namely, a round pricing strategy and a "just below" pricing strategy. The round pricing strategy is negatively associated with the cost of rounding as well as the estimation of prices. Consequently, properties are mainly priced using a “just below” strategy. Conversely, the study stated that properties priced using a round number have a shorter time on the market and sell at a higher price. The selling price correlates with the time on the market and the listing price of the property. The pricing strategy can be seen as a price illusion and has a direct connection with the cognitive processes of the customer. These cognitive effects can be summarised under the following levels: firstly, customers round down and see R0.99 as R0.90; secondly, it was found that customers have limited memory and remember the leftmost digits in a price rather than the rightmost digits; and thirdly, customers encode prices leftwards and give more value to the numbers on the left (Brenner & Brenner 1982:147; Stiving & Winer, 1997:57; Gendall *et al.,* 1997:799).

Similarly, Schindler and Kirby (1997:192) analysed selling prices and their rightmost digits, presented as the numbers 0, 5 and 9. Customers have a high cognitive accessibility for round numbers; therefore, the ending numbers 0, 5 and 9 were used. Consequently, the usage of price endings with the number 9 had two effects: firstly, it was perceived by customers as a round number with a small give-back amount; and secondly, supporting the above studies, the number can be perceived as the left-to-right comparison, where the customer only sees the round number on the right.

These price ending strategies are common practice as most houses are advertised just below a round number. This is an attempt to take advantage of a buyer’s cognitive process since the “just below” pricing strategy affects the perception of the buyer. This “just below” pricing strategy attempt can also be seen as "charm" pricing (Allen & Dare, 2004:695).

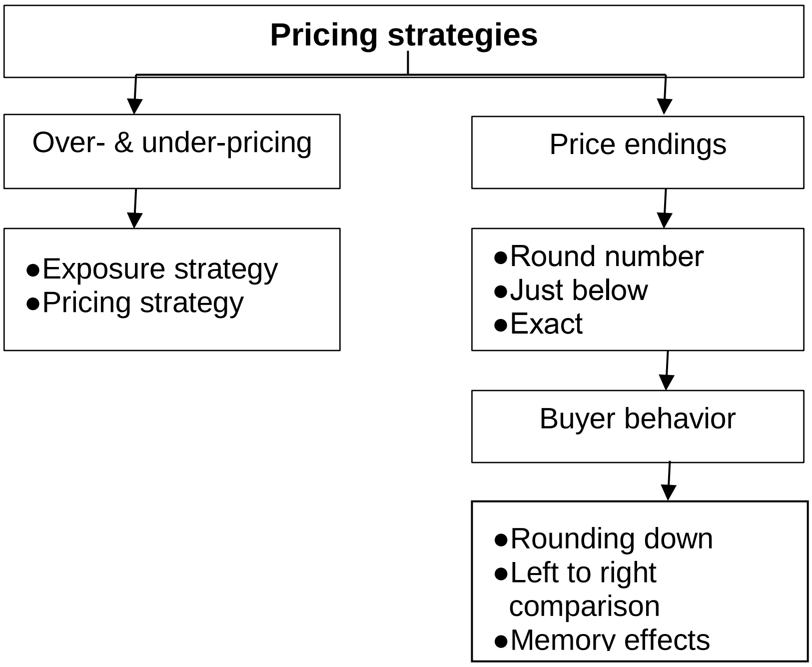
Beracha and Seiler (2014:237) studied the effect of asking price strategy on transaction selling prices. The pricing strategy of the asking price set by the seller can be categorised into three classifications, namely, “just below”, round price or a precise price. The “just below” price refers to a price that ends on a “9” rather than a “0”, for example, R2 999 999. Round pricing refers to a price that ends on a “0”, for example, R2 000 000, while a precise price refers to the accurate price of a property, for example, R2 549 350. Beracha and Seiler (2014:241) found that buyers are more drawn to “just below” priced properties; however, buyers also tend to negotiate the price even lower. The study suggested that listed homes using a “just below” pricing strategy can be seen as the greatest discount and would, in most cases, result in the selling price being closer to the asking price. Therefore, the study further suggests that the “just below” pricing strategy is the most effective in comparison to the round price and precise pricing strategies in terms of optimising yield. The empirical findings of this study have shown significance and are robust from a buyer’s and seller’s perspectives as well as for multiple home price ranges.

In addition, Allen and Dare (2004:695) empirically investigated the effects of the “just below” pricing strategy on house selling prices using sample data. The results of this study corresponded with Beracha and Seiler (2014:239) as there was significant evidence that, if the asking price of a house was listed using the “just below” pricing strategy, the house would sell for a price closer to the asking price. The study further suggests that house sellers would benefit from an increased selling price if they carefully and strategically set their house prices using the “just below” pricing strategy.

Miller and Sklarz (1987:31) tested the theory that higher asking prices would lead to higher selling prices. However, the study found that higher listing prices do not inevitably lead to higher selling prices. The study concluded that the “price reliance” phenomenon is not likely to be a prominent feature in the housing market. On the other hand, Knight *et al.* (1994:182) developed a theoretical model of the housing market by using asking prices as signals and then studied the responses thereof. The study found that lower asking prices increased the number of offers received.

To conclude, sellers have two main objectives, namely, to sell their houses at a maximum price and within a minimum time on the market. Subsequently, the asking price must be strategically set. Pricing strategies include over- and under-pricing of properties as well as price endings. The over- or under-pricing of properties can signal sellers’ willingness to sell their properties. The under-pricing strategy can be seen as a price strategy with little exposure since the property is well priced, whereas over-pricing properties represents an exposure strategy where the broker attracts more buyers and offers by doing more marketing. However, over-pricing a property will result in a house being on the market for a longer time. Regarding price endings as price strategies, three strategies were identified, namely, a round number, a “just below” number and an exact number. In terms of asking prices, mainly round number and “just below” strategies were followed. Of the two, the latter was mostly used as it is an attempt to affect the perception of a buyer. Results from studies indicated that if the “just below” pricing strategy is used, a house would sell close to the asking price. Figure 5 illustrates a pricing strategy summary constructed from the above studies.

Figure 5. Pricing strategies summary



Source: Adjusted from Stiving and Winer (1997:58)

2.7. CONCLUSION

The above-mentioned studies found that a house can be valued according its characteristic attributes. However, only a few studies have been done in South Africa with regard to house prices and the determining factors. Furthermore, studies have been done on asking price strategies as well as how the asking price affects the selling price. Yet, few studies were found on house pricing strategies with the selling price and time on the market TOM factor in South Africa. In addition, no prior study has considered house prices with a combination of characteristic attributes and price strategies of the asking price. Consequently, a gap in the research can be identified.

The next chapter provides background to the empirical study by discussing research approaches, the research questions, a data discussion and methodology, thereby indicating the methods the study made use of in order to answer the research questions.

CHAPTER 3

RESEARCH METHODOLOGY & DATA ANALYSIS

3.1. INTRODUCTION

This chapter provides the background to the empirical study. The chapter includes a discussion of the research paradigm, research approach and research questions, after which the research methodology and a study area discussion indicating how the study answers the provided research questions. The applied method will explain which characteristics best explain house asking and selling prices as well as the relationship between pricing strategies and house prices.

Methodology can be described as the bridge between the philosophical standpoints of ontology, epistemology and research methods (Nieuwenhuis, 2016:49). Research can be categorised into three types of studies: firstly, explanatory research, by filling a missing gap; secondly, descriptive research elaborates on other studies; and thirdly, causal research determines the causal relationship by means of empirical data (Wilson, 2014:104). A causal research type was followed in this study with the support of a literature review, in order to identify theories, and an empirical study for testing the identified theories. This study was experimental since data were collected in order to determine an outcome. A quantitative deductive approach was followed as theories had to be tested. The ontological assumption deals with the nature of reality and will be objective. The rhetorical language of the study is the impersonal voice using scientific facts. The methodological process of research is deductive reasoning.

The layout of this chapter is as follows: firstly, various research paradigms and the appropriate paradigm for the study are discussed; secondly, a brief discussion on the subject of the research approach is provided; thirdly, the strategy and research design are discussed; fourthly, data description and data collection procedures follow an explanation of data cleaning procedures and the methods used to transform textual variables into suitable variables for regressions; and lastly, the validity, reliability, ethics and limitations of the study are discussed.

3.2. RESEARCH PARADIGM

A positivistic paradigm increases the understanding of house prices and pricing strategies as these factors are empirical. Subsequently, due to the quantitative approach of studying housing prices, the use of a positivistic paradigm enables future predictions. An advantage of the positivistic paradigm is that the results can be used to generalise to a larger degree, saving time in studying a large population (Johnson & Onwuegbuzie, 2007:121). In addition, the results could be counted on for long as they remain ontologically realistic.

3.3. RESEARCH APPROACH

An argument can be either deductive or inductive. Inductive reasoning implies that viewed premises supply strong or weak evidence in support of the truth of a conclusion. On the other hand, deductive reasoning is more certain, based on evidence; the approach is more concerned with theory testing (Wilson, 2014:12). Deductive reasoning is commonly associated with quantitative studies (Ghauri, 2005:110). Theories will be tested; consequently, a deductive approached has been followed.

3.4. RESEARCH QUESTIONS

The study has two research questions, as discussed below:

3.4.1. The determinants of house prices in Potchefstroom

The first research question is to determine the relationship between house prices and house characteristics. To test the theory that house prices can be explained using house characteristics, the objective is to find specific house characteristics explaining house selling and asking prices in Potchefstroom. The following mathematical house price model was proposed:

HousePrice = β_1+ β_2Characteristics$_i$

Where HousePrice refers to the asking and selling prices and i represents the different characteristics influencing house prices.

3.4.2. The pricing strategy impact on the selling price

The second research question is to measure the influence of the pricing strategy, derived from the house asking price, on the selling price. As previously stated, the asking price influences the selling price (see section 2.6.1.); the pricing strategy influences the time on the market factor and the selling price. Therefore, to test if these theories are applicable in the Potchefstroom area and in support of the research question, three objectives were identified: firstly, to determine the impact of the asking price on the selling price; secondly, to determine the relationship between pricing strategies and the time on the market; and thirdly, to determine the relationship between pricing strategy and the selling price. The objectives are answered by OLS regressions including the following identified regressions:

TOM = β_1+ β_2(D)PricingStrategy +β_3Control variables

SellingPrice = β_1+ β_2(D)PricingStrategy +β_3Control variables

PriceDifference = β_1+ β_2(D)PricingStrategy +β_3Control variables

3.5. STRATEGY AND RESEARCH DESIGN

The term “research design” refers to the strategy a researcher chooses to use in order to ensure that the results from a study will address the research problem in a logical manner (Mouton, 2001:55). It includes the data collection method and the measurements thereof. Since a descriptive research method is followed in this study, the three main types of a descriptive research method include case study methods, surveys and observational methods (Yin, 2009:55). Consequently, since this study focusses on Potchefstroom, a description of a case study and the relevant methods follows.

3.5.1. Method

A quantitative approach is followed since the data used by the study comprises numerical information, which includes house prices, countable characteristics and distances that are measurable. In contrast, a qualitative approach includes any non-numerical information that can be captured; the non-numerical information can be quantified by making use of dummy variables.

Since quantitative data are used, a quantitative empirical study can be conducted by using time series data or cross-sectional data. Time series data are observations over a period observing the same subjects. Cross-sectional data are also observational, yet compare different subjects at the same time. The cross-sectional data method is utilised when a variable of interests share characteristics (Daniels, 2011:1). The cross-sectional method will enable the empirical regressions to explain house prices according to house characteristics as well as enable the regression of correlations between pricing strategies, over-pricing and time on the market in order to reach the objectives of the study.

The foundation of the empirical analysis is supported by the Ordinary Least Squares (OLS) method. The OLS method represents a line of best fit through the relationship between a response variable (Y) and an explanatory variable (X), to such an extent that the variable Y is predicted by the variable X (Hutcheson, 2011:224; Asterou & Hall, 2016:32). A linear relationship equation can be mathematically expressed as follows:

$$Y = \alpha + \beta X_t \quad (4)$$

Where α refers to the intercept (the value of Y when X is equal to zero). The regression coefficient β represents the slope of the regression line and explains the change in Y for every unit change in X. However, the equation may be extended by adding more explanatory variables to the equation. Y will then be explained by multiple explanatory variables and can be expressed as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k \quad (5)$$

Where Y is explained by more than one explanatory variable. OLS is a method used to estimate unknown parameters in linear regression models with the goal of minimising differences between the observed responses in arbitrary datasets and the responses predicted by the linear approximation of data. Through this method, house prices are explained as a function of house characteristics as well as a function of measuring the interrelationship between pricing strategies, over-pricing and time on the market with control variables.

3.5.1.1. Assumptions

The Classical Linear Regression Model (CLRM) has eight assumptions for observations to be regressed. Firstly, linearity is considered; the dependent variable should be linear in independent parameters with an error term (Asteriou & Hall, 2016:36), expressed by the mathematical term as follows, where the model is linear in a and b coefficients:

$$Y = \alpha + \beta X_t + u_t \tag{6}$$

Secondly, it should be strictly exogenous, meaning that the expected value of the disturbance term is zero (Asteriou & Hall, 2016:36), mathematically expressed as:

$$E(u_t) = 0 \tag{7}$$

Thirdly, there has to be a variation of observations within a sample. Therefore, not all the observations, expressed as X_t, are the same (Asteriou & Hall, 2016:36). It can mathematically be expressed as:

$$Var(X_t) \neq 0 \tag{8}$$

Fourthly, the observations, X_t, on independent variables should be fixed when the sample is repeated, indicating that X_t is non-stochastic (Asteriou & Hall, 2016:36). It can be mathematically expressed as:

$$Cov(X_s, u_t) = 0 \tag{9}$$

For all s and t = 1,2,3,n, indicating that X_t and u_t are uncorrelated.

Fifthly, the error independent variables should be independent from error terms. As soon as independent variables and error terms are correlated, the estimates are invalid (Asteriou & Hall, 2016:36). It can be expressed as follows:

$$Cov(u_t, u_s) = 0 \quad \text{For all } t \neq s \tag{10}$$

Sixth, the error term is required to have the same variance, indicating homoscedasticity (Asteriou & Hall, 2016:36).

$$Var(u_t) = \sigma^2 \tag{11}$$

Seventh, error terms are normally distributed (independently and identically) with a common variance and a zero mean (Asteriou & Hall, 2016:36).

$$u_t \sim N(\mu, \sigma^2) \quad (12)$$

Eighth, there should be more than two observations and there should be no linear relationship between the explanatory variables, indicating no multicollinearity (Asteriou & Hall, 2016:36).

3.5.2. Empirical validity

The following actions should be taken to test and improve the validity of the regression models as stated by the CLRM assumptions, using cross-sectional data.

3.5.2.1. Multicollinearity

Multicollinearity occurs when two or more explanatory variables in a regression model correlate highly – indicating that a variable can be predicted from other variables to a certain degree (Asteriou & Hall*,* 2016:104). Multicollinearity affects the efficiency of hedonic models and increases the uncertainty of the true parameter value. Multicollinearity is common in hedonic models, but one has to determine the seriousness of problems created by multicollinearity.

The variables that can cause potential multicollinearity problems are bathrooms and bedrooms – the more bedrooms a house has, the more bathrooms there are expected to be. All the variables were tested for multicollinearity through the use of a correlation matrix, as illustrated in Table 14.

3.5.2.2. Heteroscedasticity

Heteroscedasticity indicates an unequal variance of error terms. A variable is unequal across the range of values due to a second variable that projects the variable. Heteroscedasticity is treacherous as it causes confidence intervals and hypotheses tests to be unreliable. If heteroscedasticity exists, the Ordinary Leased Square (OLS) estimator can, therefore, no longer operate as the Best Linear Unbiased Estimator (BLUE) (Asteriou & Hall, 2016:32).

For this reason, White’s test is used to detect heteroscedasticity within the models. If heteroscedasticity is detected, the models are adjusted by making use of the White heteroscedasticity-consistent standard errors and covariance.

3.5.3. Case study research

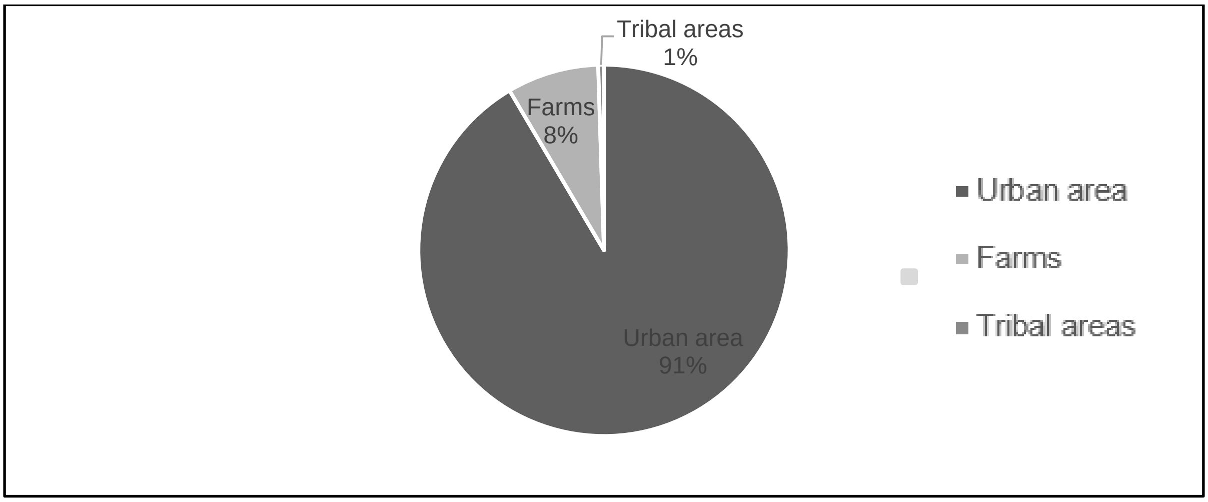
In order to explain the observed variation in Potchefstroom’s house prices, this study was conducted in the form of a case study that focused on suburbs in Potchefstroom. A case study was used to contribute knowledge to individuals and groups and structural and related occurrences. A case study can be an investigation of a specific city or region (Yin, 2009:55). The advantage of a case study is that it enables researchers to retain meaningful characteristics of real-life events, such as neighbourhood changes and price changes (Yin, 2009:55).

3.5.3.1. Study area

The investigated area, Potchefstroom, has a population of 162 762 residents, of which 71,3 per cent are black African, 20,6 per cent are white and 8,1 per cent are made up by other population groups (Stats SA, 2011).

Amenities are located in close proximity since Potchefstroom is approximately only 10 km long (Google Maps, 2017). Amenities include: the North-West University Potchefstroom Campus (Potchefstroom is sometimes referred to as an academic town); the Army Support Base (ASB); Potchefstroom South African National Defence Force (SANDF); the Mooirivier Mall; Potchefstroom Aerodrome; various monuments and heritage sites; secondary and high schools; sport stadiums; and the Aardklop National Arts Festival, which is an annual event. Potchefstroom is situated on the banks of the Mooirivier, the only river that flows through the town.

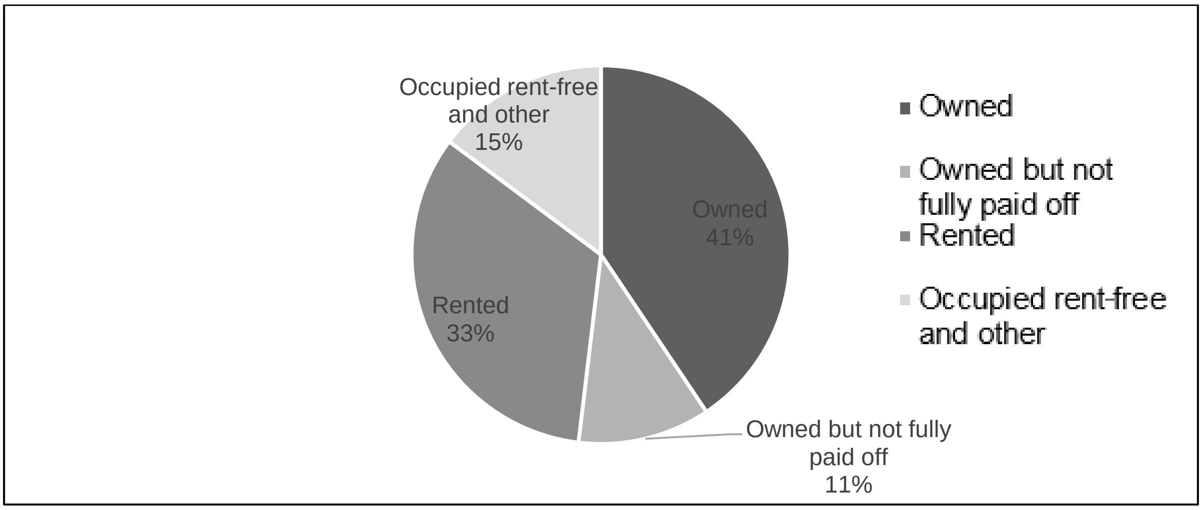
Figure 6. Potchefstroom settlement types



Source: Stats SA (2011)

Referring to Figure 6, the urban area makes up the largest percentage (91%) of the settlement types in Potchefstroom. Potchefstroom further comprises farms (8%) and tribal areas (1%). Figure 7 illustrates the tenure status where 41 per cent of the properties in Potchefstroom are owned, 11 per cent are owned but not paid off, 33 per cent of the properties are rented and 15 present are occupied rent-free.

Figure 7. Potchefstroom tenure status

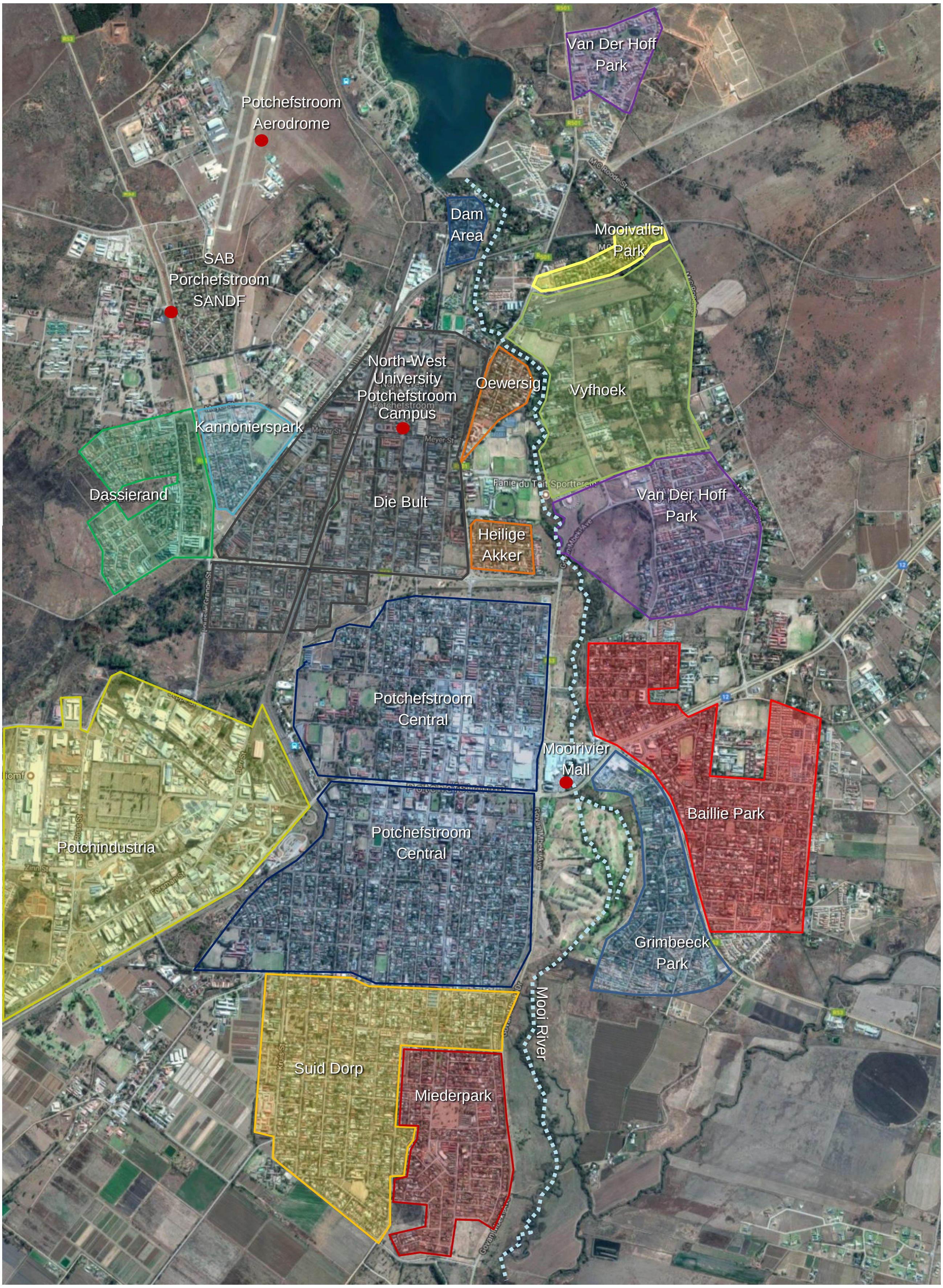


Source: Stats SA (2011)

Potchefstroom encompasses the following suburbs, as indicated in Figure 8: Potchindustria, Potchefstroom Central, Suid Dorp, Miederpark, Grimbeeck Park, Baillie Park, Van Der Hoff Park, Die Bult, Dam area, Mooivallei Park, Oewersig, Heilige Akker, Vyfhoek, Kannonierspark, Dassierand.

Since the university is situated in Die Bult area, it mostly consists of sectional title properties, flats and townhouses, while some houses are transformed into student houses. It also accounts for the surrounding suburbs, Kannonierspark and Dassierand; however, these suburbs are situated close to the Army Support Base. Other smaller suburbs, namely, the Dam area, Mooivallei Park, Oewersig and the Heilige Akker are also included. However, since these suburbs are so small, they are grouped into the Van Der Hoff Park suburb and only a few observations were generated. Consequently, the main suburbs used for the purposes of this study are Potchefstroom Central, Suid Dorp, Miederpark, Grimbeeck Park, Baillie Park and Van Der Hoff Park. These areas mostly embody freestanding low-density residential houses that had data available.

Figure 8. Map of Potchefstroom



Source: Google Maps (2017)

3.6. DATA COLLECTION

Sufficient information was available on the characteristics of houses sold in Potchefstroom. Various official platforms list the selling prices of houses per neighbourhood. The data used in the study were manually collected by the author from Property24® (2017), a South African property search engine.

Property24® (2017), real estate agencies and Google Maps (2017) were used as the main data sources of the study. Property24® (2017) offers a rich data base of properties for sale in South Africa with approximately 8 500 properties for sale in Potchefstroom in 2017. These properties consist of sectional title apartments or flats, townhouses, properties within estates, full title houses, vacant land or plots, farms, commercial properties and industrial properties. For the purpose of the study, only full title houses within Potchefstroom were considered, since these properties are less affected by student accommodation trends. There were, on average, approximately 1 700 houses listed for sale in Potchefstroom between 2016 and 2017 (Property24®, 2017).

The house characteristics frequently available on Property24® (2017) include the asking price, listing date, the suburb, number of bedrooms, number of bathrooms, number of garages, plot size and the presence of a pool. The photos of advertised properties assisted in identifying pitched or flat roofs and whether these houses have metal or tiled roofs. As soon as a listed property has been sold and registered, it is documented in accordance with the registration month and year by the Deeds Office in South Africa. A municipal valuation roll, for the period 2013 to 2017, was used to confirm the plot size for each property. Real estate agencies contributed data in the form of listings as well as confirmed the sold house prices and the house characteristics.

The house characteristics and asking prices were accumulated from 2016 to 2017, provided by listings on Property24® (2017), after which the selling prices and the dates of registration of corresponding houses were compared. The data was documented on an Excel spreadsheet.

The following Potchefstroom suburbs are acknowledged by Property24® (2017): Baillie Park; Grimbeeck Park; Miederpark; Potchefstroom Central; Mooivallei Park;

Van Der Hoff Park; Dassierand; Die Bult; Heilige Akker; and Suid Dorp. The author visited the named areas within Potchefstroom as well as identified the exact location of the North-West University Potchefstroom Campus. Google Maps (2017) was used to measure the distance (km) from the relevant house address to the identified location.

3.6.1. Variables

Although studies on this topic have mainly been researched internationally, property prices and their characteristics differ geographically. As stated in the data collection section above, not all the variables were available and not all are relevant, for example, floor level and attic space. Therefore, the following variables were used to formulate regressions and correlations: asking price; selling price; listing date; date of registration; the location of the property; number of bedrooms; number of bathrooms; number of garages; plot size; the presence of a pool; pitched or flat roofs; and metal or tiled roofs. The over-priced variable was calculated as the difference between the selling price and the asking price; the percentage over-priced is calculated as the percentage difference between the selling and the asking prices. The time on the market variable was calculated as the difference between the listing date and the registration date, expressed in months. The pricing strategy of houses can be derived from the house asking price; this is not dependent on geography, although the strategies used may differ geographically.

3.6.1.1. Dummy variables

Along with the quantitative data, several dummy variables were included in the analysis. Pool was defined as 1 if a pool is present and 0 if there was no pool present; pitched is 1 if the roof was pitched and 0 if the roof was flat; and tiled as 1 if the roof was tiled and 0 if the roof was metal. The area values for the dummy variables were defined as follows: Baillie Park as 1 if the property was located in Baillie Park and 0 if the property was located in another area; the same was done for the other suburbs. The basis area is Central and Suid Dorp.

Regarding pricing strategies, as stated in the literature study, house asking prices that end with the numerical number 5 have a significant impact on selling prices.

Therefore, the pricing strategy was defined as 1 if the house asking prices ended on a 5 and 0 if the house was priced differently.

Table 3. Variable summary

Housing characteristics included in analysis	
Structural characteristics	
Variables	**Definition**
Bedroom	Number of bedrooms
Bathroom	Number of bathrooms
Garages	Number of garage places
Plot size	Plot size in square meter
Pool	1 if pool is present, 0 otherwise
Roof type: Tile/Metal	1 if roof is tiled, 0 otherwise
Pitched/Flat	1 if roof is pitched, 0 otherwise
Locational characteristics	
Distance	Distance to North-West University, in kilometre
Area: Baillie Park	1 if situated in Baillie Park, 0 otherwise
Van Der Hoff	1 if situated in Van Der Hoff Park, 0 otherwise
Grimbeeck	1 if situated in Grimbeeck Park, 0 otherwise
Miederpark	1 if situated in Miederpark, 0 otherwise
House prices	
Variables	**Definition**
Asking price	Actual listed asking price in Rand
Selling price	Actual selling price in Rand
Over-pricing	Difference between selling and asking prices
Percentage over-priced	The percentage difference between the asking and selling prices
Pricing strategy	1 if the asking price ended on a 5, 0 otherwise
TOM	Time on the market, in months

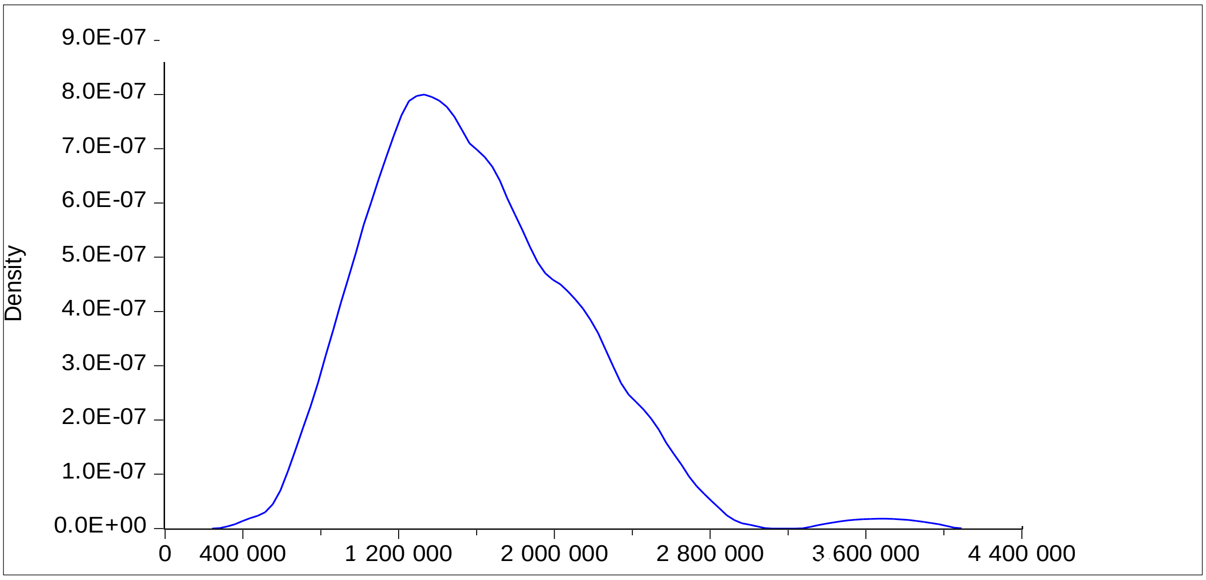
3.6.2. Data description

A total of 131 houses that were sold in Potchefstroom were identified, although some of them provided incomplete data. The data set included 108 properties with available characteristics that were sold in Potchefstroom. Since three outliers have been omitted, only 105 observations were used as a sample containing noteworthy data. The following section describes house price trends.

3.7. HOUSE PRICE TRENDS

House prices are discussed, followed by a discussion of house prices per suburb as well as the house characteristics per suburb with descriptive statistics.

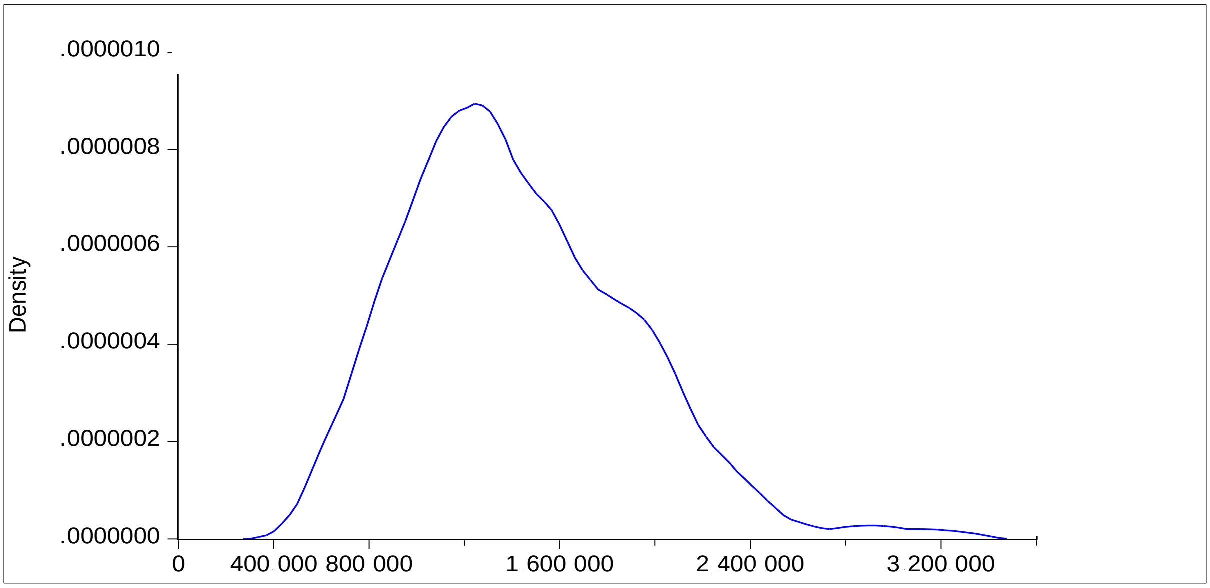
Figure 9. Asking price kernel density estimate



Source: Compiled by author with Eviews

Figure 9 illustrates a density peak at about R1 350 000. However, it is positively skewed, indicating a higher mean value. The minimum asking price was R670 000 with a maximum asking price of R3 675 000.

Figure 10. Selling prices kernel density estimate



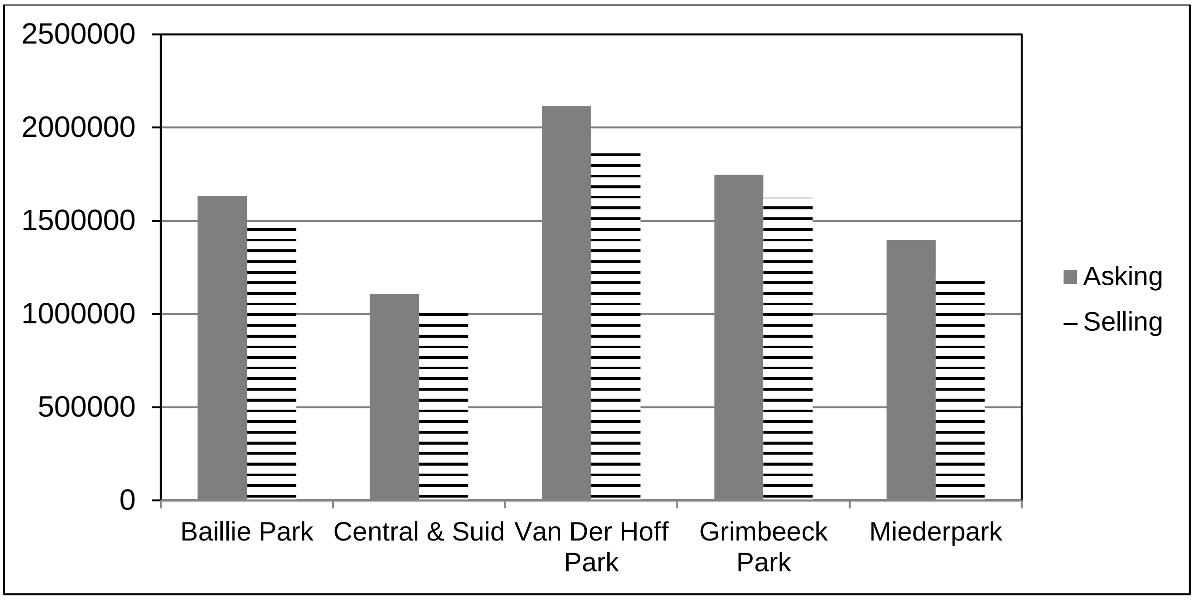
Source: Compiled by author with Eviews

Figure 10 illustrates a density peak of about R1 250 000. However, similar to the asking price, it is positively skewed, indicating that the mean will be higher. The minimum asking price was R660 000 with a maximum asking price of R3 100 000.

The average house asking price in Potchefstroom was R1 592 000 for the years 2016 and 2017. From Figure 9 and Figure 10, it is evident that that the average selling price is less than the average asking price, with an average selling price of R1 435 481, indicating that Potchefstroom houses were over-priced by an average of R156 519 (9.7%) in 2016/2017.

3.7.1. House prices per suburb

Figure 11. Average house prices per suburb



Source: Compiled by author with accumulated data

The average house asking price in Baillie Park was R1 658 556, with an average selling price of R1 495 000; Central and Suid Dorp had an average asking price of R1 106 478, with an average selling price of R1 010 652; Van Der Hoff Park had an average house asking price of R2 213 846, with an average selling price of R1 952 308; Grimbeeck Park had an average asking price of R1 709 133, with an average selling price of R1 589 667; Miederpark had an average asking price of R1 407 000, with an average selling price of R1 216 667. The average house prices per suburb could be an indication of different social classes including low-income, middle-income and high-income status.

These suburbs were investigated accordingly with the support of the following tables, which present descriptive data summaries (mean, median, maximum, minimum and std. dev.) of the suburbs included in the sample. The descriptive data summaries in the columns are independent of each other.

Table 4. Baillie Park house price statistics

	Asking Price	Selling Price	Over-priced	Percentage Over-priced	Pricing Strategy	TOM (months)
Mean	R1 658 556	R1 495 000	R163 556	10.35%	0.583	8.81
Median	R1 550 000	R1 400 000	R125 000	7.97%	1	8
Maximum	R2 700 000	R2 700 000	R450 000	30%	1	20
Minimum	R950 000	R870 000	R-10 000	-0.371747	0	2
Std. Dev.	374715.9	402841.7	118078.5	7.728218	0.5	4.281652

Source: Estimated by author on accumulated data

In Baillie Park, the over-priced variable indicates that a specific property was, however, under-priced by R10 000. This could be that the agency that advertised the house did not sell it and the house was sold by another agency or it was sold privately by the owner for more. However, the over-priced percentage is moderately high at 10.35 per cent. The mean of the pricing strategy was 0.58, an indication that about 60 per cent of the properties in Baillie Park had an asking price that ended on a 5. The mean time on the market was almost nine months in Baillie Park.

Table 5. Central and Suid Dorp house price statistics

	Asking Price	Selling Price	Over-priced	Percentage Over-priced	Pricing Strategy	TOM
Mean	R1 106 478	R1 010 652	R95 826	8.9%	0.30	6.87
Median	R1 126 000	R1 075 000	R90 000	8.38%	0	6
Maximum	R1 390 000	R1 390 000	R415 000	35.78%	1	14
Minimum	R670 000	R660 000	0	0%	0	2
Std. Dev.	189132.2	212192.6	87360.62	7.921839	0.470472	3.507192

Source: Estimated by author on accumulated data

Central and Suid Dorp had lower house prices and would, therefore, result in a lower over-priced mean. Moreover, the houses were over-priced by 8.9 per cent. Few homeowners or agencies made use of the pricing strategy since only 30 per cent of the asking prices ended on a 5. The mean time on the market in Central and Suid Dorp was approximately seven months.

Table 6. Van der Hoff Park house price statistics

	Asking Price	Selling Price	Over-priced	Percentage Over-priced	Pricing Strategy	TOM
Mean	R2 213 846	R1 952 308	R261 538	10.81%	0.538	9
Median	R2 000 000	R1 820 000	R180 000	10.71%	1	7
Maximum	R3 675 000	R3 100 000	R850 000	33.33%	1	20
Minimum	R1 550 000	R1 500 000	0	0%	0	4
Std. Dev.	544262.3	409921.8	232256.9	8.195253	0.518875	5.016639

Source: Estimated by author on accumulated data

Van Der Hoff Park had the highest average-priced houses of the considered suburbs. Closely related to Baillie Park, the houses in this suburb were over-priced by 10.81 per cent and were also on the market for nine months. The pricing strategy indicates that approximately 54 per cent of the asking prices ended on a 5.

Table 7. Grimbeeck Park house price statistics

	Asking Price	Selling Price	Over-priced	Percentage Over-priced	Pricing Strategy	TOM
Mean	R1 709 133	R1 589 667	R119 466	6.11%	0.33	8.8
Median	R1 930 000	R1 550 000	R57 000	3.63%	0	9
Maximum	R2 300 000	R2 300 000	R595 000	29.82%	1	18
Minimum	R980 000	R975 000	-R65 000	-5.49%	0	2
Std. Dev.	502561.1	451388.6	173254.5	8.69%	0.487950	4.616740

Source: Estimated by author on accumulated data

Similar to Baillie Park, Grimbeeck Park had a house that sold for R65 000 more than the asking price. Grimbeeck Park had a slightly lower over-priced percentage of 6.11 per cent. As with Central and Suid Dorp, only a few homeowners or agencies made use of the pricing strategy, since only 33 per cent of the asking prices ended on a 5. The mean time on the market was approximately nine months.

Table 8. Miederpark house price statistics

	Asking Price	Selling Price	Over-priced	Percentage Over-priced	Pricing Strategy	TOM
Mean	R1 407 000	R1 216 667	R190 333	13.12%	0.42	9.17
Median	R1 425 000	R1 300 000	R170 000	12.42%	0	8.5
Maximum	R1 950 000	R1 500 000	R550 000	28.21%	1	18
Minimum	R990 000	R800 000	R0	0%	0	2
Std. Dev.	283763.3	223335.6	135815.6	7.202835	0.514929	5.305800

Source: Estimated by author on accumulated data

The houses in Miederpark were the most over-priced in comparison to the other suburbs, being 13.12 per cent. Approximately 40 per cent of the asking prices ended on a 5 and Miederpark had the longest mean time on the market, being slightly longer than nine months.

3.7.1.1. Suburb price comparison

The houses in Grimbeeck Park were the least overpriced at 6.11 per cent, whereas the houses in Miederpark are the most over-priced by 13.12 per cent. Van Der Hoff Park and Baillie Park, with higher priced houses, made the most use of pricing strategies at 54 per cent and 58 per cent respectively. Central and Suid Dorp, with the lowest priced houses, made the least use of pricing strategies; only 30 per cent of house asking prices ended on a 5. In addition, Central and Suid Dorp had the lowest time on the market with just less than seven months. Miederpark, on the other hand, had the longest time on the market, slightly more than nine months.

3.7.2. House characteristics per suburb

The following tables present descriptive data summaries of house characteristics per suburb for 2016 and 2017.

Table 9. Baillie Park house characteristic statistics

	Bedrooms	Bathrooms	Plot Size	Garage	Distance
Mean	2.2027	3.5675	1266.1	1.9459	5.227
Median	2	3	1209	2	5.5
Maximum	5	4	3320	4	6.2
Minimum	3	1	600	0	3.6
Std. Dev.	0.7116	0.6472	398.10	0.7049	0.7748

Source: Estimated by author on accumulated data

The number of bedrooms in Baillie Park ranged from three to five, while the number of bathrooms ranged from one to four. The number of garages ranged from zero to four. The mean plot size was approximately 1 266 square meter. Approximately 81 per cent of the roofs were pitched and around 51 per cent were tiled. Approximately 49 per cent of the properties had pools. The distance from the houses in Baillie Park to the North-West University indicated a mean of approximately 5.2 kilometre.

Table 10. Central and Suid Dorp house characteristic statistics

	Bedrooms	Bathrooms	Plot Size	Garage	Distance
Mean	3.3043	1.9782	992.78	1.3043	4.5
Median	3	2	925	1	4.7
Maximum	5	4	1703	3	6.1
Minimum	3	1	618	0	2.4
Std. Dev.	0.5587	0.6822	265.78	0.8756	0.8738

Source: Estimated by author on accumulated data

The number of bedrooms in Central and Suid Dorp ranged from three to five, while the number of bathrooms ranged from one to four. The number of garages ranged from zero to three. The mean plot size was approximately 992 square meter. Approximately 95 per cent of the roofs were pitched and around 21 per cent were tiled. Approximately 40 per cent of the properties had pools. The distance from the houses in Central and Suid Dorp to the North-West University indicated a mean of approximately 4.5 kilometre.

Table 11. Van der Hoff Park house characteristic statistics

	Bedrooms	Bathrooms	Plot Size	Garage	Distance
Mean	3.5714	2.6785	1006.7	2.1428	3.24
Median	3	3.	1010	2	3.75
Maximum	5	3.5	1806	3	5
Minimum	3	2	116	2	0.6
Std. Dev.	0.7559	0.5409	453.27	0.3631	1.3658

Source: Estimated by author on accumulated data

The number of bedrooms in Van Der Hoff Park ranged from three to five, while the number of bathrooms ranged from two to three and a half. The number of garages ranged from two to three. The mean plot size was approximately 1 007 square meter. Approximately 86 per cent of the roofs were pitched and around 71 per cent were tiled. Approximately 38 per cent of the properties had pools. The distance from the houses in Van Der Hoff Park to the North-West University indicated a mean of approximately 3.2 kilometre.

Table 12. Grimbeeck Park house characteristic statistics

	Bedrooms	Bathrooms	Plot Size	Garage	Distance
Mean	3.18	2.294	1044.9	2.058	6.24
Median	3	2	1235	2	6.4
Maximum	5	3	2338	4	6.9
Minimum	2	2	266	1	5.1
Std. Dev.	0.9510	0.4696	576.10	0.6586	0.6000

Source: Estimated by author on accumulated data

The number of bedrooms in Grimbeeck Park ranged from two to five, while the number of bathrooms ranged from two to three. The number of garages ranged from one to four. The mean plot size was approximately 1 044 square meter. Approximately 88 per cent of the roofs were pitched and around 64 per cent were tiled. Approximately 52 per cent of the properties had pools. The distance from the houses in Grimbeeck Park to the North-West University indicated a mean of approximately 6.2 kilometre.

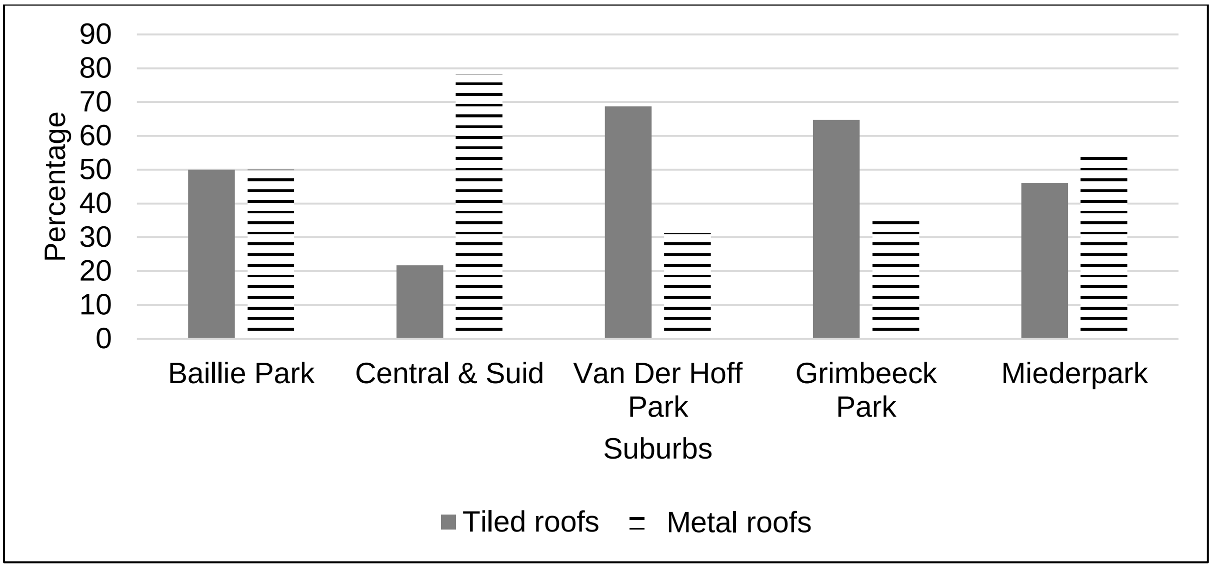
Table 13. Miederpark house characteristic statistics

	Bedrooms	Bathrooms	Plot Size	Garage	Distance
Mean	3.62	2.31	1014	2.077	5.54
Median	4	2	975	2	5.5
Maximum	5	4	1428	4	6.7
Minimum	3	1	770	1	4.3
Std. Dev.	0.6504	0.8788	202.40	0.9540	0.7489

Source: Estimated by author on accumulated data

The number of bedrooms in Miederpark ranged from three to five, while the number of bathrooms ranged from one to four. The number of garages ranged from one to four. The mean plot size was 1 014 square meter. Approximately 61 per cent of the roofs were pitched and around 46 per cent of the roofs were tiled. Approximately 54 per cent of the properties had pools. The distance from the houses in Miederpark to the North-West University indicated a mean of approximately 5.5 kilometre.

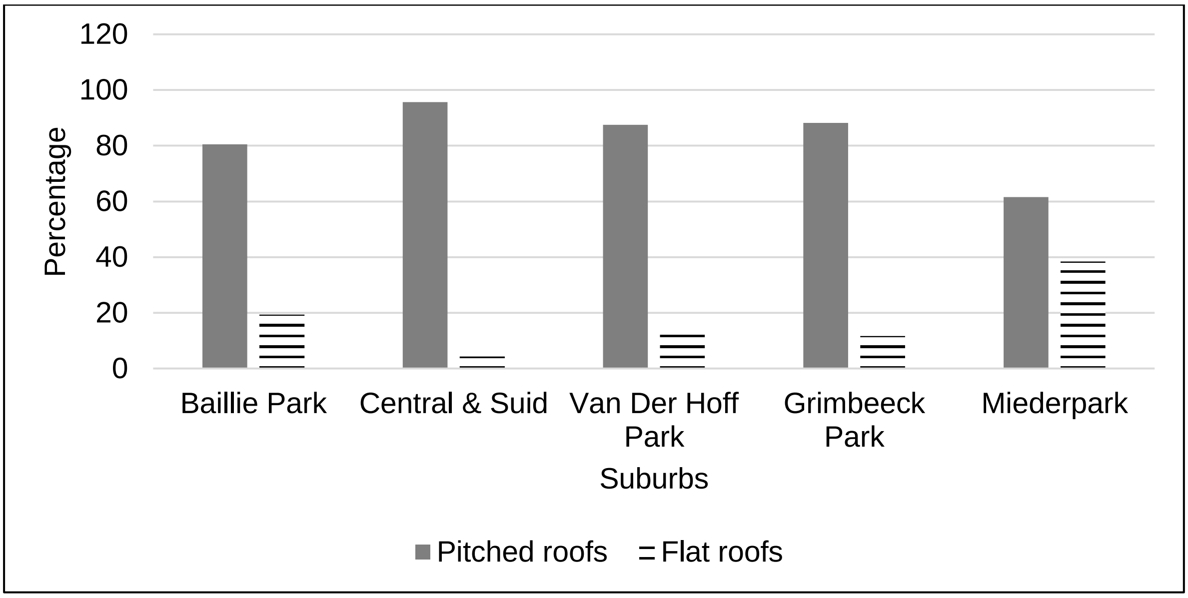
Figure 12. Roof type per suburb: tiled or metal



Source: Compiled by author with accumulated data

The suburbs with the most tiled roofs were Van Der Hoff Park and Grimbeeck Park, where almost 70 per cent of the houses had tiled roofs. On the other hand, Central and Suid Dorp, the oldest and least expensive suburbs in Potchefstroom, had the most houses with metal roofs, almost 80 per cent. Miederpark had the second-most houses with metal roofs, slightly more than 50 per cent.

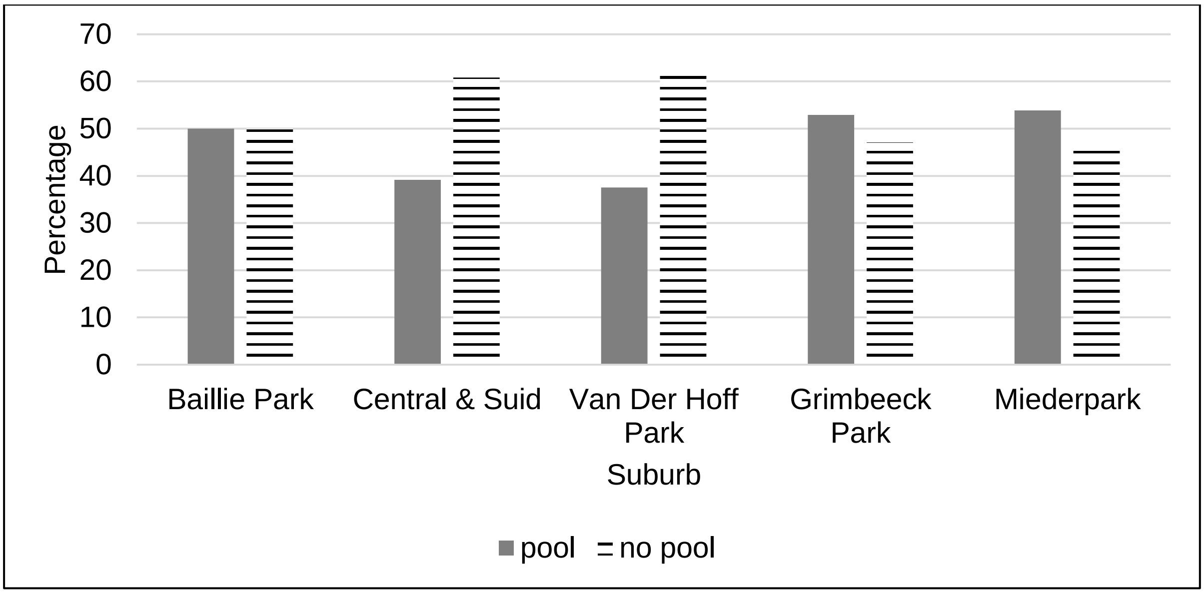
Figure 13. Roof type per suburb: pitched or flat



Source: Compiled by author with accumulated data

Potchefstroom suburbs mainly had pitched roofs; all the suburbs had more pitched roofs than flat roofs. Central and Suid Dorp had the largest ratio of pitched roofs to flat roofs; more than 90 per cent of houses had pitched roofs. Miederpark had the most number of houses with flat roofs, almost 40 per cent.

Figure 14. Presence of pools per suburb



Source: Compiled by author with accumulated data

The suburbs with the most pools were Grimbeeck Park and Miederpark with slightly more than 50 per cent of houses having a pool. On the other hand, Van Der Hoff

Park and Central and Suid Dorp had the most houses without pools; almost 60 per cent of the houses, in both suburbs, did not have pools.

3.7.1.1. Suburb characteristic comparison

The number of bedrooms varied from two to five across all suburbs, while the number of bathrooms varied from one to five across all suburbs. Baillie Park had the largest mean plot size of 1 266 square meter, whereas Central and Suid Dorp had the lowest, with a mean plot size of 993 square meter. Miederpark was the suburb with the most pools, where 54 per cent of the houses had pools, while Van Der Hoff Park had the least number of pools – only 38 per cent of the houses had pools. Baillie Park had the most houses with tiled roofs, with more than 80 per cent tiled, while Central and Suid Dorp had the most metal roofs, approximately 80 per cent. Grimbeeck Park is situated the furthest from the university, 6.24 kilometre away, while Van Der Hoff Park is situated the closest, only 3.24 kilometre away.

3.8. ETHICS

The information used to conduct the study was accessible on computer files, protected on a USB stick that was password protected. To ensure confidentiality, the data was only accessible to the author and the study supervisors. The real estate agencies who participated in the research did so voluntarily and were assured that the information provided by them would be treated confidentially.

A statement of research ethics was provided by the author and approved by the Faculty's Research Ethics Committee. Since the study was quantitative in nature, the document stated that no vulnerable participants would be involved, no sensitive topics would be discussed and that no personal identification was required. Consequently, the study was of low risk.

3.9. VALIDITY

Validity is considered as an indication of how thoroughly the research is conducted. Subsequently, validity applies to the methods and the design of one's research (Maree, 2016:169).

Accordingly, the problem statement acknowledged that homeowners selling their house have to decide on an appropriate value for their property regarding house characteristics as well as decide on a pricing strategy. Consequently, the research questions stated that characteristic determinants should be found for house prices and that a relationship between pricing strategies and selling prices needed to be determined. Theories regarding characteristic determinants and pricing strategies were identified and the study was not derived from the identified theories. The methodology chapter described in detail the research method and the regressions that were used. During the data accumulation process, the data was double-checked. Following this, assumptions of CRLM regressions were implemented to improve the validity of the empirical study.

3.10. RELIABILITY

Reliability is when the same instrument, which is used various times with different respondents, produces stable and consistent results (Maree, 2016:238). Consequently, data was collected form reliable sources, namely, Property24® (2017) and Google Maps (2017). As previously stated (see section 3.6.), a municipal valuation role was used to confirm the addresses of sold properties as well as the plot size of each property. In addition, real estate agencies confirmed the prices of the sold houses and their characteristics.

The outliers within the data were excluded to make the data more reliable. Since a few observations per area would lead to insignificance, the areas with only a few observations were added to the area closest to them.

3.11. CONCLUSION

This chapter identified that a quantitative approach is followed since the data used by the study comprises numerical information, which includes house prices, countable characteristics and distances that are measurable. Therefore, a positivistic paradigm is followed due to the quantitative approach and since this paradigm enables future predictions. The research approach will be deductive as theories will be tested. Further, this study focusses on Potchefstroom, therefore, a case study with the relevant methods are followed.

The data is accumulated by the author and the variables were categorised into the following three categories with the substantial variables. Structural variables: bedroom, bathroom, garages, plot size, pool, roof type. Locational variables:

distance, Baillie Park, Van Der Hoff Park, Grimbeeck Park, Miederpark. House prices: asking price, selling price, over-pricing, percentage over-priced, pricing strategy, time on the market (TOM).

A data description followed which included a house price per suburb comparison and house characteristics per suburb comparison. Lastly, the validity, reliability, ethics and limitations of the study were discussed.

The following chapter deals with the results and findings of the estimated models and regressions.

CHAPTER 4

RESULTS AND FINDINGS

4.1. INTRODUCTION

This chapter deals with the model specification and empirical models. The models include a hedonic pricing model, OLS regressions and logarithmic models to determine robust significant house characteristics. The validity tests include a correlation matrix and a Ramsey Regression Equation Specification Error Test (RESET). The models employed independent variables which include structural and locational characteristics, time on the market (TOM), overpriced percentage and a pricing strategy variable that are applicable to the Potchefstroom neighbourhood suburbs.

The layout of this chapter is as follows: firstly a model specification followed by a multicolinearity validity test. Secondly an empirical analysis will be conducted to determine which characteristics explain house prices and to measure the impact of the pricing strategy on Potchefstroom suburbs and its characteristics independently. Lastly a final conclusion will be reached.

4.2. MODEL SPECIFICATION

Hedonic modelling by means of OLS regressions were used as the basis of the empirical study. The models explain house prices as a function of house characteristics. In the process, the best and most significant models were selected and discussed.

Apart from explaining selling prices by means of house characteristics, the asking price and a measure of over-pricing are modelled as dependent variables. Pricing strategy and TOM are added as explanatory variables.

4.3. VALIDITY TESTS

The quantifiable variables were tested for multicollinearity through the use of a correlation matrix, as illustrated in the following table.

Table 14. Correlation matrix

	Bedroom	Bathroom	Garage	Plot Size	Pool	Baillie Park	Grimbeek	Van Der Hoff	Miederpark	Pitched	Tile
Bedroom	1										
Bathroom	0.46083	1									
Garage	0.173782	0.287518	1								
Plot Size	0.286277	0.024637	0.014554	1							
Pool	0.402308	0.253436	0.153293	0.170115	1						
Baillie Park	0.131609	-0.02275	0.091998	0.270278	0.035625	1					
Grimbeeck	-0.17586	0.024008	0.104893	-0.04711	0.047792	-0.3259	1				
Van Der Ho	0.064536	0.244938	0.136066	-0.08577	-0.03745	-0.29073	-0.17634	1			
Miederpark	0.085455	0.028085	0.098436	-0.07426	0.047741	-0.27859	-0.16898	-0.15074	1		
Pitched	-0.08291	-0.15819	-0.13824	0.035313	0.056944	-0.05804	0.056772	0.023709	-0.22479	1	
Tile	-0.02239	0.117776	0.131535	0.002661	0.008308	0.021359	0.143777	0.181607	-0.01817	0.274853	1
Distance	-0.12911	-0.03467	0.047477	0.056426	0.030057	0.136019	0.447211	-0.56859	0.165508	-0.05237	0.08677

The highest correlation is between bathrooms and bedrooms, which is correlated slightly positive at 47 per cent. Distance from the university is positively correlated with Grimbeeck Park at 46 per cent and negatively correlated with Van Der Hoff Park at 54 per cent since this suburb is situated closest to the university.

The correlations between plot size and bedrooms, bathrooms and garages are not as high as may be expected. Due to the low correlations reported in Table 14, no further tests were done for multicollinearity. The regressions also do not show the usual signs of multicollinearity (wrong signs of coefficients, low t-values coupled with high R^2s) – a further indication that multicollinearity is not present.

4.4. EMPIRICAL ANALYSIS

4.4.1. The determinants of house prices in Potchefstroom

Two models were generated to answer the first research question, with the dependent variables being the house asking price and the selling price, function of the independent variables being structural and locational characteristics.

1. Asking price model

AskingPrice = β_1+ β_2Bedrooms +β_3Bathrooms + β_4Garages + β_5PlotSize + β_6(D)Pool + β_7(D)BailliePark + β_8(D)GrimbeeckPark +β_9(D)VanDerHoffPark + β_{10}(D)Miederpark +β_{11}(D)Pitched + β_{12}(D)Tile + β_{13}Distance

2. Selling price model

SellingPrice = β_1+ β_2Bedrooms +β_3Bathrooms + β_4Garages + β_5PlotSize + β_6(D)Pool + β_7(D)BailliePark + β_8(D)GrimbeeckPark +β_9(D)VanDerHoffPark + β_{10}(D)Miederpark +β_{11}(D)Pitched + β_{12}(D)Tile + β_{13}Distance

Table 15. Price models results

	Asking price model		Selling price model	
Independent	**Coefficient**	**Probability**	**Coefficient**	**Probability**
C	-484141.3	-0.1129	-276744.9	0.3209
Bedrooms	249077.9	0.0002***	230884.6	0.0001***
Bathrooms	66362.97	0.2804	42077.98	0.5418
Garage	77293.54	0.0318**	62184.48	0.0398**
Plot size m^2	196.7243	0.0126**	129.4100	0.1835
Pool	38204.75	0.5791	47279.91	0.4551
Baillie Park	322337.8	0.0000***	303600.7	0.0001***
Grimbeeck Park	464164.0	0.0000***	493198.4	0.0000***
Van Der Hoff Park	900025.7	0.0000***	752965.7	0.0000***
Miederpark	91931.82	0.2548	38049.60	0.5998
Pitched roof	120633.7	0.1217	107230.6	0.1626
Tiled roof	117043.5	0.0548*	117465.5	0.0481**
Distance	40975.86	0.2937	18898.06	0.6325
Adjusted R^2	0.668389		0.613512	
Heteroscedasticity	Yes, adjusted		Yes, adjusted	
Multicollinearity	No		No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Heteroscedaticity was detected in both models and the results were adjusted accordingly. No multicollinearity was found. Heteroscedasticity and multicollinearity tests were done for all the rest of the models, as indicated in the tables below. Heteroscedasticity was identified in the models and adjusted accordingly and no multicollinearity was detected.

The asking price model had the following significant structural characteristics: bedrooms, garage, plot size and tiled roof. The significant locational characteristics were Baillie Park, Grimbeeck Park and Van Der Hoff Park. Except for the constant variable, all the variables that represented house characteristics were positive, as expected. For every additional bedroom, the asking price would increase with R249 078; for every additional garage, the asking price would increase with

R77 294; for every additional square meter in plot size, the asking price would increase with R197. If a house had a tiled roof, the asking price would be R117 044 more than the asking price of a house with a metal roof. The most expensive suburbs, namely, Van Der Hoff Park and Grimbeeck Park had the most houses with tiled roofs (see Figure 11), while in Central and Suid Dorp, together with Miederpark, the less expensive suburbs, the houses mostly had metal roofs, which explains the high prices asked for tiled roofs.

Since Central and Suid Dorp were used as the basis for both models, a house situated in Baillie Park would have an asking price of R322 338 more than a house situated in Central or Suid Dorp, while a house situated in Grimbeeck Park would have an asking price of R464 164 more than a house situated in Central or Suid Dorp. Similarly, a house in Van Der Hoff Park would have an asking price of R900 025 more than a house situated in the basis suburbs. The adjusted R squared of the asking price model indicates that 67 per cent of the variation in asking price is explained by the regression.

The selling price model had bedrooms, garage and tiled roof as significant structural characteristics; significant locational characteristics included the suburbs Baillie Park, Grimbeeck Park and Van Der Hoff Park. All the variables had positive coefficients, indicating a positive effect on the selling price, which is supported by the literature study; however, the constant variable was negative and insignificant. For every additional bedroom, the house selling price would increase with R230 885; for every additional garage, the selling price would increase with R62 184. If a house had a tiled roof, the selling price would be R117 466 more than if a metal roof was present.

Regarding the suburbs used in the selling price model, Central and Suid Dorp are used as the basis. Therefore, if a house was situated in Baillie Park, the selling price would be R303 600 more than if it was situated in Central or Suid Dorp; if a house was situated in Grimbeeck Park, the selling price would be R493 198 more than a house situated in Central or Suid Dorp; if a house was situated in Van Der Hoff Park, the selling price would be R752 965 more than a house situated in Central or Suid Dorp. The adjusted R squared indicates the percentage of the response variable variation that is explained by a linear model; the selling price model, therefore, explains 61 per cent of the variation.

The dummy variable for Miederpark was not statistically significant in any of the two models. This means that there is no significant difference between the asking and selling prices of Central and Suid Dorp versus Miederpark. The average house price per suburb (see section 3.7.1., Table 11) indicates that prices in Central and Suid Dorp do not differ that much from Miederpark. As such, the insignificant coefficient could be expected.

The asking price of houses in Potchefstroom was significantly higher than the selling price. For this reason, it is expected that the significant variables of the asking price model's coefficients should be more than the comparable significant variables of the selling price model. The statement is true for almost all the significant variables for both models, except for the suburb, Grimbeeck Park, since the variable's coefficient is much more in the selling price model than in the asking price model. In addition, the tiled roof variable had a slightly higher coefficient in the selling price model; however, it is also more significant. Another difference between the two models is that plot size is significant in explaining the asking price, while it is insignificant in explaining the selling price.

The hypothesis for the F-statistic of the overall significance is as follows: H_0 − the fit of the intercept-only model and the regressed model is equal; and H_1 − the fit of the intercept-only model is significantly reduced compared to the regressed model. For the asking price model, referring to Table 35 (Addendum A), the H_0 can be rejected since the probability of the F-statistic is 0 – indicating a significant model. For the selling price model, referring to Table 38 (Addendum A), the H_0 can be rejected as the probability of the F-statistic is 0 – also indicating a significant model.

4.4.1.1. Squared explanatory variable model

In addition to the described tests, the Ramsey Regression Equation Specification Error Test (RESET), a specification test for non-linear combinations of fitted values to help explain the response variables (Ramsey, 1969:350) was conducted after each of the models discussed above. The RESET test did not indicate any sign of misspecification. However, it was decided to experiment with the squared version of plot size as explanatory variable. If the squared term was found to be statistically significant in the selling price model, it would mean that the selling price does not display a linear relationship with plot size. In such a quadratic relationship, a turning point is reached at some stage.

Table 16. Squared explanatory variable model – plot size

Variable	**Coefficient**	**Probability**
C	-521032.8	0.0724*
Bedroom	236747.9	0.0000***
Bathroom	40904.00	0.5300
Garage	55379.23	0.0561*
Plot size	801.0099	0.0278**
Plot size^2	-0.308821	0.0583*
Pool	30605.15	0.6251
Baillie Park	300565.7	0.0000***
Grimbeeck Park	589530.1	0.0000***
Van Der Hoff Park	756908.4	0.0000***
Miederpark	36155.19	0.5736
Pitched roof	83890.28	0.2962
Tiled roof	156552.4	0.0086***
Adjusted R^2	0.632245	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

In comparison to the selling price model in Table 15, it is evident that the same variables are significant in this extended model. However, the variable plot size and the added variable plot size squared are also significant. The initial positive coefficient indicates that there is a positive relationship – the selling price increases as the plot size increases. The negative coefficient of the squared term indicates that a turning point is reached at some stage, after which the selling price actually decreases or does not increase any longer. The specific plot size turning point is calculated as 1 296[1].

For the whole sample, the plot size mean was 1 075 square meter with a median of 1 109 square meter. The minimum plot size was 116 square meter and the maximum was 2 338 square meter. Therefore, the estimated turning point is well within the range of observed values. Thus, if the plot size exceeds 1 296 square meter, the selling price would be influenced negatively or at least not increase further.

4.4.1.2. Logarithmic models

Since price models are usually estimated in logarithmic format, logarithmic estimations are done as a robustness check for the selling price model. Firstly, the option is to log all the independent variables with positive numbers, including the dependent variable selling price but not the dummies. Secondly, the option is to log the dependent variable selling price only.

[1] Turning point: Selling price = 801Plot size – 0.309 $(\text{Plot size})^2$
(dSelling price)/(dPlot size) = 801 – 0.618 Plot size To optimise set = 0
Plot size = 801/0.618, therefore, Plot size turning point = 1296

Table 17. Logarithmic selling price models

Variable	Coefficient	Probability	Variable	Coefficient	Probability
C	12.54317	0.0000***	C	12.97185	0.0000***
Log(Bedroom)	0.559579	0.0000***	Bedroom	0.148459	0.0000***
Log(Bathroom)	0.079493	0.3080	Bathroom	0.028267	0.4835
Garage	0.048300	0.0419**	Garage	0.057186	0.0149**
Log(Plot size)	0.054028	0.2017	Plot size	8.50E-05	0.1746
Pool	0.032077	0.4054	Pool	0.040088	0.3078
Log(Distance)	-0.001095	0.9847	Distance	2.47E-06	0.9999
Baillie Park	0.266778	0.0000***	Baillie Park	0.262925	0.0000***
Grimbeeck Park	0.414577	0.0000***	Grimbeeck Park	0.387288	0.0000***
Van Der Hoff Park	0.514620	0.0000***	Van Der Hoff Park	0.513855	0.0000***
Miederpark	0.083636	0.1506	Miederpark	0.086042	0.1602
Pitched roof	0.087946	0.1048	Pitched roof	0.098089	0.0729*
Tiled roof	0.092504	0.0194**	Tiled roof	0.080710	0.0385**
Adjusted R^2	0.665612		0.651738		
Heteroscedasticity	Yes, adjusted		Yes, adjusted		
Multicollinearity	No		No		

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

From the results in Table 17, it is evident that the same variables are significant in explaining house prices in the log models as was found in the first models on prices in levels. The robust variables are bedrooms, garage, a tiled roof and the areas Baillie Park, Grimbeeck Park and Van Der Hoff Park.

4.4.2. The impact of the pricing strategy

To answer the second objective, the following OLS regressions and dependent and independent variables were considered.

4.4.2.1. Pricing strategy and time on the market

The dependent variable, time on the market, is a function of the pricing strategy with the following control variables: bedrooms, plot size and distance. Bedrooms and plot size were chosen as a size proxy, since the more bedrooms a house has, the larger the house would be. As a result, size may have an influence on the time on the market. The distance variable was used as a proxy representing different suburbs; since different suburbs might be more desirable than others, this could affect the time on the market.

TOM = β_1+ β_2(D)PricingStrategy +β_3Bedrooms + β_4PlotSize + β_5Distance

Table 18. TOM regression results

Variable	Coefficient	Probability
C	7.160022	0.0264*
Pricing strategy	0.616611	0.5274
Bedrooms	0.313854	0.6657
Plot size m^2	0.000211	0.8787
Distance	-0.068215	0.8570
Adjusted R^2	-0.074818	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Pricing strategy was found to have a positive relationship with the time on the market; however, the pricing strategy variable and the control variables were statistically insignificant, although the constant variable is significant. The adjusted R squared is negative, indicating that the model does not fit a horizontal line and does not follow the data trend.

4.4.2.2. Pricing strategy and selling price

The selling price as dependent variable is a function of the pricing strategy and the following control variables: distance and time on the market. Similar to the previous regression, the variable distance was used as a proxy to represent the different suburbs; since the different suburbs have different selling prices, this variable was considered. The time on the market factor was incorporated as it is expected that higher priced homes will have a longer time on the market.

SellingPrice = β_1+ β_2(D)PricingStrategy +β_3TOM + β_4Distance

Table 19. Selling price regression results

Variable	**Coefficient**	**Probability**
C	1428908	0.0000*
Pricing Strategy	2500.032	0.9782
TOM	12883.09	0.1751
Distance	-23205.91	0.5026
Adjusted R^2	-0.011449	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The pricing strategy had a positive relationship with the selling price. However, the pricing strategy variable, together with the control variables, were statistically insignificant. The constant variable is significant.

In addition to the above model, the selling price was used as dependent variable, including all the house characteristics together with the pricing strategy as independent variables in the table below.

Table 20. Selling price regression results with house characteristics

Variable	Coefficient	Probability
C	-229654.9	0.2775
Pricing strategy	-134725.1	0.0258**
Bedroom	255348.1	0.0000***
Bathroom	45384.81	0.4507
Garage	56110.57	0.0666*
Plot size	107.2240	0.2261
Pool	26763.48	0.6538
Baillie Park	370590.9	0.0000***
Grimbeeck Park	556200.0	0.0000***
Van Der Hoff park	765079.4	0.0000***
Miederpark	86149.90	0.1903
Pitched roof	143523.3	0.0527*
Tiled roof	93723.55	0.1055
Adjusted R^2	0.636768	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Although the results in Table 19 indicate an insignificant pricing strategy, the above model in Table 20 indicates that pricing strategy is significant. Since the adjusted R squared is 64 per cent for the selling price model with house characteristics and the previous model had a negative adjusted R squared, the second model with a significant pricing strategy variable is more reliable. However, the pricing strategy coefficient is negative showing that, if the pricing strategy is followed, the selling price would be R134 725 less than if the pricing strategy is not followed. This amount is less than the over-priced mean of R166 144 for all the suburbs, indicating that the house would sell for more.

4.4.2.3. Pricing strategy and overpriced percentage

The over-priced percentage, as the dependent variable, is a function of the pricing strategy and the control variables, distance and time on the market. Distance is used as a proxy to represent the different suburbs and over-pricing can differ from suburb to suburb. The time on the market variable was incorporated into this model since it was expected that over-pricing would result in a longer time on the market.

Over-pricedPercentage = β_1+ β_2(D)PricingStrategy +β_3TOM + β_4Distance

Table 21. Over-priced percentage regression results

Variable	**Coefficient**	**Probability**
C	7.562464	0.0384**
Pricing strategy	3.297973	0.0492**
TOM	0.100813	0.5249
Distance	-0.038315	0.9508
Adjusted R^2	0.016905	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The pricing strategy had a positive relationship with the over-priced percentage variable. If the pricing strategy is used, it is expected that houses are over-priced by 3.3 per cent. The pricing strategy mean varied between 6.11 per cent and 13.12 per cent as indicated in Table 7 and Table 8; this, therefore, indicates that the pricing strategy is a significant marketing tool, in other words, to have the selling price close to the asking price. On the other hand, the control variables were statistically insignificant. The constant variable is significant.

4.4.2.3.1. Squared explanatory variable

The RESET test did not indicate any sign of misspecification in the above model. However, it was decided to experiment with the distance explanatory variable. The over-priced percentage model was extended for this experiment; expressed in the following function:

Table 22. Squared explanatory variable – distance

Variable	**Coefficient**	**Probability**
C	-2.646710	0.4312
Pricing strategy	2.854685	0.0990*
TOM	0.119552	0.4343
Distance	5.143969	0.0224**
Distance^2	-0.591742	0.0472**
Adjusted R^2	0.033641	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The pricing strategy is significant together with the distance and distance squared variables in explaining the over-priced percentage. The pricing strategy was slightly lower in comparison to the previous model. However, the pricing strategy was more significant in the previous model.

4.4.2.4. Pricing strategy and house characteristics

In addition, in order to determine the effect of the pricing strategy on the over-priced percentage for specific house characteristics, the following house characteristics were considered: bedrooms; bathrooms; pool; and garage. Similar to the above models, the over-priced percentage as the dependent variable is a function of the pricing strategy and the control variables, time on the market and distance. Since the distance variable indicated significance in the previous model, the models below include both the distance and the distance-squared variables.

4.4.2.4.1. Bedrooms

Table 23. Houses with more than three bedrooms

Variable	**Coefficient**	**Probability**
C	18.04999	0.0931
Pricing strategy	5.028976	0.0226**
TOM	-0.078145	0.7055
Distance	-6.480668	0.2500
Distance^2	0.854050	0.2249
Adjusted R^2	0.093306	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The above model indicates a significant pricing strategy relationship with the over-priced percentage when there are more than three bedrooms. If a house has more than three bedrooms and the pricing strategy is used, the over-priced percentage will be 5.03 per cent, in comparison to the over-priced percentage mean that varied between 6.11 per cent and 13.12 per cent as indicated in Table 7 and Table 8; this indicates a prosperous marketing approach. The control variables and the constant variable were insignificant. On the other hand, if a house has less than four bedrooms, the pricing strategy will be insignificant in explaining the over-priced percentage (see Addendum A, Table 68).

4.4.2.4.2. Bathrooms

Table 24. Houses with two bathrooms

Variable	Coefficient	Probability
C	-0.545231	0.8934
Pricing strategy	4.879985	0.0438**
TOM	0.082851	0.6527
Distance	4.806155	0.0465**
Distance^2	-0.638052	0.0455**
Adjusted R^2	0.117442	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Since the pricing strategy is significant in the above model, if a house has two bathrooms and the pricing strategy is followed, 4.88 per cent will be added in explaining the over-priced percentage. The distance variables were also significant. However, the time on the market and the constant variables were statistically insignificant. On the other hand, if a house has more than two bathrooms, the pricing strategy, the time on the market and the distance variables are statistically insignificant in explaining the over-priced percentage (see Addendum A, Table 74).

4.4.2.4.3. Pool

Table 25. Houses with a pool

Variable	Coefficient	Probability
Pricing strategy	4.986198	0.0329**
TOM	-0.144165	0.5249
Distance	-8.892939	0.0573*
Distance^2	1.123220	0.0543*
C	23.88233	0.0130**
Adjusted R^2	0.111944	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Since pricing strategy is significant in the above model, if a house has a pool, the pricing strategy will add 4.99 per cent to the over-priced percentage. The distance variables and the constant variable were also significant; however, time on the market was insignificant. On the other hand, the pricing strategy and the time on the market variables were statistically insignificant in explaining the over-priced percentage when a house does not have a pool.

4.4.2.4.4. Garage

Table 26. Houses with more than one garage

Variable	Coefficient	Probability
C	-0.607435	0.8780
Pricing strategy	5.410826	0.0056***
TOM	0.061606	0.7144
Distance	3.604937	0.1465
Distance^2	-0.419797	0.2093
Adjusted R^2	0.095319	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Since the pricing strategy is significant in the above model, it indicates that if a house has more than one garage and the pricing strategy is followed, 5.41 per cent is added to the over-priced percentage. The constant variable, time on the market and distance variables were statistically insignificant. However, if a house has only one garage, the pricing strategy, time on the market and the distance variables are statistically insignificant in explaining the over-priced percentage (see Addendum A, Table 86).

4.4.2.5. Pricing strategy and suburbs

In order to measure the pricing strategy effect per suburb, the following models include the pricing strategy with the house characteristics as independent variables.

Table 27. Suburb effect

Variable	Coefficient	Probability
C	7.919582	0.1213
Pricing strategy	3.539063	0.0561*
Bedroom	-1.485958	0.2748
Bathroom	0.944021	0.6227
Garage	0.220313	0.8202
Plot size	0.003541	0.2483
Pool	0.726681	0.6163
Baillie Park	-0.350990	0.8816
Grimbeeck Park	-3.569704	0.1652
Van Der Hoff Park	0.241673	0.9336
Miederpark	3.886375	0.1838
Pitched	-1.063300	0.6551
Tile	-0.580611	0.7363
Adjusted R^2	0.014680	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The above model indicates that if the pricing strategy is significant at ten per cent and if followed, the difference between the asking and selling prices is smaller than the mean over-priced percentage – this finding is consistent with the above findings where the pricing strategy lowers the difference between the asking and selling prices.

In addition to the above model, the independent variables, time on the market and distance, are included in the following model.

Table 28. Suburb effect with TOM

Variable	Coefficient	Probability
C	4.577439	0.4561
Pricing strategy	3.487442	0.0757*
Bedroom	-1.642603	0.2996
Bathroom	0.966453	0.6352
Garage	0.481217	0.6398
Plot size	0.003434	0.2963
Pool	0.704511	0.6380
Baillie Park	-1.050030	0.6654
Grimbeeck Park	-5.142573	0.1303
Van Der Hoff Park	0.735234	0.8223
Miederpark	2.751890	0.3683
Pitched roof	-0.938412	0.7109
Tiled roof	-0.897914	0.6359
TOM	0.163284	0.2990
Distance	0.540747	0.5072
Adjusted R^2	-0.016358	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

Similar to the previous model, the above model indicates pricing strategy as significant in explaining the over-priced percentage. However, for the above two models, all the suburbs and the house characteristics were statistically insignificant. With reference to Table 7 and Table 8, the over-priced percentage varied between 6.11 per cent and 13.12 per cent. Since the over-priced percentage is approximately the same, it is not expected to see a suburb effect.

Table 29. Whole sample excluding suburbs

Variable	Coefficient	Probability
C	6.603289	0.2549
Pricing strategy	3.385935	0.0777*
Bedroom	-0.651419	0.6804
Bathroom	0.525705	0.7873
Garage	0.336732	0.7505
Plot size	0.002857	0.3272
Pool	0.415220	0.7959
Pitched roof	-1.430027	0.5586
Tiled roof	-0.922029	0.6170
TOM	0.134984	0.3977
Distance	-0.145950	0.8144
Adjusted R^2	-0.033985	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The above model indicates a significant pricing strategy in explaining the over-priced percentage, indicating that the over-priced percentage will be 3.4 per cent if the strategy is followed, thus closely corresponding with the previous two models with a pricing strategy coefficient of 3.5 per cent. The house characteristics and the constant variable were statistically insignificant.

The following models will determine the effect of the pricing strategy on the over-priced percentage in the suburbs; this allows comparisons to be made between suburbs. The over-priced percentage was used as the dependent variable, while pricing strategy and time on the market were used as independent variables, together with the house characteristic variables, for each suburb.

Table 30. Baillie Park

Variable	Coefficient	Probability
C	6.784648	0.7972
Pricing strategy	6.013084	0.0430**
Bedroom	-3.457589	0.3181
Bathroom	0.521477	0.8562
Garage	2.427657	0.1908
Plot size	0.006761	0.2876
Pool	1.833692	0.5678
Pitched roof	-4.892369	0.1776
Tiled roof	-2.720927	0.3813
TOM	0.470496	0.0705*
Distance	-0.274773	0.9019
Adjusted R^2	0.028622	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The pricing strategy and the time on the market variables were significant in Baillie Park. Therefore, if the pricing strategy is followed in Baillie Park, the over-priced percentage will be 6 per cent, compared to the Baillie Park over-priced percentage mean of 10.35 per cent. It is, therefore, indicated that the selling price would be closer to the asking price than when the pricing strategy is not followed. The time on the market factor had a positive relationship with the over-priced percentage, therefore, the longer the time on the market, the larger the difference between the asking and selling prices would be. Consequently, there is an indication that the time on the market would affect the selling price negatively in Baillie Park. The other house characteristics were statistically insignificant.

Miederpark did not have sufficient observations and, due to similarities with Central and Suid Dorp, the three suburbs were combined in the following model.

Table 31. Miederpark, Suid Dorp and Central

Variable	**Coefficient**	**Probability**
C	13.91996	0.1886
Pricing strategy	2.255811	0.5246
Bedrooms	-1.387402	0.6455
Bathrooms	1.871202	0.5985
Garage	-0.358581	0.8397
Plot size	-0.014447	0.0092***
Pool	-1.595706	0.6598
Pitched roof	1.406060	0.7104
Tiled roof	1.347757	0.6903
TOM	0.345309	0.2764
Distance	1.647365	0.2239
Adjusted R^2	-0.003641	
Heteroscedasticity	Yes, adjusted	
Multicollinearity	No	

*** Significance at one per cent − there is strong sample evidence that H_0 should be rejected in favour of H_1.
** Significance at five per cent − there is slight sample evidence that H_0 should be rejected in favour of H_1.
* Significance at ten per cent − there is weaker sample evidence that H_0 should be rejected in favour of H_1.

The above model indicates a negative significant relationship between plot size and over-priced percentage. A larger plot size is favourable in Miederpark and Central and Suid Dorp, since for every additional square meter of plot size, the over-priced percentage will decrease with 0.015 per cent. The pricing strategy and the house characteristics were statistically insignificant for Miederpark and Central and Suid Dorp.

The suburbs, Grimbeeck Park and Van der Hoff Park, indicate that pricing strategy, time on the market and house characteristics are statistically insignificant in explaining the over-priced percentage (see Addendum A, Table 104 and Table 107).

4.4.2.6. Conclusion

The pricing strategy had a significant impact on the over-priced percentage. For the whole sample, pricing strategy was significant at 10 per cent (see Table 27 to Table 29). With reference to the suburbs, Baillie Park indicated a significant pricing strategy. The following house characteristics had a significant pricing strategy in explaining the over-priced percentage: houses with more than three bedrooms; houses with two bathrooms; houses with a pool; and houses with more than one garage. The time on the market factor was only significant in Baillie Park, at 8 per cent.

4.5. FINAL CONCLUSION

In Chapter Four, the results of the hedonic price model for the dependent variables, asking price and selling price, were illustrated and explained. The models employed independent variables categorised as structural and locational variables. The robust significant house characteristics were bedrooms, garage, a tiled roof, Baillie Park, Grimbeeck Park and Van Der Hoff Park. It did not matter if log or level models were used since the same variables were significant in explaining house prices. The turning point for plot size was calculated and it was found that, if the plot size exceeded 1 296 square meter, the selling price would be influenced negatively. Furthermore, the pricing strategy was used as an independent variable in three main models to determine if it had a relationship with the time on the market, the selling price and the over-priced percentage. The variables, time on the market and house characteristics, were used as control variables. The pricing strategy had no significant relationship with the time on the market. A significant negative relationship was found between the pricing strategy and the selling price, indicating that if the pricing strategy is followed, the selling price would be R134 725 cheaper than if the strategy is not followed. In addition, the pricing strategy had a significant positive relationship with the over-priced percentage. The pricing strategy was significant, specifically for the area of Baillie Park for houses with more than three bedrooms, two bathrooms, a pool and more than one garage. The results indicate that pricing strategies are an effective marketing approach since selling prices are closer to asking prices than when the approach is not used.

The next chapter revises the research problems, objectives and the methodology used to reach the objectives of the study. It further summarises the main findings of the literature study and the results found by the empirical study. Lastly, recommendations and a final conclusion are made.

CHAPTER 5

SUMMERY AND CONCLUSION

5.1. INTRODUCTION

The goal of this chapter is to conclude the study with an overview of the research conducted and state whether the objectives listed in chapter 1 were reached. Therefore, the layout for the last chapter is as follows: firstly, the research problems and the employed methodology are revisited in order to ensure that the objectives of the study have been reached. Thereafter, the findings are summarised followed by the conclusions. Lastly, contributions and recommendations are provided.

5.2. PROBLEM STATEMENT AND OBJECTIVES

Home equity is a large component of a household's wealth. Therefore, sellers have strong incentives to gain as high a yield as possible on their houses. House sellers have one goal in common, which is to sell a house at a maximum price and as quickly as possible. However, the real estate market offers a constant variation of the number houses for sale on the market as well as house prices. This leads to difficulty when valuing a house, since houses have characteristics which differ from each other. A two-fold problem was identified: firstly, homeowners face the problem of determining their house's value since homeowners and potential buyers' value physical characteristics differently; and secondly, while sellers need to determine an asking price, they also need to decide on an appropriate pricing strategy. The asking price can be defined as a suggested price for the property by its seller; the price the property will be advertised for. The selling price is defined as the value of a property, usually a price (based on the seller's asking price) offered by the buyer and accepted by the seller; the property ownership will transfer based on this amount.

Therefore, the research question was identified as: what are the characteristic determinants of house prices in Potchefstroom (selling price as well as asking price)? The question was supported by two objectives (see chapter 1, section 1.4.2.). A second research question was identified as: does the pricing strategy (asking price) have an impact on the time on the market (TOM), selling price and over-priced percentage? The second question was supported by three research questions (see Chapter 1, section 1.4.2.).

5.3. METHODOLOGY

With the support of a literature study, theories were identified, while the empirical study was used to test the identified theories. Since theories were tested, a quantitative deductive approach was followed. A quantitative approach was also followed since the study made use of numeric information. A cross-sectional method was applied in order to empirically explain house prices and to determine whether a relationship exists between pricing strategies, time on the market and over-pricing percentage.

To answer the first research question, house prices and the determining house characteristics were analysed. To test the theory that house prices can be explained by house characteristics, the objective was to find specific house characteristics explaining house selling and asking prices in Potchefstroom. To answer the second research question, the relationship between the pricing strategy, derived from the house asking price, and the time on the market, selling price and over-priced percentage was tested. The empirical analysis was based on a hedonic pricing function in order to empirically test the first objective and, with the support of an Ordinary Least Squares (OLS) method, the second objective was answered. Since cross-sectional data have been used, the following actions had to be taken in order to test and improve the validity of the regression models: firstly, multicollinearity, as it occurs when two or more explanatory variables in a regression model correlate highly; and secondly, heteroscedasticity, which is treacherous as it causes confidence intervals and hypotheses tests to be unreliable.

5.3.1. Research area

The economy consists of a network of geographical areas, each with their individual characteristics. For example, in Gauteng, the difference between the asking and selling prices is less than in Cape Town. Furthermore, Cape Town as well as Potchefstroom experienced high house price inflation. The factors in the house price growth in Potchefstroom were not the focus of this study; however, the uniqueness of this trend resulted in Potchefstroom being chosen as a case study for evaluation.

The study specifically focussed on freestanding low-density residential houses, registered in Potchefstroom for the period 2015 to 2017. Therefore, the trend in Potchefstroom, which is influenced by flats and townhouses, was eliminated.

5.4. SUMMERY OF FINDINGS

5.4.1. Literature review

In Chapter 2, a literature review was conducted with regard to house prices and house characteristics, namely, structural and locational characteristics, empirical models and various pricing strategies.

The literature study helped to define and identify the research problem. In addition, a deeper understanding of the research problem was provided. Furthermore, the literature study provided practical and theoretical insights into the research problem.

5.4.1.1. House characteristics

Since houses are unique and have different characteristics, it is important to identify the characteristics that explain house prices. The identified characteristics were then empirically regressed to give a numerical value to each characteristic, where house prices were the dependent variables and house characteristics were the independent variables. The house characteristics were divided into two subsections, namely, structural and locational characteristics. Table 32 represents a summary of the characteristics identified by the literature study.

Table 32. House characteristics summary

House characteristics	
Structural characteristics	**Location characteristics**
Lot size	Gated community
Square feet	Presence of shops
Number of bedrooms	Quality of schools
Number of bathrooms	Pollution level
Number of garages	Distance from work
Age of property	Distance from school
Sprinkler system	Distance from airport
Number of stories (floor level)	Distance from hospital

Attic space	Distance from metro station
Room size	View (obstructive/open)
Electric Fencing	View (street view/no street view)
Roof type	Greening rate
Balcony	Distance from park (natural/urban)
Property type	Distance from CBD
Exterior condition	Presence of a cemetery
On-site parking	Area (or Suburb)
Direction of building	
CC&R regulations	
Age	
Fireplace	
Pool	
Remodelling of house	
Lift	
Separate kitchen	

5.4.1.2. Estimation techniques

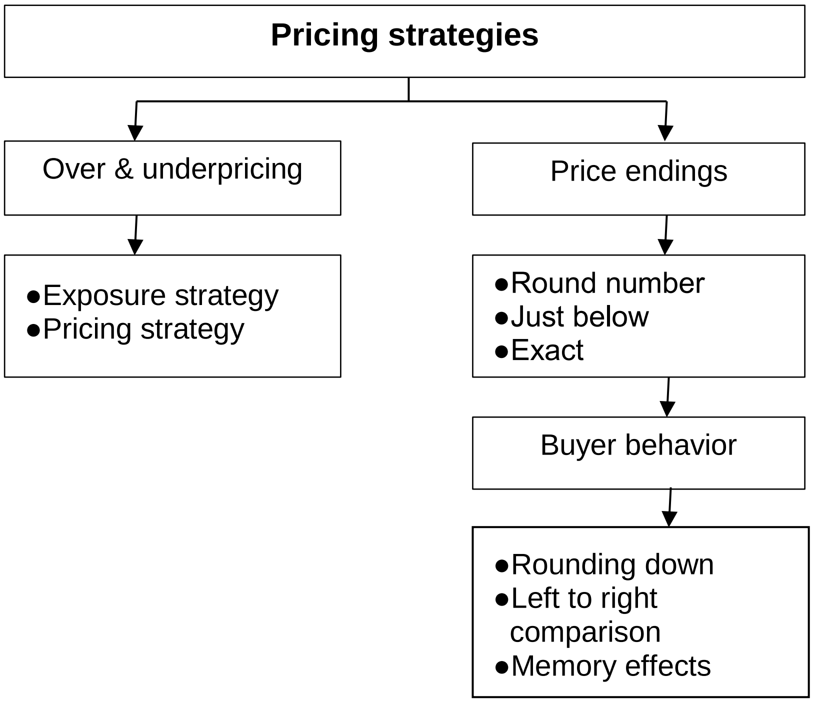
Houses are defined as a long-lasting durable and heterogeneous good – a bundle of individual characteristics. A hedonic price function represents values for individual characteristics that determine house prices. It is also important to take note that none of these characteristics can be independently utilised; since these characteristics are utilised together, they have to be seen as a bundle. To explain house prices in terms of characteristics, the hedonic price function is most commonly considered.

In addition, the following estimation techniques were also used: OLS regression; quantiles by using a VC; Box-Cox quantile regression; Rosen's two-step model; artificial neural network (ANN); and a geographic information system (GIS).

5.4.1.3. Pricing strategies

House sellers want their properties to sell within the minimum time on the market at the maximum price. The house asking price sends out a signal to buyers, therefore, there is importance in strategically setting the asking price as it is an attempt to affect the perception of the buyer. Pricing strategies include over- and under-pricing of houses, where under-pricing sends out a willingness signal to buyers and over-pricing represents an exposure strategy since a broker will make a greater effort to market a house. Furthermore, pricing strategies include price endings, where houses are advertised with an asking price which ends on a round number (0), a "just below" number (5/9) or an exact value. Round numbers and "just below" pricing strategies are used most often and it has been found that when the "just below" strategy is used, a house will sell for a price closer to the asking price. Figure 14 illustrates a pricing strategy summery constructed from a previous study.

Figure 15. Pricing strategies summary



Source: Adjusted from Stiving and Winer (1997:58)

5.4.2. Empirical study

An empirical study was conducted on the determinants of Potchefstroom house prices. The data used in the study were manually collected by the author. The focus area of this study was Potchefstroom, where six suburbs were included, namely, Van der Hoff Park, Baillie Park, Grimbeeck Park, Miederpark, Suid Dorp and Potchefstroom Central. The hedonic price model indicated, in agreement with the literature study, that house characteristics are able to explain house prices since both structural and locational characteristics indicated significance for both the *asking price* and the *selling price*. The significant characteristics for the asking price model were bedrooms, garage, plot size, a tiled roof, Baillie Park, Grimbeeck Park and Van Der Hoff Park. The significant characteristics for the selling price model were bedrooms, garage, plot size, plot size^2, a tiled roof, Baillie Park, Grimbeeck Park and Van Der Hoff Park. Furthermore, the impact of a pricing strategy was determined by using pricing strategy as an independent variable along with control variables. The dependent variables for three separate models were *time on the market, selling price and over-priced percentage*. The pricing strategy indicated statistically insignificant relationships with the time on the market variable; however, a significant relationship was identified for the selling price and the over-priced percentage variables. The results indicate that, if a pricing strategy is implemented, a house will sell for a price closer to the asking price.

5.5. LIMITATIONS

It is noted that some areas only had a few observations which limits the study. In addition, the data timespan used is from 2015 to 2017 and would not be long enough to identify various phases of the business cycle and their potential macroeconomic impact on the housing sector.

5.6. DISCUSSION AND CONCLUSION

This study investigated house asking and selling prices as dependent variables determined by house characteristic attributes. Moreover, in terms of the asking price, a pricing strategy was considered in order to determine the influence thereof. The first research question of this study was stated as follows: firstly, what are the characteristic determinants of house prices in Potchefstroom (selling price as well as asking price)? The specific objectives to support the research question were, firstly, to determine the specific characteristics of a house in explaining the selling and asking price, and, secondly, to calculate the price difference between the asking price and the selling price of houses, thereby determining the over-priced factor. A hedonic model was regressed with an OLS regression to determine values for house characteristics for both the asking price and the selling price of houses. To conclude, significance was found for both structural and locational characteristics in explaining the asking and selling prices. Furthermore, as indicated by the literature study, house sellers over-price homes for negotiation purposes.

The second research question was stated as follows: does the pricing strategy (asking price) have an impact on the Time on the market (TOM), selling price and over-priced percentage? The specific objectives to support the research question were to determine whether a relationship exists between the pricing strategy and the time on the market, the selling price and the over-pricing of a house. Ordinary Least Squares (OLS) regressions were used to answer the objectives, using a pricing strategy with control variables as the independent variables, in three different models; TOM, the selling price and the over-priced percentage were used as the dependent variables. Regarding the pricing strategy, a price ending, "just below" pricing strategy was used in the empirical study, where asking prices ended on a five. To conclude, the pricing strategy and the TOM had a statistically insignificant relationship. On the other hand, the pricing strategy had a significant relationship with the selling price and the over-priced percentage.

The general objective of the study was to discover the determinants of house prices in Potchefstroom based on the specific characteristics of a house and to determine whether there is a relationship between the pricing strategy and the TOM, selling price and over-priced percentage. The general objective has been answered since characteristics were found to explain house prices and relationships between the pricing strategy, the selling price and the over-priced percentage were identified.

The practical implication of this study is that these findings can be used for valuing, forecasting and investment purposes.

The contribution of this study is that house characteristics, namely, structural and locational characteristics, can be used to explain house prices in Potchefstroom with unique qualities such as high house price inflation, the academic town traits and the presence of the Army Support Base (ASB). The practical implementation is that, in this unique town, house characteristics are able to explain house selling prices. The house characteristics include bedrooms, garage, plot size, a tiled roof, Baillie Park, Grimbeeck Park and Van Der Hoff Park. Another contribution is that house characteristics do not only explain the selling price, but also explain the asking price with the same house characteristics as those for the selling price.

A further contribution is that the selling price and the over-priced percentage had a significant relationship with the pricing strategy in the unique Potchefstroom environment. The practical implication is that the selling price and pricing strategy indicate that a house would sell for R134 725 less if a pricing strategy is followed. However, this amount is less than the mean of R166 144 for all the included suburbs, an indication that a house would sell for more. Furthermore, the pricing strategy had a positive relationship with the over-priced percentage variable indicating that, if a pricing strategy is implemented, a house would sell for a price closer to its asking price, especially if the house has one of the following qualities: situated in Baillie Park; more than three rooms; two bathrooms; a swimming pool; or more than one garage.

5.7. RECOMMENDATIONS

- It is recommended that house sellers and developers use the hedonic price model in order to value and determine a house price since the study found house characteristics to significantly explain house prices. It is a more effective valuation method than setting one's house price by comparing it with house prices in the same street or area since houses have different characteristics.
- If value needs to be added to a house, it is recommended that an additional bedroom should be added since this would add R249 077 to the value of a house in Potchefstroom, whereas an additional garage would only add R77 293 value.
- It is further recommended that, when marketing a house for sale, real estate agents and sellers should use a pricing strategy where the asking price ends on a five since a pricing strategy will then influence buyers and a house will sell for a higher price, than when a pricing strategy is not followed. In addition, if a pricing strategy is followed, the selling price should be closer to the asking price.
- The pricing strategy is especially recommended if a house has the following characteristics: situated in Baillie Park; more than three bedrooms; two bathrooms; more than one garage; or a pool.

5.8. FUTURE RESEARCH

Further research on this topic is recommended. With a longer time span for house price data, research on house prices over time could be conducted. This would enable the detection of economic expansion and declines and macroeconomic influences on house prices. Furthermore, the following questions may be asked: to what degree are house prices affected by macroeconomic factors; and which factors influence house price cycles the most?

5.9. FINAL CONCLUSION

The objective of the study was to find values for house determinants in Potchefstroom and to determine the influence of a pricing strategy. Since significant variables were found for structural and locational characteristics explaining house asking and selling prices, the problem of valuing houses in Potchefstroom, each with unique characteristics, is solved. Subsequently, the pricing strategy had a significant impact on the over-priced percentage and indicates that a pricing strategy would result in a selling price being closer to the asking price. It is advisable to use a “just below” pricing strategy in Potchefstroom when advertising a property. Consequently, the objectives of this study were reached and recommendations were made for future research.

REFERENCE LIST

Adair, A.S., Berry, J.N. & McGreal, W.S. 1996. Hedonic modelling, housing submarkets and residential valuation. *Journal of Property Research*, 13(1):67-83.

Adams, Z. & Füss, R. 2010. Macro-economic determinants of international housing markets. *Journal of Housing Economics*, 19(1):38-50.

Allen, M.T. & Dare, W.H. 2004. The effects of charm listing prices on house transaction prices. *Real Estate Economics*, 32(4):695-713.

Arimah, B.C. 1992. Hedonic prices and the demand for housing attributes in a third world city: the case of Ibadan, Nigeria. *Urban Studies*, 29(5):639-651.

Asabere, P., Huffman, F. & Mehdian, S. 1993. Mispricing and optimal time on the market. *Journal of Real Estate Research*, 8(1):149-155.

Asteriou, D. & Hall S.G. 2016. Applied econometrics. London: Palgrave.

Belkin, J., Hempel, D.J. & McLeavey, D.W. 1976. An empirical study of time on market using multidimensional segmentation of housing markets. *Real Estate Economics*, 4(2):57-75.

Benjamin, J. & Chinloy, P. 2000. Pricing, exposure and residential listing strategies. *Journal of Real Estate Research*, 20(1-2):61-74.

Beracha, E. & Seiler, M. J. 2014. The effect of listing price strategy on transaction selling prices. *Journal of Real Estate Finance and Economics*, 49(2):237-255.

Black, R.T. & Diaz III, J. 1996. The use of information versus asking price in the real property negotiation process. *Journal of Property Research*, 13(4):287-297.

Brasington, D.M. & Hite, D. 2005. Demand for environmental quality: a spatial hedonic analysis. *Regional Science and Urban Economics*, 35(1):57-82.

Brenner, G.A. & Brenner, R. 1982. Memory and markets, or why are you paying $2.99 for a widget? *Journal of Business*:147-158.

Burger, P. & Janse van Rensburg, L. 2008. Metropolitan house prices In South Africa: do they converge? *South African Journal of Economics*, 76(2):291-297.

Choy, L.H.T., Ho, W.K.O. & Mak, S.W.K. 2009. On FDI and domestic capital stock: a panel data study of Chinese regions. Paper presented at the Building and Real Estate Workshop at The Hong Kong Polytechnic University, Hong Kong. http://www.bre.polyu.edu.hk/BRE_workshop/pdf/FDI_China.pdf Date of access: 12 February 2017.

Choy, L.H.T., Ho, W.K.O. & Mak, S.W.K. 2012. Housing attributes and Hong Kong real estate prices: a quantile regression analysis. *Construction Management and Economics*, 30(5):359-366.

Collen, H. & Hoekstra, J. 2001. Values as determinants of preferences for housing attributes. *Journal of Housing and the Built Environment*, 16(3):285-306.

Daniels C.D (2011). Cross-Sectional Research. New York: Springer US.

Day, B.H. 2001. The theory of hedonic markets: obtaining welfare measures for changes in environmental quality using hedonic market data. London: Centre for Social and Economic Research on the Global Environment (CSERGE).

De Angelo, C.F. & Fávero, L.P.L. 2003. A model of hedonic prices to the evaluation of residential launchings in the city of Sao Paulo. FEA-USP Working Paper 03/002. https://www.researchgate.net/profile/Luiz_Favero/publication/238662079_A_MODEL_OF_HEDONIC_PRICES_TO_THE_EVALUATION_OF_RESIDENTIAL_LAUNCHINGS_IN_THE_CITY_OF_SAO_PAULO/links/560496fe08ae8e08c08aa80b.pdf Date of access: 20 Apr. 2017.

Dumm, R.E., Sirmans, G.S. & Smersh, G.T. 2016. Price variation in waterfront properties over the economic cycle. *Journal of Real Estate Research*, 38(1):1-25.

Du Preez, M. & Sale, M.C. 2013. The impact of social housing developments on nearby property prices: a Nelson Mandela Bay case study. *South African Journal of Economics*, 81(3):451-466.

Du Preez, M. & Sale, M.C. 2014. Municipal assessments versus actual sales price information in hedonic price studies: a South African case study. ERSA Working Paper 411. https://econrsa.org/system/files/publications/working_papers/working_paper_411.pdf Date of access: 24 Apr. 2017.

Égert, B. & Mihaljek, D. 2007. Determinants of house prices in Central and Eastern Europe. Basel: Monetary and Economic Department of the Bank for International Settlements.

Epple, D. 1987. Hedonic prices and implicit markets: estimating demand and supply functions for differentiated products. *Journal of Political Economy*, 95(1):59-80.

Follain, J.R. & Jimenez, E. 1985. The demand for housing characteristics in developing countries. *Urban Studies*, 22(5):421-432.

Gendall, P., Holdershaw, J. & Garland, R. 1997. The effect of odd pricing on demand. *European Journal of Marketing*, 31(11/12):799-813.

Genesove, D. & Mayer, C.J. 1994. Equity and time to sale in the real estate market. *American Economic Review,* 87(3):255-269.

Ghauri, P. & Grohaug, K. 2005. Research methods in business studies: A practical guide. London. Prentice Hall.

Goodman, A.C. 1977. A comparison of block group and census tract data in a hedonic housing price model. *Land Economics*, 53(4):483-487.

Google Maps. 2017. Potcefstroom. https://www.google.co.za/maps/@-26.7103642,27.0992303,13z?hl=en Date of access: 4 May 2014.

Gupta, R. & Das. S. 2008. Spatial Bayesian methods of forecasting house prices in six metropolitan areas of South Africa. *South African Journal of Economics*, 76(2):298-313.

Gyourko, J. & Tracy, J.S. 1999. A look at real housing prices and incomes: some implications for housing affordability and quality. *Economic Policy Review* (Federal Reserve Bank of New York), 5(3):63-77.

Holmes, M.K. 2007. How convergent are regional house prices in the United Kingdom? Some new evidence from panel data unit root testing. *Journal of Economic and Social Research*, 9(1):1-17.

Horowitz, J.L. 1992. The role of the list price in housing markets: theory and an econometric model. *Journal of Applied Econometrics*, 7(2):115-129.

Hort, K. 1998. The determinants of urban house price fluctuations in Sweden 1968-1994. *Journal of Housing Economics*, 7(1):93-120.

Hui, E., Wong, J. & Wong, K.T. 2012. Marketing time and pricing strategies. *Journal of Real Estate Research*, 34(3):375-398.

Hutcheson, G.D. 2011. Ordinary least-squares regression. Pages 224–228 in L. Moutino and G.D. Hutcheson, editors. *The SAGE dictionary of quantitative management research.* SAGE Publications, Thousand Oaks, California, USA. http://dx.doi.org/10.4135/9781446251119.n67 Date of access: 23 Feb. 2017.

Johnson, R.B., Onwuegbuzie, A.J. & Turner, L.A. 2007. Toward a definition of mixed methods research. *Journal of mixed methods research*, 1(2):112-133.

Kalra, R. & Chan, K. 1994. Censored sample bias, macroeconomic factors, and time on market of residential housing. *Journal of Real Estate Research*, 9(2):253-262.

Kang, H. & Gardner, M. 1989. Selling price and marketing time in the residential real estate market. *Journal of Real Estate Research*, 4(1):21-35.

Kim, H.G., Hung, K.C. & Park, S.Y. 2015. Determinants of housing prices in Hong Kong: a Box-Cox quantile regression approach. *Journal of Real Estate Financial Economics*, 50(2):270-287.

Kim, H., Park, S.W., Lee, S. & Xue, X. 2015. Determinants of house prices in Seoul: a quantile regression approach. *Pacific Rim Property Research Journal*, 21(2):91-113.

Knight, J.R., Sirmans, C.F. & Turnbull, G.K. 1994. List price signaling and buyer behavior in the housing market. *Journal of Real Estate Finance and Economics*, 9(3):177-192.

Konecny, K.D. 2012. Urban form and home value: a hedonic analysis in Sacramento, California. City: University. (Dissertation – PhD).

Liao, W.C. & Wang, X. 2012. Hedonic house prices and spatial quantile regression. *Journal of Housing Economics*, 21(1):16-27.

Lightstone Property. 2017. Residential property indices. http://www.lightstoneproperty.co.za/news/Residential_Property_Indices_October_2016.pdf Date of access: 6 Jun. 2017.

Liu, S. & Hite, D. 2013. Measuring the effect of green space on property value: an application of the hedonic spatial quantile regression. Paper presented at the Annual Meeting of the Southern Agricultural Economics Association, Orlando, Florida, 3-5 February. https://ageconsearch.umn.edu/bitstream/143045/2/2013%20SAEA%20Selected%20Paper%20Liu.pdf Date of access: 20 Apr. 2017.

Malpezzi, S., Ozanne, L. & Thibodeau, T. 1980. Characteristic prices of housing in fifty-nine metropolitan areas. Washington: The Urban Institute.

Marcato, G. & Nanda, A. 2016. Information content and forecasting ability of sentiment indicators: case of real estate market. *Journal of Real Estate Research,* 38(2):166-203.

Maree, K. 2016. First steps in research. Pretoria: Van Schaik.

McMillen, D.P. 2008. Changes in the distribution of house prices over time: structural characteristics, neighborhood, or coefficients? *Journal of Urban Economics,* 64(3):573-589.

Merlo, A., Ortalo-Magné, F. & Rust, J. 2015. The home selling problem: theory and evidence. *International Economic Review*, 56(2):457-484.

Miller, N. & Sklarz, M. 1987. Pricing strategies and residential property selling prices. *Journal of Real Estate Research*, 2(1):31-40.

Mimis, A., Rovolis, A. & Stamou, M. 2013. Property valuation with artificial neural network: the case of Athens. *Journal of Property Research*, 30(2):128-143.

Mouton, J. 2001. How to succeed in your master's and doctoral studies: A South African guide and resource book. Pretoria: Van Schaik.

Muller, J. 2010. Tale of many markets. *Fin24*, 23 Apr. http://www.fin24.com/Finweek/Money-clinic/Tale-of-many-markets-20100422 Date of access: 7 May. 2017.

Naude, W.A. & Krugell, W.F. 2006. Sub-national growth rate differentials in South Africa: an econometric analysis. *Regional Science*, 85(3):443-57.

Nguyen, T.T.T. 2012. Pricing attributes of day cruises in Nha Trang bay using hedonic pricing. Tromso, Norway: University of Tromso. (Thesis – Masters).

Nicodemo, C. & Raya, J. M. 2012. Change in the distribution of house prices across Spanish cities. *Regional Science and Urban Economics*, 42(4):739-748.

Northcraft, G.B. & Neale, M.A. 1987. Experts, amateurs, and real estate: an anchoring-and-adjustment perspective on property pricing decisions. *Organizational Behavior and Human Decision Processes*, 39(1):84-97.

Nieuwenhuis, J. 2016. Introducing qualitative research. (In Maree, K., ed. First steps in research. Pretoria. Van Schaik. p. 49-70).

Oczkowski, E. 1994. A hedonic price function for Australian premium table wine. *Australian Journal of Agricultural and Resource Economics*, 38(1)93-110.

Palmon, O., Smith, B. & Sopranzetti, B. 2004. Clustering in real estate prices: determinants and consequences. *Journal of Real Estate Research*, 26(2):115-136.

Property24®. 2017. Potchefstroom property trends and statistics. https://www.property24.com/potchefstroom/potchefstroom/property-trends/5068 Date of access: 20 Sep. 2016.

Quantec. 2017. House Price Index (Absa): Purchase Price. http://www.easydata.co.za/data/timeseries/ABS-AA0000PPL/ Date of access: 29 Apr. 2017.

Rosen, S. 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy*, 82(1):34-55.

Schindler, R.M. & Kirby, P.N. 1997. Patterns of rightmost digits used in advertised prices: implications for nine-ending effects. *Journal of Consumer Research*, 24(2):192-201.

Simo-Kengne, B.D., Bittencourt, M. & Gupta, R. 2012. House prices and economic growth in South Africa: evidence from provincial-level data. *Journal of Real Estate Literature*, 20(1):97-117.

Sirmans, G.S., Macpherson, D.A. & Zietz, E.N. 2005. The composition of hedonic pricing models. *Journal of Real Estate Literature*, 13(1):3-41.

South African Property Valuations. 2017. Price of property valuations. https://www.sapv.co.za/price-of-property-valuations/ Date of access: 23 Jul. 2017.

Stats SA. 2011. Tlokwe City Council. http://www.statssa.gov.za/?page_id=993&id=tlokwe-city-council-municipality Date of access: 7 Oct. 2017.

Stiving, M. & Winer, R.S. 1997. An empirical analysis of price endings with scanner data. *Journal of Consumer Research*, 24(1):57-67.

Steynberg, D.A. 2017. Why pricing your home according to the portals may never see it sell. *Home times,* 14 Aug. http://hometimes.co.za/2017/08/why-pricing-your-home-according-to-the-portals-may-see-it-never-sell/ Date of access: 12 Feb. 2017.

Taltavull De La Paz, P. 2003. Determinants of housing prices in Spanish cities. *Journal of Property Investment & Finance,* 21(2), 109-135.

Thériault, M., Des Rosiers, F., Villeneuve, P. & Kestens, Y. 2003. Modelling interactions of location with specific value of housing attributes. *Property Management*, 21(1):25-62.

Tlokwe City Councill. 2017. Potchefstroom. Valuation Roll for the period 2013/2017.

Van der Walt, S. 2010. Determinants of house prices in Hout Bay. Stellenbosch: University of Stellenbosch. (Dissertation – PhD).

Wan, A.T., Xie, S. & Zhou, Y. 2017. A varying coefficient approach to estimating hedonic housing price functions and their quantiles. *Journal of Applied Statistics*, 44(11):1979-1999.

Wang, K. & Zhou, Y. 2006. Equilibrium real options exercise strategies with multiple players: the case of real estate markets. *Journal of Real Estate Economics*, 34(1):1-49.

Willson, J. 2014. Essentials of business research: A guide to doing your research project. 2nd. London. SAGE publications.

Windeed. 2017. WinDeed Property Report. https://search.windeed.co.za/DeedsOffice/Property Date of access: 29 May 2017.

Witte, A.D., Sumka, H.J. & Erekson, H. 1979. An estimate of a structural hedonic price model of the housing market: an application of Rosen's theory of implicit markets. *Econometrica: Journal of the Econometric Society*:1151-1173.

Yin, R.K. 2009. Case study research: design and methods. California: SAGE.

Zietz, J., Zietz, E.N. & Sirmans, G.S. 2008. Determinants of house prices: a quantile regression approach. *Journal of Real Estate Financial Economics*, 37(4):317–333.

ADDENDUM A

Table 33. Price model result – asking price

Dependent Variable: ASKING
Method: Least Squares
Date: 11/19/17 Time: 20:47
Sample (adjusted): 1 104
Included observations: 103 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-484141.3	252198.5	-1.919683	0.0581
BEDROOMS	249077.9	51974.90	4.792273	0.0000
BATHROOMS	66362.97	51491.20	1.288822	0.2008
GARAGE	77293.54	40629.02	1.902422	0.0603
PLOT_SIZE	196.7243	89.69131	2.193349	0.0309
POOL	38204.75	63719.68	0.599575	0.5503
BAILLIE_PARK	322337.8	89981.54	3.582266	0.0006
GRIMBEECK_PARK	464164.0	115821.6	4.007577	0.0001
VAN_DER_HOFF	900025.7	120435.2	7.473110	0.0000
MIEDERPARK	91931.82	115506.9	0.795899	0.4282
PITCHED	120633.7	86350.97	1.397016	0.1658
TILE	117043.5	64612.18	1.811478	0.0734
DISTANCE	40975.86	33885.40	1.209248	0.2297

R-squared	0.707402	Mean dependent var	1588039.
Adjusted R-squared	0.668389	S.D. dependent var	499625.5
S.E. of regression	287712.8	Akaike info criterion	28.09482
Sum squared resid	7.45E+12	Schwarz criterion	28.42736
Log likelihood	-1433.883	Hannan-Quinn criter.	28.22951
F-statistic	18.13243	Durbin-Watson stat	1.965405
Prob(F-statistic)	0.000000		

Table 34. Heteroscedasticity test: Price model results – asking price

Heteroscedasticity Test: White

F-statistic	1.283645	Prob. F(12,90)	0.2420
Obs*R-squared	15.05245	Prob. Chi-Square(12)	0.2386
Scaled explained SS	21.03332	Prob. Chi-Square(12)	0.0499

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 35. Adjusted price model results – asking price

Dependent Variable: ASKING
Method: Least Squares
Date: 11/19/17 Time: 20:48
Sample (adjusted): 1 104
Included observations: 103 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-484141.3	302425.5	-1.600861	0.1129
BEDROOMS	249077.9	64883.85	3.838828	0.0002
BATHROOMS	66362.97	61109.87	1.085962	0.2804
GARAGE	77293.54	35436.73	2.181170	0.0318
PLOT_SIZE	196.7243	77.28318	2.545499	0.0126
POOL	38204.75	68617.88	0.556775	0.5791
BAILLIE_PARK	322337.8	71673.77	4.497291	0.0000
GRIMBEECK_PARK	464164.0	101097.8	4.591238	0.0000
VAN_DER_HOFF	900025.7	146615.5	6.138679	0.0000
MIEDERPARK	91931.82	80214.05	1.146081	0.2548
PITCHED	120633.7	77213.56	1.562338	0.1217
TILE	117043.5	60156.26	1.945659	0.0548
DISTANCE	40975.86	38797.13	1.056157	0.2937

R-squared	0.707402	Mean dependent var	1588039.
Adjusted R-squared	0.668389	S.D. dependent var	499625.5
S.E. of regression	287712.8	Akaike info criterion	28.09482
Sum squared resid	7.45E+12	Schwarz criterion	28.42736
Log likelihood	-1433.883	Hannan-Quinn criter.	28.22951
F-statistic	18.13243	Durbin-Watson stat	1.965405
Prob(F-statistic)	0.000000	Wald F-statistic	16.31075
Prob(Wald F-statistic)	0.000000		

Table 36. Price model result – selling price

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 20:51
Sample (adjusted): 1 104
Included observations: 103 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-276744.9	249691.1	-1.108349	0.2707
BEDROOMS	230884.6	51458.15	4.486843	0.0000
BATHROOMS	42077.98	50979.25	0.825394	0.4113
GARAGE	62184.48	40225.07	1.545914	0.1256
PLOT_SIZE	129.4100	88.79956	1.457327	0.1485
POOL	47279.91	63086.15	0.749450	0.4555
BAILLIE_PARK	303600.7	89086.90	3.407916	0.0010
GRIMBEECK_PARK	493198.4	114670.0	4.301022	0.0000
VAN_DER_HOFF	752965.7	119237.8	6.314823	0.0000
MIEDERPARK	38049.60	114358.5	0.332722	0.7401
PITCHED	107230.6	85492.43	1.254270	0.2130
TILE	117465.5	63969.78	1.836265	0.0696
DISTANCE	18898.06	33548.50	0.563306	0.5746

R-squared	0.658981	Mean dependent var	1430971.
Adjusted R-squared	0.613512	S.D. dependent var	458196.1
S.E. of regression	284852.2	Akaike info criterion	28.07484
Sum squared resid	7.30E+12	Schwarz criterion	28.40738
Log likelihood	-1432.854	Hannan-Quinn criter.	28.20953
F-statistic	14.49289	Durbin-Watson stat	1.999682
Prob(F-statistic)	0.000000		

Table 37. Heteroscedasticity test: Price model results – selling price

Heteroscedasticity Test: White

F-statistic	3.272233	Prob. F(77,25)	0.0007
Obs*R-squared	93.70269	Prob. Chi-Square(77)	0.0947
Scaled explained SS	149.2735	Prob. Chi-Square(77)	0.0000

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 38. Adjusted price model results – selling price

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 20:52
Sample (adjusted): 1 104
Included observations: 103 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-276744.9	277264.6	-0.998125	0.3209
BEDROOMS	230884.6	55776.90	4.139431	0.0001
BATHROOMS	42077.98	68699.88	0.612490	0.5418
GARAGE	62184.48	29803.38	2.086491	0.0398
PLOT_SIZE	129.4100	96.55558	1.340264	0.1835
POOL	47279.91	63031.15	0.750104	0.4551
BAILLIE_PARK	303600.7	74731.28	4.062565	0.0001
GRIMBEECK_PARK	493198.4	103335.4	4.772793	0.0000
VAN_DER_HOFF	752965.7	124795.8	6.033582	0.0000
MIEDERPARK	38049.60	72257.75	0.526582	0.5998
PITCHED	107230.6	76167.59	1.407824	0.1626
TILE	117465.5	58632.21	2.003429	0.0481
DISTANCE	18898.06	39389.05	0.479780	0.6325

R-squared	0.658981	Mean dependent var	1430971.
Adjusted R-squared	0.613512	S.D. dependent var	458196.1
S.E. of regression	284852.2	Akaike info criterion	28.07484
Sum squared resid	7.30E+12	Schwarz criterion	28.40738
Log likelihood	-1432.854	Hannan-Quinn criter.	28.20953
F-statistic	14.49289	Durbin-Watson stat	1.999682
Prob(F-statistic)	0.000000	Wald F-statistic	18.74362
Prob(Wald F-statistic)	0.000000		

Table 39. Squared explanatory variable model – plot size

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 20:54
Sample (adjusted): 1 104
Included observations: 104 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-521032.8	251986.3	-2.067703	0.0415
BEDROOMS	236747.9	49888.66	4.745525	0.0000
BATHROOMS	40904.00	49377.93	0.828386	0.4096
GARAGE	55379.23	38276.85	1.446808	0.1514
PLOT_SIZE	801.0099	350.6508	2.284352	0.0247
PLOT_SIZE^2	-0.308821	0.156662	-1.971250	0.0517
POOL	30605.15	61923.47	0.494241	0.6223
BAILLIE_PARK	300565.7	84341.12	3.563691	0.0006
GRIMBEECK_PARK	589530.1	104474.2	5.642832	0.0000
VAN_DER_HOFF	756908.4	107407.3	7.047083	0.0000
MIEDERPARK	36155.19	107009.1	0.337870	0.7362
PITCHED	83890.28	84030.64	0.998330	0.3208
TILE	156552.4	64592.64	2.423688	0.0173

R-squared	0.675090	Mean dependent var	1435481.
Adjusted R-squared	0.632245	S.D. dependent var	458280.1
S.E. of regression	277913.9	Akaike info criterion	28.02448
Sum squared resid	7.03E+12	Schwarz criterion	28.35503
Log likelihood	-1444.273	Hannan-Quinn criter.	28.15839
F-statistic	15.75648	Durbin-Watson stat	1.956034
Prob(F-statistic)	0.000000		

Table 40. Heteroscedasticity test: Squared explanatory variable model – plot size

Heteroscedasticity Test: White

F-statistic	2.059601	Prob. F(76,27)	0.0188
Obs*R-squared	88.70002	Prob. Chi-Square(76)	0.1512
Scaled explained SS	134.3564	Prob. Chi-Square(76)	0.0000

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 41. Adjusted squared explanatory variable model – plot size

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 20:54
Sample (adjusted): 1 104
Included observations: 104 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-521032.8	286664.4	-1.817571	0.0724
BEDROOMS	236747.9	54338.49	4.356910	0.0000
BATHROOMS	40904.00	64885.06	0.630407	0.5300
GARAGE	55379.23	28625.52	1.934610	0.0561
PLOT_SIZE	801.0099	358.2224	2.236069	0.0278
PLOT_SIZE^2	-0.308821	0.161044	-1.917621	0.0583
POOL	30605.15	62423.88	0.490279	0.6251
BAILLIE_PARK	300565.7	68796.99	4.368879	0.0000

GRIMBEECK_PARK	589530.1	94446.72	6.241933	0.0000
VAN_DER_HOFF	756908.4	97113.41	7.794066	0.0000
MIEDERPARK	36155.19	64018.83	0.564759	0.5736
PITCHED	83890.28	79851.94	1.050573	0.2962
TILE	156552.4	58314.46	2.684624	0.0086

R-squared	0.675090	Mean dependent var	1435481.
Adjusted R-squared	0.632245	S.D. dependent var	458280.1
S.E. of regression	277913.9	Akaike info criterion	28.02448
Sum squared resid	7.03E+12	Schwarz criterion	28.35503
Log likelihood	-1444.273	Hannan-Quinn criter.	28.15839
F-statistic	15.75648	Durbin-Watson stat	1.956034
Prob(F-statistic)	0.000000	Wald F-statistic	18.53607
Prob(Wald F-statistic)	0.000000		

Logarithmic models:

Table 42. Logarithmic model 1 – selling price

Dependent Variable: LOG(SELLING)
Method: Least Squares
Date: 11/19/17 Time: 20:59
Sample (adjusted): 1 104
Included observations: 103 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.54317	0.336457	37.28020	0.0000
LOG(BEDROOMS)	0.559579	0.110560	5.061302	0.0000
LOG(BATHROOMS)	0.079493	0.067849	1.171611	0.2444
GARAGE	0.048300	0.026040	1.854829	0.0669
LOG(PLOT_SIZE)	0.054028	0.048890	1.105091	0.2721
POOL	0.032077	0.040655	0.789002	0.4322
LOG(DISTANCE)	-0.001095	0.069957	-0.015652	0.9875
BAILLIE_PARK	0.266778	0.055808	4.780285	0.0000
GRIMBEECK_PARK	0.414577	0.069009	6.007565	0.0000
VAN_DER_HOFF	0.514620	0.077497	6.640513	0.0000
MIEDERPARK	0.083636	0.071644	1.167388	0.2461
PITCHED	0.087946	0.054979	1.599635	0.1132
TILE	0.092504	0.041177	2.246463	0.0271

R-squared	0.704952	Mean dependent var	14.12459
Adjusted R-squared	0.665612	S.D. dependent var	0.315981
S.E. of regression	0.182720	Akaike info criterion	-0.444218
Sum squared resid	3.004786	Schwarz criterion	-0.111680
Log likelihood	35.87725	Hannan-Quinn criter.	-0.309529
F-statistic	17.91959	Durbin-Watson stat	2.165970
Prob(F-statistic)	0.000000		

Table 43. Heteroscedasticity test: Logarithmic model 1 – selling price

Heteroscedasticity Test: White

F-statistic	2.098607	Prob. F(77,25)	0.0197
Obs*R-squared	89.19989	Prob. Chi-Square(77)	0.1614
Scaled explained SS	72.96663	Prob. Chi-Square(77)	0.6091

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below

Table 44. Adjusted logarithmic model 1 – selling price

Dependent Variable: LOG(SELLING)
Method: Least Squares
Date: 11/19/17 Time: 21:01
Sample (adjusted): 1 104
Included observations: 103 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.54317	0.282857	44.34454	0.0000
LOG(BEDROOMS)	0.559579	0.097384	5.746115	0.0000
LOG(BATHROOMS)	0.079493	0.077537	1.025234	0.3080
GARAGE	0.048300	0.023402	2.063921	0.0419
LOG(PLOT_SIZE)	0.054028	0.042007	1.286171	0.2017
POOL	0.032077	0.038372	0.835945	0.4054
LOG(DISTANCE)	-0.001095	0.057034	-0.019199	0.9847
BAILLIE_PARK	0.266778	0.053347	5.000837	0.0000
GRIMBEECK_PARK	0.414577	0.065636	6.316259	0.0000
VAN_DER_HOFF	0.514620	0.065699	7.832980	0.0000
MIEDERPARK	0.083636	0.057689	1.449780	0.1506
PITCHED	0.087946	0.053681	1.638304	0.1048
TILE	0.092504	0.038871	2.379787	0.0194

R-squared	0.704952	Mean dependent var	14.12459
Adjusted R-squared	0.665612	S.D. dependent var	0.315981
S.E. of regression	0.182720	Akaike info criterion	-0.444218
Sum squared resid	3.004786	Schwarz criterion	-0.111680
Log likelihood	35.87725	Hannan-Quinn criter.	-0.309529
F-statistic	17.91959	Durbin-Watson stat	2.165970
Prob(F-statistic)	0.000000	Wald F-statistic	22.42258
Prob(Wald F-statistic)	0.000000		

Table 45. Logarithmic model 2 – selling price

Dependent Variable: LOG(SELLING)
Method: Least Squares
Date: 11/19/17 Time: 21:01
Sample (adjusted): 1 104
Included observations: 103 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.97185	0.163455	79.36061	0.0000
BEDROOMS	0.148459	0.033686	4.407153	0.0000
BATHROOMS	0.028267	0.033372	0.847032	0.3992
GARAGE	0.057186	0.026332	2.171710	0.0325
PLOT_SIZE	8.50E-05	5.81E-05	1.462837	0.1470
POOL	0.040088	0.041298	0.970714	0.3343
DISTANCE	2.47E-06	0.021962	0.000112	0.9999
BAILLIE_PARK	0.262925	0.058319	4.508419	0.0000
GRIMBEECK_PARK	0.387288	0.075066	5.159286	0.0000
VAN_DER_HOFF	0.513855	0.078056	6.583127	0.0000

MIEDERPARK	0.086042	0.074862	1.149338	0.2535
PITCHED	0.098089	0.055966	1.752672	0.0831
TILE	0.080710	0.041876	1.927348	0.0571

R-squared	0.692710	Mean dependent var	14.12459
Adjusted R-squared	0.651738	S.D. dependent var	0.315981
S.E. of regression	0.186472	Akaike info criterion	-0.403563
Sum squared resid	3.129464	Schwarz criterion	-0.071025
Log likelihood	33.78350	Hannan-Quinn criter.	-0.268874
F-statistic	16.90688	Durbin-Watson stat	2.198564
Prob(F-statistic)	0.000000		

Table 46. Heteroscedasticity test: Logarithmic model 2 – selling price

Heteroscedasticity Test: White

F-statistic	2.801518	Prob. F(77,25)	0.0025
Obs*R-squared	92.30279	Prob. Chi-Square(77)	0.1126
Scaled explained SS	76.85938	Prob. Chi-Square(77)	0.4831

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 47. Adjusted logarithmic model 2 – selling price

Dependent Variable: LOG(SELLING)
Method: Least Squares
Date: 11/19/17 Time: 21:02
Sample (adjusted): 1 104
Included observations: 103 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.97185	0.151130	85.83228	0.0000
BEDROOMS	0.148459	0.030248	4.908031	0.0000
BATHROOMS	0.028267	0.040178	0.703554	0.4835
GARAGE	0.057186	0.023047	2.481316	0.0149
PLOT_SIZE	8.50E-05	6.21E-05	1.368521	0.1746
POOL	0.040088	0.039089	1.025575	0.3078
DISTANCE	2.47E-06	0.022447	0.000110	0.9999
BAILLIE_PARK	0.262925	0.054726	4.804418	0.0000
GRIMBEECK_PARK	0.387288	0.070894	5.462943	0.0000
VAN_DER_HOFF	0.513855	0.068287	7.524881	0.0000
MIEDERPARK	0.086042	0.060753	1.416258	0.1602
PITCHED	0.098089	0.054055	1.814630	0.0729
TILE	0.080710	0.038424	2.100493	0.0385

R-squared	0.692710	Mean dependent var	14.12459
Adjusted R-squared	0.651738	S.D. dependent var	0.315981
S.E. of regression	0.186472	Akaike info criterion	-0.403563
Sum squared resid	3.129464	Schwarz criterion	-0.071025
Log likelihood	33.78350	Hannan-Quinn criter.	-0.268874
F-statistic	16.90688	Durbin-Watson stat	2.198564

Prob(F-statistic)	0.000000	Wald F-statistic	23.50057
Prob(Wald F-statistic)	0.000000		

Time on the market and pricing strategy:

Table 48. TOM regression results

Dependent Variable: TOM
Method: Least Squares
Date: 11/19/17 Time: 21:03
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.160022	3.209338	2.230997	0.0281
PRICE_STRAT	0.616611	0.936479	0.658436	0.5119
BEDROOMS	0.313854	0.705005	0.445180	0.6572
PLOT_SIZE	0.000211	0.001347	0.156284	0.8761
DISTANCE	-0.068215	0.378635	-0.180162	0.8574

R-squared	0.010480	Mean dependent var	8.404040
Adjusted R-squared	-0.031627	S.D. dependent var	4.409913
S.E. of regression	4.479107	Akaike info criterion	5.885909
Sum squared resid	1885.866	Schwarz criterion	6.016976
Log likelihood	-286.3525	Hannan-Quinn criter.	5.938939
F-statistic	0.248884	Durbin-Watson stat	2.052115
Prob(F-statistic)	0.909679		

Table 49. Heteroscedasticity test: TOM regression results

Heteroscedasticity Test: White

F-statistic	0.782637	Prob. F(13,85)	0.6761
Obs*R-squared	10.58325	Prob. Chi-Square(13)	0.6457
Scaled explained SS	8.114696	Prob. Chi-Square(13)	0.8360

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 50. Adjusted TOM regression results

Dependent Variable: TOM
Method: Least Squares
Date: 11/19/17 Time: 21:04
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.160022	3.174343	2.255592	0.0264

PRICE_STRAT	0.616611	0.971974	0.634390	0.5274
BEDROOMS	0.313854	0.724161	0.433404	0.6657
PLOT_SIZE	0.000211	0.001375	0.153089	0.8787
DISTANCE	-0.068215	0.377602	-0.180654	0.8570

R-squared	0.010480	Mean dependent var	8.404040
Adjusted R-squared	-0.031627	S.D. dependent var	4.409913
S.E. of regression	4.479107	Akaike info criterion	5.885909
Sum squared resid	1885.866	Schwarz criterion	6.016976
Log likelihood	-286.3525	Hannan-Quinn criter.	5.938939
F-statistic	0.248884	Durbin-Watson stat	2.052115
Prob(F-statistic)	0.909679	Wald F-statistic	0.261121
Prob(Wald F-statistic)	0.902168		

Selling price and pricing strategy:

Table 51. Selling price regression results

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 21:05
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1428908.	222794.9	6.413561	0.0000
PRICE_STRAT	2500.032	93555.07	0.026723	0.9787
TOM	12883.09	10619.26	1.213181	0.2281
DISTANCE	-23205.91	38535.91	-0.602189	0.5485

R-squared	0.019514	Mean dependent var	1422121.
Adjusted R-squared	-0.011449	S.D. dependent var	459254.1
S.E. of regression	461875.5	Akaike info criterion	28.96354
Sum squared resid	2.03E+13	Schwarz criterion	29.06840
Log likelihood	-1429.695	Hannan-Quinn criter.	29.00597
F-statistic	0.630248	Durbin-Watson stat	1.361634
Prob(F-statistic)	0.597262		

Table 52. Heteroscedasticity test: Selling price regression results

Heteroscedasticity Test: White

F-statistic	0.839239	Prob. F(8,90)	0.5706
Obs*R-squared	6.872616	Prob. Chi-Square(8)	0.5504
Scaled explained SS	8.823639	Prob. Chi-Square(8)	0.3574

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 53. Adjusted selling price regression results

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 21:06
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1428908.	188252.9	7.590367	0.0000
PRICE_STRAT	2500.032	91192.05	0.027415	0.9782
TOM	12883.09	9429.616	1.366237	0.1751
DISTANCE	-23205.91	34484.62	-0.672935	0.5026

R-squared	0.019514	Mean dependent var	1422121.
Adjusted R-squared	-0.011449	S.D. dependent var	459254.1
S.E. of regression	461875.5	Akaike info criterion	28.96354
Sum squared resid	2.03E+13	Schwarz criterion	29.06840
Log likelihood	-1429.695	Hannan-Quinn criter.	29.00597
F-statistic	0.630248	Durbin-Watson stat	1.361634
Prob(F-statistic)	0.597262	Wald F-statistic	0.746857
Prob(Wald F-statistic)	0.526818		

Table 54. Selling price regression results with house characteristics

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 21:07
Sample (adjusted): 1 104
Included observations: 104 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-229654.9	185903.4	-1.235346	0.2199
PRICE_STRAT	-134725.1	59848.92	-2.251087	0.0268
BEDROOMS	255348.1	50942.31	5.012496	0.0000
BATHROOMS	45384.81	49014.92	0.925939	0.3569
GARAGE	56110.57	37983.14	1.477249	0.1431
PLOT_SIZE	107.2240	86.00685	1.246692	0.2157
POOL	26763.48	61643.62	0.434165	0.6652
BAILLIE_PARK	370590.9	86854.60	4.266796	0.0000
GRIMBEECK_PARK	556200.0	99345.58	5.598639	0.0000
VAN_DER_HOFF	765079.4	107019.6	7.148969	0.0000
MIEDERPARK	86149.90	106635.8	0.807889	0.4213
PITCHED	143523.3	84328.88	1.701948	0.0922
TILE	93723.55	62881.25	1.490485	0.1396

R-squared	0.679086	Mean dependent var	1435481.
Adjusted R-squared	0.636768	S.D. dependent var	458280.1
S.E. of regression	276199.5	Akaike info criterion	28.01210
Sum squared resid	6.94E+12	Schwarz criterion	28.34265
Log likelihood	-1443.629	Hannan-Quinn criter.	28.14602
F-statistic	16.04712	Durbin-Watson stat	1.986502
Prob(F-statistic)	0.000000		

Table 55. Heteroscedasticity test: Selling price regression results with house characteristics

Heteroscedasticity Test: White

F-statistic	2.105526	Prob. F(76,27)	0.0162
Obs*R-squared	88.98556	Prob. Chi-Square(76)	0.1464
Scaled explained SS	122.6449	Prob. Chi-Square(76)	0.0006

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 56. Adjusted selling price regression results with house characteristics

Dependent Variable: SELLING
Method: Least Squares
Date: 11/19/17 Time: 21:08
Sample (adjusted): 1 104
Included observations: 104 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-229654.9	210206.4	-1.092521	0.2775
PRICE_STRAT	-134725.1	59434.82	-2.266771	0.0258
BEDROOMS	255348.1	50363.51	5.070102	0.0000
BATHROOMS	45384.81	59919.45	0.757430	0.4507
GARAGE	56110.57	30226.79	1.856319	0.0666
PLOT_SIZE	107.2240	87.97560	1.218793	0.2261
POOL	26763.48	59476.10	0.449987	0.6538
BAILLIE_PARK	370590.9	78821.64	4.701639	0.0000
GRIMBEECK_PARK	556200.0	86620.08	6.421144	0.0000
VAN_DER_HOFF	765079.4	94725.70	8.076789	0.0000
MIEDERPARK	86149.90	65284.88	1.319600	0.1903
PITCHED	143523.3	73112.74	1.963041	0.0527
TILE	93723.55	57320.13	1.635090	0.1055

R-squared	0.679086	Mean dependent var	1435481.
Adjusted R-squared	0.636768	S.D. dependent var	458280.1
S.E. of regression	276199.5	Akaike info criterion	28.01210
Sum squared resid	6.94E+12	Schwarz criterion	28.34265
Log likelihood	-1443.629	Hannan-Quinn criter.	28.14602
F-statistic	16.04712	Durbin-Watson stat	1.986502
Prob(F-statistic)	0.000000	Wald F-statistic	18.36884
Prob(Wald F-statistic)	0.000000		

Over-priced percentage and pricing strategy:

Table 57. Over-priced percentage regression results

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:08
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.562464	3.851968	1.963273	0.0525
PRICE_STRAT	3.297973	1.617502	2.038930	0.0442
TOM	0.100813	0.183600	0.549091	0.5842
DISTANCE	-0.038315	0.666259	-0.057508	0.9543

R-squared	0.046999	Mean dependent var	9.716932
Adjusted R-squared	0.016905	S.D. dependent var	8.053870
S.E. of regression	7.985506	Akaike info criterion	7.032698
Sum squared resid	6057.988	Schwarz criterion	7.137552
Log likelihood	-344.1186	Hannan-Quinn criter.	7.075122
F-statistic	1.561715	Durbin-Watson stat	2.123632
Prob(F-statistic)	0.203787		

Table 58. Heteroscedasticity test: Over-priced percentage regression results

Heteroscedasticity Test: White

F-statistic	0.705648	Prob. F(8,90)	0.6858
Obs*R-squared	5.843192	Prob. Chi-Square(8)	0.6648
Scaled explained SS	9.185071	Prob. Chi-Square(8)	0.3269

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 59. Adjusted over-priced percentage regression results

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:09
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.562464	3.602432	2.099266	0.0384
PRICE_STRAT	3.297973	1.654959	1.992782	0.0492
TOM	0.100813	0.157967	0.638189	0.5249
DISTANCE	-0.038315	0.619823	-0.061817	0.9508

R-squared	0.046999	Mean dependent var	9.716932
Adjusted R-squared	0.016905	S.D. dependent var	8.053870
S.E. of regression	7.985506	Akaike info criterion	7.032698

Sum squared resid	6057.988	Schwarz criterion	7.137552
Log likelihood	-344.1186	Hannan-Quinn criter.	7.075122
F-statistic	1.561715	Durbin-Watson stat	2.123632
Prob(F-statistic)	0.203787	Wald F-statistic	1.551298
Prob(Wald F-statistic)	0.206373		

Table 60. Squared explanatory variable – distance

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:10
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.648344	7.344920	-0.360568	0.7192
PRICE_STRAT	2.855911	1.626488	1.755876	0.0824
TOM	0.119542	0.182390	0.655418	0.5138
DISTANCE	5.144073	3.252102	1.581769	0.1171
$DISTANCE^2$	-0.591719	0.363581	-1.627475	0.1070

R-squared	0.073117	Mean dependent var	9.716932
Adjusted R-squared	0.033675	S.D. dependent var	8.053870
S.E. of regression	7.917102	Akaike info criterion	7.025113
Sum squared resid	5891.968	Schwarz criterion	7.156179
Log likelihood	-342.7431	Hannan-Quinn criter.	7.078142
F-statistic	1.853782	Durbin-Watson stat	2.127818
Prob(F-statistic)	0.125089		

Table 61. Heteroscedasticity test: Squared explanatory variable – distance

Heteroscedasticity Test: White

F-statistic	0.640299	Prob. F(12,86)	0.8022
Obs*R-squared	8.119620	Prob. Chi-Square(12)	0.7757
Scaled explained SS	12.70222	Prob. Chi-Square(12)	0.3911

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 62. Adjusted squared explanatory variable – distance

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:11
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.646710	3.347715	-0.791090	0.4312

PRICE_STRAT	2.854685	1.712983	1.667215	0.0990
TOM	0.119552	0.152220	0.785325	0.4343
DISTANCE	5.143969	2.215673	2.321675	0.0224
$DISTANCE^2$	-0.591742	0.294272	-2.010791	0.0472

R-squared	0.073117	Mean dependent var	9.716932
Adjusted R-squared	0.033675	S.D. dependent var	8.053870
S.E. of regression	7.917102	Akaike info criterion	7.025113
Sum squared resid	5891.968	Schwarz criterion	7.156179
Log likelihood	-342.7431	Hannan-Quinn criter.	7.078142
F-statistic	1.853782	Durbin-Watson stat	2.127818
Prob(F-statistic)	0.125089	Wald F-statistic	4.895332
Prob(Wald F-statistic)	0.001250		

Bedrooms:

Table 63. Houses with more than three bedrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:14
Sample: 1 105 IF BEDROOMS>3
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.04221	14.29877	1.261802	0.2151
PRICE_STRAT	5.029574	2.108987	2.384829	0.0225
TOM	-0.078198	0.221177	-0.353555	0.7257
DISTANCE	-6.477171	6.343448	-1.021080	0.3140
$DISTANCE^2$	0.853701	0.696714	1.225325	0.2284

R-squared	0.183995	Mean dependent var	10.04120
Adjusted R-squared	0.093328	S.D. dependent var	6.812556
S.E. of regression	6.486871	Akaike info criterion	6.691287
Sum squared resid	1514.862	Schwarz criterion	6.900259
Log likelihood	-132.1714	Hannan-Quinn criter.	6.767383
F-statistic	2.029345	Durbin-Watson stat	1.746873
Prob(F-statistic)	0.110953		

Table 64. Heteroscedasticity test: Houses with more than three bedrooms

Heteroscedasticity Test: White

F-statistic	2.312509	Prob. F(12,28)	0.0332
Obs*R-squared	20.40811	Prob. Chi-Square(12)	0.0597
Scaled explained SS	14.96653	Prob. Chi-Square(12)	0.2433

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 65. Adjusted houses with more than three bedrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:18
Sample: 1 105 IF BEDROOMS>3
Included observations: 41
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.04221	10.46742	1.723655	0.0933
PRICE_STRAT	5.029574	2.110436	2.383192	0.0226
TOM	-0.078198	0.205109	-0.381252	0.7053
DISTANCE	-6.477171	5.544096	-1.168301	0.2504
$DISTANCE^2$	0.853701	0.691834	1.233967	0.2252

R-squared	0.183995	Mean dependent var	10.04120
Adjusted R-squared	0.093328	S.D. dependent var	6.812556
S.E. of regression	6.486871	Akaike info criterion	6.691287
Sum squared resid	1514.862	Schwarz criterion	6.900259
Log likelihood	-132.1714	Hannan-Quinn criter.	6.767383
F-statistic	2.029345	Durbin-Watson stat	1.746873
Prob(F-statistic)	0.110953	Wald F-statistic	1.620597
Prob(Wald F-statistic)	0.190250		

Table 66. Houses with less than four bedrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:28
Sample: 1 105 IF BEDROOM_S_<4
Included observations: 58

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.193945	8.947819	-0.803989	0.4250
PRICE_STRAT	1.624893	2.373811	0.684508	0.4966
TOM	0.311074	0.275151	1.130559	0.2633
DISTANCE	8.212045	3.942179	2.083123	0.0421
$DISTANCE^2$	-1.022159	0.445016	-2.296902	0.0256

R-squared	0.129208	Mean dependent var	9.487710
Adjusted R-squared	0.063488	S.D. dependent var	8.878277
S.E. of regression	8.591826	Akaike info criterion	7.221762
Sum squared resid	3912.432	Schwarz criterion	7.399387
Log likelihood	-204.4311	Hannan-Quinn criter.	7.290951
F-statistic	1.966028	Durbin-Watson stat	1.924823
Prob(F-statistic)	0.113123		

Table 67. Heteroscedasticity test: Houses with less than four bedrooms

Heteroscedasticity Test: White

F-statistic	0.669305	Prob. F(4,53)	0.6162
Obs*R-squared	2.788909	Prob. Chi-Square(4)	0.5937
Scaled explained SS	3.774394	Prob. Chi-Square(4)	0.4374

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 68. Adjusted houses with less than four bedrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:27
Sample: 1 105 IF BEDROOM_S_<4
Included observations: 58
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.193945	3.178456	-2.263346	0.0277
PRICE_STRAT	1.624893	2.516502	0.645695	0.5213
TOM	0.311074	0.238743	1.302968	0.1982
DISTANCE	8.212045	2.291228	3.584125	0.0007
$DISTANCE^2$	-1.022159	0.303997	-3.362393	0.0014

R-squared	0.129208	Mean dependent var	9.487710
Adjusted R-squared	0.063488	S.D. dependent var	8.878277
S.E. of regression	8.591826	Akaike info criterion	7.221762
Sum squared resid	3912.432	Schwarz criterion	7.399387
Log likelihood	-204.4311	Hannan-Quinn criter.	7.290951
F-statistic	1.966028	Durbin-Watson stat	1.924823
Prob(F-statistic)	0.113123	Wald F-statistic	5.869058
Prob(Wald F-statistic)	0.000550		

Bathrooms:

Table 69. Houses with two bathrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:19
Sample: 1 105 IF BATHROOMS=2
Included observations: 58

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.546458	7.309362	-0.074761	0.9407
PRICE_STRAT	4.881516	1.967958	2.480497	0.0163
TOM	0.082973	0.201575	0.411622	0.6823
DISTANCE	4.805388	3.287631	1.461657	0.1497
$DISTANCE^2$	-0.637924	0.368318	-1.731991	0.0891

R-squared	0.179440	Mean dependent var	8.757858
Adjusted R-squared	0.117511	S.D. dependent var	7.292866
S.E. of regression	6.850984	Akaike info criterion	6.768924
Sum squared resid	2487.607	Schwarz criterion	6.946549
Log likelihood	-191.2988	Hannan-Quinn criter.	6.838113
F-statistic	2.897507	Durbin-Watson stat	1.888457

Prob(F-statistic)	0.030478

Table 70. Heteroscedasticity test: Houses with two bathrooms

Heteroscedasticity Test: White

F-statistic	2.640384	Prob. F(12,45)	0.0092
Obs*R-squared	23.96448	Prob. Chi-Square(12)	0.0206
Scaled explained SS	33.88299	Prob. Chi-Square(12)	0.0007

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 71. Adjusted houses with two bathrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:19
Sample: 1 105 IF BATHROOMS=2
Included observations: 58
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.546458	4.046626	-0.135040	0.8931
PRICE_STRAT	4.881516	2.362816	2.065974	0.0437
TOM	0.082973	0.183055	0.453267	0.6522
DISTANCE	4.805388	2.356949	2.038817	0.0465
$DISTANCE^2$	-0.637924	0.311540	-2.047649	0.0456

R-squared	0.179440	Mean dependent var	8.757858
Adjusted R-squared	0.117511	S.D. dependent var	7.292866
S.E. of regression	6.850984	Akaike info criterion	6.768924
Sum squared resid	2487.607	Schwarz criterion	6.946549
Log likelihood	-191.2988	Hannan-Quinn criter.	6.838113
F-statistic	2.897507	Durbin-Watson stat	1.888457
Prob(F-statistic)	0.030478	Wald F-statistic	4.242857
Prob(Wald F-statistic)	0.004718		

Table 72. Houses with more than two bathrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:25
Sample: 1 105 IF BATHROOM_S_>2
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.809907	21.41835	-0.317947	0.7532
PRICE_STRAT	2.106395	3.975733	0.529813	0.6009
TOM	-0.013608	0.443970	-0.030651	0.9758
DISTANCE	7.704389	9.373123	0.821966	0.4189

DISTANCE^2	-0.825434	1.045866	-0.789235	0.4374

R-squared	0.045742	Mean dependent var	11.16300
Adjusted R-squared	-0.106939	S.D. dependent var	9.701555
S.E. of regression	10.20712	Akaike info criterion	7.635060
Sum squared resid	2604.632	Schwarz criterion	7.868593
Log likelihood	-109.5259	Hannan-Quinn criter.	7.709769
F-statistic	0.299593	Durbin-Watson stat	1.503289
Prob(F-statistic)	0.875412		

Table 73. Heteroscedasticity test: Houses with more than two bathrooms

Heteroscedasticity Test: White

F-statistic	1.112996	Prob. F(4,25)	0.3725
Obs*R-squared	4.534823	Prob. Chi-Square(4)	0.3384
Scaled explained SS	3.869262	Prob. Chi-Square(4)	0.4240

H0: homoscedasticity. If LM-stat > Chi Square value, reject H0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 74. Adjusted houses with more than two bathrooms

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:26
Sample: 1 105 IF BATHROOM_S_>2
Included observations: 30
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.809907	7.843191	-0.868257	0.3935
PRICE_STRAT	2.106395	4.081223	0.516119	0.6103
TOM	-0.013608	0.287535	-0.047326	0.9626
DISTANCE	7.704389	5.724533	1.345854	0.1904
DISTANCE^2	-0.825434	0.739306	-1.116498	0.2748

R-squared	0.045742	Mean dependent var	11.16300
Adjusted R-squared	-0.106939	S.D. dependent var	9.701555
S.E. of regression	10.20712	Akaike info criterion	7.635060
Sum squared resid	2604.632	Schwarz criterion	7.868593
Log likelihood	-109.5259	Hannan-Quinn criter.	7.709769
F-statistic	0.299593	Durbin-Watson stat	1.503289
Prob(F-statistic)	0.875412	Wald F-statistic	1.753125
Prob(Wald F-statistic)	0.169987		

Pool:

Table 75. Houses with a pool

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:20
Sample: 1 105 IF POOL=1
Included observations: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.87182	13.63253	1.751092	0.0876
PRICE_STRAT	4.986346	2.201328	2.265153	0.0290
TOM	-0.144041	0.257410	-0.559580	0.5789
DISTANCE	-8.889358	5.881718	-1.511354	0.1386
$DISTANCE^2$	1.122898	0.651524	1.723496	0.0925

R-squared	0.192677	Mean dependent var	9.933431
Adjusted R-squared	0.111944	S.D. dependent var	7.576807
S.E. of regression	7.140133	Akaike info criterion	6.873779
Sum squared resid	2039.260	Schwarz criterion	7.074519
Log likelihood	-149.6600	Hannan-Quinn criter.	6.948613
F-statistic	2.386612	Durbin-Watson stat	1.876635
Prob(F-statistic)	0.067144		

Table 76. Heteroscedasticity test: Houses with a pool

Heteroscedasticity Test: White

F-statistic	2.099353	Prob. F(12,32)	0.0468
Obs*R-squared	19.82176	Prob. Chi-Square(12)	0.0705
Scaled explained SS	13.82168	Prob. Chi-Square(12)	0.3122

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 77. Adjusted houses with a pool

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:20
Sample: 1 105 IF POOL=1
Included observations: 45
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.87182	9.183518	2.599419	0.0130
PRICE_STRAT	4.986346	2.255985	2.210274	0.0329
TOM	-0.144041	0.224740	-0.640926	0.5252
DISTANCE	-8.889358	4.544953	-1.955874	0.0575

$DISTANCE^2$	1.122898	0.566748	1.981302	0.0545

R-squared	0.192677	Mean dependent var	9.933431
Adjusted R-squared	0.111944	S.D. dependent var	7.576807
S.E. of regression	7.140133	Akaike info criterion	6.873779
Sum squared resid	2039.260	Schwarz criterion	7.074519
Log likelihood	-149.6600	Hannan-Quinn criter.	6.948613
F-statistic	2.386612	Durbin-Watson stat	1.876635
Prob(F-statistic)	0.067144	Wald F-statistic	1.738089
Prob(Wald F-statistic)	0.160660		

Table 78. Houses without a pool

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:23
Sample: 1 105 IF POOL=0
Included observations: 54

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.842516	8.501241	-1.040144	0.3034
PRICE_STRAT	-0.022202	2.274701	-0.009760	0.9923
TOM	0.297302	0.248558	1.196107	0.2374
DISTANCE	9.698311	3.843649	2.523204	0.0149
$DISTANCE^2$	-1.224990	0.431033	-2.841989	0.0065

R-squared	0.191497	Mean dependent var	9.536516
Adjusted R-squared	0.125497	S.D. dependent var	8.497428
S.E. of regression	7.946358	Akaike info criterion	7.071326
Sum squared resid	3094.085	Schwarz criterion	7.255491
Log likelihood	-185.9258	Hannan-Quinn criter.	7.142351
F-statistic	2.901465	Durbin-Watson stat	2.140792
Prob(F-statistic)	0.031148		

Table 79. Houses without a pool

Heteroskedasticity Test: White

F-statistic	0.556625	Prob. F(4,49)	0.6951
Obs*R-squared	2.347045	Prob. Chi-Square(4)	0.6722
Scaled explained SS	4.217038	Prob. Chi-Square(4)	0.3774

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 80. Adjusted houses without a pool

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:23
Sample: 1 105 IF POOL=0

Included observations: 54
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.842516	2.885694	-3.064260	0.0035
PRICE_STRAT	-0.022202	2.291914	-0.009687	0.9923
TOM	0.297302	0.210473	1.412540	0.1641
DISTANCE	9.698311	2.565556	3.780198	0.0004
$DISTANCE^2$	-1.224990	0.326542	-3.751399	0.0005

R-squared	0.191497	Mean dependent var	9.536516
Adjusted R-squared	0.125497	S.D. dependent var	8.497428
S.E. of regression	7.946358	Akaike info criterion	7.071326
Sum squared resid	3094.085	Schwarz criterion	7.255491
Log likelihood	-185.9258	Hannan-Quinn criter.	7.142351
F-statistic	2.901465	Durbin-Watson stat	2.140792
Prob(F-statistic)	0.031148	Wald F-statistic	15.47203
Prob(Wald F-statistic)	0.000000		

Table 81. Houses with more than one garage

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:21
Sample: 1 105 IF GARAGE>1
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.607435	7.487982	-0.081121	0.9356
PRICE_STRAT	5.410826	1.786769	3.028274	0.0034
TOM	0.061606	0.199711	0.308474	0.7586
DISTANCE	3.604937	3.415213	1.055553	0.2947
$DISTANCE^2$	-0.419797	0.389049	-1.079035	0.2841

R-squared	0.142315	Mean dependent var	9.259940
Adjusted R-squared	0.095319	S.D. dependent var	8.116739
S.E. of regression	7.720215	Akaike info criterion	6.987517
Sum squared resid	4350.926	Schwarz criterion	7.138588
Log likelihood	-267.5132	Hannan-Quinn criter.	7.047994
F-statistic	3.028212	Durbin-Watson stat	1.995659
Prob(F-statistic)	0.022828		

Table 82. Heteroscedasticity test: Houses with more than one garage

Heteroscedasticity Test: White

F-statistic	1.199938	Prob. F(12,65)	0.3024
Obs*R-squared	14.14550	Prob. Chi-Square(12)	0.2915
Scaled explained SS	16.53697	Prob. Chi-Square(12)	0.1679

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 83. Adjusted houses with more than one garage

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:21
Sample: 1 105 IF GARAGE>1
Included observations: 78
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.607435	3.932703	-0.154457	0.8777
PRICE_STRAT	5.410826	1.895629	2.854370	0.0056
TOM	0.061606	0.167826	0.367080	0.7146
DISTANCE	3.604937	2.455687	1.467995	0.1464
$DISTANCE^2$	-0.419797	0.331384	-1.266800	0.2093

R-squared	0.142315	Mean dependent var	9.259940
Adjusted R-squared	0.095319	S.D. dependent var	8.116739
S.E. of regression	7.720215	Akaike info criterion	6.987517
Sum squared resid	4350.926	Schwarz criterion	7.138588
Log likelihood	-267.5132	Hannan-Quinn criter.	7.047994
F-statistic	3.028212	Durbin-Watson stat	1.995659
Prob(F-statistic)	0.022828	Wald F-statistic	4.049837
Prob(Wald F-statistic)	0.005076		

Table 84. Houses with only one garage

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:20
Sample: 1 105 IF GARAGE=1
Included observations: 14

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.23988	32.72062	-0.465758	0.6525
PRICE_STRAT	-5.569974	6.132484	-0.908274	0.3874
TOM	0.223419	0.612233	0.364925	0.7236
DISTANCE	13.65839	13.37242	1.021385	0.3337
$DISTANCE^2$	-1.482644	1.332774	-1.112450	0.2948

R-squared	0.246838	Mean dependent var	14.32949
Adjusted R-squared	-0.087901	S.D. dependent var	7.730708
S.E. of regression	8.063320	Akaike info criterion	7.284981
Sum squared resid	585.1542	Schwarz criterion	7.513216
Log likelihood	-45.99487	Hannan-Quinn criter.	7.263854
F-statistic	0.737405	Durbin-Watson stat	3.335115
Prob(F-statistic)	0.589439		

Table 85. Heteroscedasticity test: Houses with only one garage

Heteroscedasticity Test: White

F-statistic	0.782736	Prob. F(4,9)	0.5640
Obs*R-squared	3.613338	Prob. Chi-Square(4)	0.4609
Scaled explained SS	3.573911	Prob. Chi-Square(4)	0.4667

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 86. Adjusted houses with only one garage

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:21
Sample: 1 105 IF GARAGE=1
Included observations: 14
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-15.23988	21.94987	-0.694304	0.5050
PRICE_STRAT	-5.569974	3.522351	-1.581323	0.1483
TOM	0.223419	0.713810	0.312995	0.7614
DISTANCE	13.65839	11.31288	1.207332	0.2581
$DISTANCE^2$	-1.482644	1.212101	-1.223202	0.2523

R-squared	0.246838	Mean dependent var	14.32949
Adjusted R-squared	-0.087901	S.D. dependent var	7.730708
S.E. of regression	8.063320	Akaike info criterion	7.284981
Sum squared resid	585.1542	Schwarz criterion	7.513216
Log likelihood	-45.99487	Hannan-Quinn criter.	7.263854
F-statistic	0.737405	Durbin-Watson stat	3.335115
Prob(F-statistic)	0.589439	Wald F-statistic	2.241497
Prob(Wald F-statistic)	0.144669		

Suburb effects:

Table 87. Suburb effect

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:27
Sample (adjusted): 1 104
Included observations: 104 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.918931	5.290440	1.496838	0.1379
PRICE_STRAT	3.540144	1.703181	2.078548	0.0405
BEDROOMS	-1.485830	1.449717	-1.024911	0.3081
BATHROOMS	0.943896	1.394867	0.676692	0.5003

GARAGE	0.219669	1.080925	0.203223	0.8394
PLOT_SIZE	0.003541	0.002448	1.446590	0.1514
POOL	0.726926	1.754255	0.414379	0.6796
BAILLIE_PARK	-0.349636	2.471709	-0.141455	0.8878
GRIMBEECK_PARK	-3.568659	2.827178	-1.262269	0.2101
VAN_DER_HOFF	0.242429	3.045564	0.079601	0.9367
MIEDERPARK	3.888004	3.034642	1.281207	0.2034
PITCHED	-1.063197	2.399832	-0.443030	0.6588
TILE	-0.579165	1.789476	-0.323651	0.7469

R-squared	0.129502	Mean dependent var	9.701560
Adjusted R-squared	0.014711	S.D. dependent var	7.918549
S.E. of regression	7.860090	Akaike info criterion	7.077942
Sum squared resid	5622.073	Schwarz criterion	7.408491
Log likelihood	-355.0530	Hannan-Quinn criter.	7.211857
F-statistic	1.128151	Durbin-Watson stat	2.167539
Prob(F-statistic)	0.347777		

Table 88. Heteroscedasticity test: Suburb effect

Heteroscedasticity Test: White

F-statistic	1.766694	Prob. F(76,27)	0.0493
Obs*R-squared	86.58807	Prob. Chi-Square(76)	0.1907
Scaled explained SS	119.1470	Prob. Chi-Square(76)	0.0012

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H_0 is rejected, indicating that there is heteroscedasticity present and the model have to be adjusted.

Table 89. Adjusted suburb effect

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:28
Sample (adjusted): 1 104
Included observations: 104 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.918931	5.063480	1.563931	0.1213
PRICE_STRAT	3.540144	1.829303	1.935242	0.0561
BEDROOMS	-1.485830	1.352294	-1.098748	0.2748
BATHROOMS	0.943896	1.912150	0.493631	0.6228
GARAGE	0.219669	0.966669	0.227243	0.8207
PLOT_SIZE	0.003541	0.003048	1.161571	0.2484
POOL	0.726926	1.445268	0.502970	0.6162
BAILLIE_PARK	-0.349636	2.349175	-0.148834	0.8820
GRIMBEECK_PARK	-3.568659	2.551246	-1.398791	0.1653
VAN_DER_HOFF	0.242429	2.890423	0.083873	0.9333
MIEDERPARK	3.888004	2.901019	1.340220	0.1835
PITCHED	-1.063197	2.372638	-0.448107	0.6551
TILE	-0.579165	1.718478	-0.337022	0.7369

R-squared	0.129502	Mean dependent var	9.701560
Adjusted R-squared	0.014711	S.D. dependent var	7.918549

S.E. of regression	7.860090	Akaike info criterion	7.077942
Sum squared resid	5622.073	Schwarz criterion	7.408491
Log likelihood	-355.0530	Hannan-Quinn criter.	7.211857
F-statistic	1.128151	Durbin-Watson stat	2.167539
Prob(F-statistic)	0.347777	Wald F-statistic	1.547569
Prob(Wald F-statistic)	0.121815		

Table 90. Suburb effect with TOM

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:30
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.576264	7.607498	0.601547	0.5491
PRICE_STRAT	3.488598	1.806537	1.931097	0.0568
BEDROOMS	-1.642203	1.646447	-0.997422	0.3214
BATHROOMS	0.966172	1.523174	0.634315	0.5276
GARAGE	0.480475	1.163406	0.412990	0.6807
PLOT_SIZE	0.003434	0.002567	1.337470	0.1847
POOL	0.704678	1.862520	0.378346	0.7061
BAILLIE_PARK	-1.048567	2.674445	-0.392069	0.6960
GRIMBEECK_PARK	-5.141066	3.527107	-1.457587	0.1487
VAN_DER_HOFF	0.736023	3.513759	0.209469	0.8346
MIEDERPARK	2.753714	3.380748	0.814528	0.4176
PITCHED	-0.938089	2.575203	-0.364278	0.7166
TILE	-0.896351	1.906442	-0.470170	0.6395
TOM	0.163201	0.198452	0.822371	0.4132
DISTANCE	0.540823	0.978375	0.552777	0.5819

R-squared	0.128855	Mean dependent var	9.716932
Adjusted R-squared	-0.016336	S.D. dependent var	8.053870
S.E. of regression	8.119388	Akaike info criterion	7.165114
Sum squared resid	5537.655	Schwarz criterion	7.558314
Log likelihood	-339.6731	Hannan-Quinn criter.	7.324203
F-statistic	0.887485	Durbin-Watson stat	2.226625
Prob(F-statistic)	0.574742		

Table 91. Heteroscedasticity test: suburb effect with TOM

Heteroscedasticity Test: White

F-statistic	1.504819	Prob. F(14,84)	0.1272
Obs*R-squared	19.85086	Prob. Chi-Square(14)	0.1349
Scaled explained SS	25.33178	Prob. Chi-Square(14)	0.0314

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 92. Adjusted model: suburb effect with TOM

Dependent Variable: OVERPRICED_

Method: Least Squares
Date: 11/19/17   Time: 21:31
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.576264	6.113592	0.748539	0.4562
PRICE_STRAT	3.488598	1.939384	1.798817	0.0756
BEDROOMS	-1.642203	1.573844	-1.043435	0.2997
BATHROOMS	0.966172	2.029456	0.476074	0.6353
GARAGE	0.480475	1.024614	0.468933	0.6403
PLOT_SIZE	0.003434	0.003268	1.050751	0.2964
POOL	0.704678	1.491986	0.472309	0.6379
BAILLIE_PARK	-1.048567	2.419015	-0.433469	0.6658
GRIMBEECK_PARK	-5.141066	3.366023	-1.527341	0.1304
VAN_DER_HOFF	0.736023	3.262832	0.225578	0.8221
MIEDERPARK	2.753714	3.041720	0.905315	0.3679
PITCHED	-0.938089	2.522734	-0.371854	0.7109
TILE	-0.896351	1.889818	-0.474306	0.6365
TOM	0.163201	0.156250	1.044485	0.2993
DISTANCE	0.540823	0.811876	0.666140	0.5071

R-squared	0.128855	Mean dependent var	9.716932
Adjusted R-squared	-0.016336	S.D. dependent var	8.053870
S.E. of regression	8.119388	Akaike info criterion	7.165114
Sum squared resid	5537.655	Schwarz criterion	7.558314
Log likelihood	-339.6731	Hannan-Quinn criter.	7.324203
F-statistic	0.887485	Durbin-Watson stat	2.226625
Prob(F-statistic)	0.574742	Wald F-statistic	1.380603
Prob(Wald F-statistic)	0.180854		

Table 93. Whole sample excluding suburbs

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17   Time: 21:32
Sample (adjusted): 1 104
Included observations: 99 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.603289	7.190800	0.918297	0.3610
PRICE_STRAT	3.385935	1.753929	1.930486	0.0568
BEDROOMS	-0.651419	1.582012	-0.411766	0.6815
BATHROOMS	0.525705	1.472157	0.357098	0.7219
GARAGE	0.336732	1.103705	0.305093	0.7610
PLOT_SIZE	0.002857	0.002490	1.147473	0.2543
POOL	0.415220	1.868638	0.222204	0.8247
PITCHED	-1.430027	2.509454	-0.569856	0.5702
TILE	-0.922029	1.816243	-0.507657	0.6130
TOM	0.134984	0.195340	0.691022	0.4914
DISTANCE	-0.145950	0.707181	-0.206383	0.8370

R-squared	0.071523	Mean dependent var	9.716932
Adjusted R-squared	-0.033985	S.D. dependent var	8.053870
S.E. of regression	8.189584	Akaike info criterion	7.148042
Sum squared resid	5902.097	Schwarz criterion	7.436389
Log likelihood	-342.8281	Hannan-Quinn criter.	7.264708
F-statistic	0.677889	Durbin-Watson stat	2.082951

Prob(F-statistic)	0.742112

Table 94. Heteroscedasticity test: whole sample excluding suburbs

Heteroscedasticity Test: White

F-statistic	0.793090	Prob. F(61,37)	0.7920
Obs*R-squared	56.09693	Prob. Chi-Square(61)	0.6538
Scaled explained SS	78.87759	Prob. Chi-Square(61)	0.0615

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 95. Adjusted model: whole sample excluding suburbs

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:32
Sample (adjusted): 1 104
Included observations: 99 after adjustments
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.603289	5.763877	1.145633	0.2551
PRICE_STRAT	3.385935	1.896068	1.785767	0.0776
BEDROOMS	-0.651419	1.577215	-0.413018	0.6806
BATHROOMS	0.525705	1.943367	0.270513	0.7874
GARAGE	0.336732	1.057400	0.318453	0.7509
PLOT_SIZE	0.002857	0.002900	0.985084	0.3273
POOL	0.415220	1.599147	0.259651	0.7957
PITCHED	-1.430027	2.435140	-0.587246	0.5585
TILE	-0.922029	1.840493	-0.500969	0.6176
TOM	0.134984	0.158889	0.849549	0.3979
DISTANCE	-0.145950	0.621023	-0.235016	0.8147

R-squared	0.071523	Mean dependent var	9.716932
Adjusted R-squared	-0.033985	S.D. dependent var	8.053870
S.E. of regression	8.189584	Akaike info criterion	7.148042
Sum squared resid	5902.097	Schwarz criterion	7.436389
Log likelihood	-342.8281	Hannan-Quinn criter.	7.264708
F-statistic	0.677889	Durbin-Watson stat	2.082951
Prob(F-statistic)	0.742112	Wald F-statistic	0.738846
Prob(Wald F-statistic)	0.686115		

Table 96. Baillie Park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:34

Sample: 1 105 IF BAILLIE_PARK=1
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.784648	23.61267	0.287331	0.7762
PRICE_STRAT	6.013084	2.865401	2.098514	0.0461
BEDROOMS	-3.457589	2.897443	-1.193324	0.2439
BATHROOMS	0.521477	2.433989	0.214248	0.8321
GARAGE	2.427657	2.161648	1.123058	0.2721
PLOT_SIZE	0.006761	0.008403	0.804592	0.4286
POOL	1.833692	3.468643	0.528648	0.6017
PITCHED	-4.892369	4.064758	-1.203607	0.2400
TILE	-2.720927	3.306108	-0.823000	0.4183
TOM	0.470496	0.351889	1.337059	0.1932
DISTANCE	-0.274773	2.012243	-0.136551	0.8925

R-squared	0.306159	Mean dependent var	10.35260
Adjusted R-squared	0.028622	S.D. dependent var	7.728218
S.E. of regression	7.616816	Akaike info criterion	7.145062
Sum squared resid	1450.397	Schwarz criterion	7.628915
Log likelihood	-117.6111	Hannan-Quinn criter.	7.313940
F-statistic	1.103130	Durbin-Watson stat	2.089734
Prob(F-statistic)	0.397384		

Table 97. Heteroscedasticity test: Baillie Park

Heteroscedasticity Test: White

F-statistic	0.929891	Prob. F(10,25)	0.5232
Obs*R-squared	9.760098	Prob. Chi-Square(10)	0.4618
Scaled explained SS	5.945646	Prob. Chi-Square(10)	0.8198

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 98 Adjusted model: Baillie park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:34
Sample: 1 105 IF BAILLIE_PARK=1
Included observations: 36
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.784648	26.12679	0.259682	0.7972
PRICE_STRAT	6.013084	2.820827	2.131674	0.0430
BEDROOMS	-3.457589	3.394371	-1.018625	0.3181
BATHROOMS	0.521477	2.848003	0.183103	0.8562
GARAGE	2.427657	1.805254	1.344773	0.1908
PLOT_SIZE	0.006761	0.006222	1.086552	0.2876
POOL	1.833692	3.167083	0.578985	0.5678
PITCHED	-4.892369	3.526663	-1.387252	0.1776

TILE	-2.720927	3.053156	-0.891185	0.3813
TOM	0.470496	0.249038	1.889254	0.0705
DISTANCE	-0.274773	2.207224	-0.124488	0.9019

R-squared	0.306159	Mean dependent var	10.35260
Adjusted R-squared	0.028622	S.D. dependent var	7.728218
S.E. of regression	7.616816	Akaike info criterion	7.145062
Sum squared resid	1450.397	Schwarz criterion	7.628915
Log likelihood	-117.6111	Hannan-Quinn criter.	7.313940
F-statistic	1.103130	Durbin-Watson stat	2.089734
Prob(F-statistic)	0.397384	Wald F-statistic	1.669632
Prob(Wald F-statistic)	0.144301		

Table 99. Miederpark, Central and Suid

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:37
Sample: 1 105 IF (MIEDERPARK+CENTRAL_SUID)=1
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.91996	14.16784	0.982504	0.3357
PRICE_STRAT	2.255811	3.403224	0.662845	0.5137
BEDROOMS	-1.387402	3.218649	-0.431051	0.6703
BATHROOMS	1.871202	2.713396	0.689616	0.4970
GARAGE	-0.358581	1.622312	-0.221031	0.8269
PLOT_SIZE	-0.014447	0.006010	-2.403699	0.0243
POOL	-1.595706	3.184330	-0.501112	0.6209
PITCHED	1.406060	4.436218	0.316950	0.7540
TILE	1.347757	3.545008	0.380185	0.7072
TOM	0.345309	0.346663	0.996092	0.3291
DISTANCE	1.647365	1.610914	1.022628	0.3167

R-squared	0.291548	Mean dependent var	10.34431
Adjusted R-squared	-0.003641	S.D. dependent var	7.843703
S.E. of regression	7.857969	Akaike info criterion	7.212211
Sum squared resid	1481.944	Schwarz criterion	7.701034
Log likelihood	-115.2137	Hannan-Quinn criter.	7.380952
F-statistic	0.987666	Durbin-Watson stat	1.827601
Prob(F-statistic)	0.479745		

Table 100. Heteroscedasticity test: Miederpark, Central and Suid

Heteroscedasticity Test: White

F-statistic	1.963460	Prob. F(10,24)	0.0853
Obs*R-squared	15.74922	Prob. Chi-Square(10)	0.1070
Scaled explained SS	10.30559	Prob. Chi-Square(10)	0.4141

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 101. Adjusted model: Miederpark, Central and Suid

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/19/17 Time: 21:37
Sample: 1 105 IF (MIEDERPARK+CENTRAL_SUID)=1
Included observations: 35
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.91996	10.28634	1.353247	0.1886
PRICE_STRAT	2.255811	3.493890	0.645644	0.5246
BEDROOMS	-1.387402	2.978254	-0.465844	0.6455
BATHROOMS	1.871202	3.506720	0.533605	0.5985
GARAGE	-0.358581	1.754131	-0.204421	0.8397
PLOT_SIZE	-0.014447	0.005103	-2.830875	0.0092
POOL	-1.595706	3.580127	-0.445712	0.6598
PITCHED	1.406060	3.742595	0.375691	0.7104
TILE	1.347757	3.341513	0.403337	0.6903
TOM	0.345309	0.310013	1.113852	0.2764
DISTANCE	1.647365	1.319449	1.248525	0.2239

R-squared	0.291548	Mean dependent var	10.34431
Adjusted R-squared	-0.003641	S.D. dependent var	7.843703
S.E. of regression	7.857969	Akaike info criterion	7.212211
Sum squared resid	1481.944	Schwarz criterion	7.701034
Log likelihood	-115.2137	Hannan-Quinn criter.	7.380952
F-statistic	0.987666	Durbin-Watson stat	1.827601
Prob(F-statistic)	0.479745	Wald F-statistic	2.538164
Prob(Wald F-statistic)	0.029955		

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 102. Grimbeeck Park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:14
Sample: 1 105 IF GRIMBEECK_PARK=1
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-56.43236	43.43819	-1.299142	0.2637

PRICE_STRAT	2.907366	6.387912	0.455136	0.6726
BEDROOM_S_	-5.250938	8.642592	-0.607565	0.5763
BATHROOM_S_	9.648439	9.855587	0.978982	0.3830
GARAGE	-4.055177	4.345058	-0.933285	0.4035
PLOT_SIZE	0.019777	0.012909	1.532048	0.2003
POOL	1.027564	8.471022	0.121303	0.9093
PITCHED	2.470043	6.575704	0.375632	0.7263
TILE	5.628187	5.435038	1.035538	0.3589
TOM	0.144301	0.752023	0.191884	0.8572
DISTANCE	5.722712	5.531496	1.034568	0.3593

R-squared	0.783034	Mean dependent var	6.110294
Adjusted R-squared	0.240618	S.D. dependent var	8.690584
S.E. of regression	7.573196	Akaike info criterion	7.032018
Sum squared resid	229.4132	Schwarz criterion	7.551255
Log likelihood	-41.74014	Hannan-Quinn criter.	7.026487
F-statistic	1.443604	Durbin-Watson stat	2.468810
Prob(F-statistic)	0.386276		

Table 103. Heteroscedasticity test: Grimbeeck Park

Heteroscedasticity Test: White

F-statistic	2.406966	Prob. F(10,4)	0.2060
Obs*R-squared	12.86246	Prob. Chi-Square(10)	0.2315
Scaled explained SS	0.781188	Prob. Chi-Square(10)	0.9999

H_0: homoscedasticity. If LM-stat > Chi Square value, reject H_0**.**

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 104. Adjusted model: Grimbeeck Park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:15
Sample: 1 105 IF GRIMBEECK_PARK=1
Included observations: 15
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-56.43236	35.08337	-1.608522	0.1830
PRICE_STRAT	2.907366	7.332743	0.396491	0.7120
BEDROOM_S_	-5.250938	7.132400	-0.736209	0.5024
BATHROOM_S_	9.648439	8.511813	1.133535	0.3203
GARAGE	-4.055177	3.559953	-1.139110	0.3182
PLOT_SIZE	0.019777	0.011696	1.690903	0.1661
POOL	1.027564	6.435954	0.159660	0.8809
PITCHED	2.470043	4.402179	0.561095	0.6047
TILE	5.628187	6.552800	0.858898	0.4388
TOM	0.144301	0.991935	0.145474	0.8914
DISTANCE	5.722712	4.845113	1.181131	0.3030

R-squared	0.783034	Mean dependent var	6.110294
Adjusted R-squared	0.240618	S.D. dependent var	8.690584
S.E. of regression	7.573196	Akaike info criterion	7.032018
Sum squared resid	229.4132	Schwarz criterion	7.551255
Log likelihood	-41.74014	Hannan-Quinn criter.	7.026487
F-statistic	1.443604	Durbin-Watson stat	2.468810
Prob(F-statistic)	0.386276	Wald F-statistic	28.11923
Prob(Wald F-statistic)	0.002842		

Table 105. Van Der Hoff Park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:13
Sample: 1 105 IF VAN_DER_HOFF=1
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-66.99090	48.24834	-1.388460	0.2994
PRICE_STRAT	-24.21338	30.79973	-0.786156	0.5141
BEDROOM_S_	2.895244	7.358933	0.393433	0.7320
BATHROOM_S_	5.947339	14.70195	0.404527	0.7250
GARAGE	15.03011	11.19289	1.342826	0.3114
PLOT_SIZE	-0.040937	0.038930	-1.051546	0.4033
POOL	-12.47936	18.41336	-0.677734	0.5678
PITCHED	30.51617	35.58566	0.857541	0.4815
TILE	-11.91229	14.22889	-0.837191	0.4906
TOM	2.309590	1.879572	1.228785	0.3441
DISTANCE	11.67347	10.48398	1.113458	0.3814

R-squared	0.777205	Mean dependent var	10.42902
Adjusted R-squared	-0.336769	S.D. dependent var	8.598253
S.E. of regression	9.941191	Akaike info criterion	7.251756
Sum squared resid	197.6546	Schwarz criterion	7.729790
Log likelihood	-36.13642	Hannan-Quinn criter.	7.153499
F-statistic	0.697687	Durbin-Watson stat	2.235284
Prob(F-statistic)	0.716418		

Table 106. Heteroscedasticity test: Van Der Hoff Park

Heteroscedasticity Test: White

F-statistic	0.616517	Prob. F(4,8)	0.6631
Obs*R-squared	3.063127	Prob. Chi-Square(4)	0.5473
Scaled explained SS	2.755047	Prob. Chi-Square(4)	0.5996

H0: homoscedasticity. If LM-stat > Chi Square value, reject H0.

The LM is higher than the critical value and therefore the H0 is rejected, indicating that there is heteroscedasticity present and the model has been adjusted in the table below.

Table 107. Adjusted model: Van Der Hoff Park

Dependent Variable: OVERPRICED_
Method: Least Squares
Date: 11/20/17 Time: 15:12
Sample: 1 105 IF VAN_DER_HOFF=1
Included observations: 13
White heteroscedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-66.99090	52.10041	-1.285804	0.3273
PRICE_STRAT	-24.21338	31.66573	-0.764656	0.5244
BEDROOM_S_	2.895244	9.133945	0.316976	0.7813
BATHROOM_S_	5.947339	18.07367	0.329061	0.7734
GARAGE	15.03011	14.97994	1.003349	0.4214
PLOT_SIZE	-0.040937	0.037771	-1.083815	0.3917
POOL	-12.47936	16.17682	-0.771435	0.5211
PITCHED	30.51617	32.68324	0.933695	0.4490
TILE	-11.91229	9.595516	-1.241444	0.3403
TOM	2.309590	1.730181	1.334884	0.3136
DISTANCE	11.67347	10.92636	1.068377	0.3972

R-squared	0.777205	Mean dependent var	10.42902
Adjusted R-squared	-0.336769	S.D. dependent var	8.598253
S.E. of regression	9.941191	Akaike info criterion	7.251756
Sum squared resid	197.6546	Schwarz criterion	7.729790
Log likelihood	-36.13642	Hannan-Quinn criter.	7.153499
F-statistic	0.697687	Durbin-Watson stat	2.235284
Prob(F-statistic)	0.716418	Wald F-statistic	5.588832
Prob(Wald F-statistic)	0.161215		