

# University of Cape Town

Department of Construction Economics  
and  
Management



## **Reducing the property appraisal bias with decision support systems: An experimental investigation in the South African property market**

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A minor dissertation presented to the Department of Construction Economics and Management in partial fulfilment of the requirements for the degree MSc in Property Studies

04 April 2016

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## **ACKNOWLEDGEMENTS**

I am grateful to the Heavenly God, for His blessing, privilege and strength to complete this research.

I would like to acknowledge the continued contributions and support of the following individuals that make it possible to complete this study:

### **Academic staff**

Special thanks to Mrs Kathleen Evans, the supervisor for this research study, for her guidance and invaluable advice during this research.

Besides, thanks to Professor Dr Carsten Lausberg from the Nürtingen-Geislingen University, whose expertise, support and assistance was indispensable for the execution of the controlled experimental study.

My sincere thanks also goes to other academic staff, namely, Mrs Karen Le Jeune for her assistance in setting up the UCT VULA website; Research Associate from the Nürtingen-Geislingen University, Mr Patrick Krieger, for his statistical advice on how to interpret the data; and Mrs Corrie Uys from the Centre for Postgraduate Studies of the Cape Peninsula University of Technology, for her help on how to use the R studio software.

### **Participants of the Study**

I would like to first thank the SA Institute of Valuers and the South African Council for the Property Valuers Profession (SACPVP) for their support. More specifically, the general secretary, Mrs Melanie Vallun from the SA Institute of Valuers for distributing the experimental study to members. Mr MC Seota, the registrar of SACPVP, for providing an hour of continuing education and training to participants who participated in the study.

I also owe a big thank you to all the expert and novice participants whose valuable contributions have added to the body of knowledge.

### **Family and friends**

I thank my friends, acquaintances and work colleagues for their continuous encouragement. I am also most grateful to Ms Leila Rostom, Ms Hanna Boodhun and Mr Stephen Koigi for their motivation and encouragement to the very end, and to Ms Sally Burt and Ms Diana Massawa for their assistance in reviewing the document.

I am thankful to my families and dear parents for always believing and supporting me in all the endeavours that I have undertaken. I will be forever grateful to them.

Last but not least, I am thankful to my fiancée, Ms Melissa Millward, for partaking in this journey with me. Thank you for your love and continuous encouragement that helped me complete this project.

### **Funding**

Finally, I would like to thank The Nürtingen-Geislingen University, Institute for Real Estate Information Technology from Germany who financed the three iPods and an iPad for this study.

## ABSTRACT

**Purpose** – The valuation tasks for manual valuation are time-demanding and cognitively challenging. Behaviourists have observed that valuation accuracy and variations are mainly caused by human adaptive approaches called cognitive shortcuts. Of particular interest for valuation tasks is the susceptibility of decision makers to anchoring heuristics. The anchoring and adjustment approach is a mental shortcut which involves deliberate and conscious adjustment of values, known to be wrong but close to a right answer. Various studies have shown that valuers are prone to anchoring to asking price, previous estimate and other reference points.

The incidence of valuation bias in the property market and the world is of concern. Few studies have used the decision-support tool to reduce property appraisal bias. The research purpose is therefore to determine the efficacy of the decision-support tool in reducing and eliminating property appraisal bias in the South African property market.

**Design/methodology/approach** – Similar to previous behavioural studies, a controlled experimental study design was used. The experimental design is based on a previous German study that uses a self-written valuation software in a MS Excel package, adapted to the South African market. The software comprises two versions, a standard software and a decision-support software, which were administered to separate groups of novices and experts. Descriptive statistics and non-parametric testing were used to interpret the results.

**Findings** – Consistent with other research on valuation accuracy and variations, the findings show that the valuation outcomes do not align with ‘margin of errors’ concept. Despite the results not being as robust as one would have expected, the study revealed that test subjects were susceptible to the anchoring effects and that use of a decision-support tool can help to reduce valuation variations.

**Practical implications** – This study heightened the need to counter the effect of bias in valuation. The high variance among the experts group is of concern and should be addressed. Other forms of cognitive shortcuts used by valuers should be incorporated into the decision-support tool, and a similar test run for different valuation settings. The behavioural contentions should be discussed and presented to novices and experts.

**Keywords** – Valuation variations, valuation bias, anchoring and adjustment heuristics, debiasing, decision support systems.

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# CHAPTER 1 INTRODUCTION AND PROBLEM STATEMENT

## 1.1 Introduction

Research into the “margin of error” and behavioural issues of valuation have dominated the early stages of real estate literature. With the advent of new technology and findings derived from computer science, psychology and other fields, interest in using computer-aided technology to improve decision-making has become the focus of much attention. Decision support systems (DSS) are computer-based information systems developed to provide decision makers with a set of support solutions for efficient and effective decision-making outcomes (Shim *et al.*, 2002).

Behaviourists and researchers assert that valuation is a discipline of social science and is viewed as “an art not a science” (French & Gabrielli, 2004; Diaz & Hansz, 2007). Amidu (2011) asserts that human judgement is central to forming a value judgement when valuing property. Given that valuation is a human activity, judgement bias may occur in the form of random and systematic error (Yiu *et al.*, 2006). The authors state that systematic bias is regarded as having a greater effect on an investor’s decision than random bias would have. Hansz and Diaz (2001) also highlight that while diversification tends to reduce random bias in large portfolios, systematic bias does not dissipate through diversification.

Tidwell and Gallimore (2014) recognise the time-demanding and cognitively challenging process of the prescribed appraisal model in practice. Due to the human short-term memory’s limited capability to resolve problems, people use cognitive shortcuts called heuristics (Simon & Newell, 1971; and Simon, 1978, cited by Tidwell & Gallimore, 2014). Among the various types of heuristics identified, the anchoring effects are observed to be most robust in psychological literature (Scott & Lizieri, 2012, citing Tversky & Kahneman, 1974).

In order to mitigate or eliminate the effects of decision-making bias, decision support systems have been designed to assist human decision-making processes. When faced with a problem, Kleinmuntz and Schkade (1993) state that decision-makers switch to a decision strategy, namely a cognitive cost-benefit system. With an improved informational display, informational search and reduced processing cost, decision support systems provide a cognitive incentive system that both enhances the decision-making process and reduces systematic bias. Tidwell and Gallimore (2014) and Lausberg and Dust (2015) found that

decision support technology has the potential to reduce anchoring bias in real estate valuations. While the study revealed the existence of anchor behaviour, it also showed that computer-based systems can be used to improve appraisal judgement. Clearly, therefore, this presents an opportunity to research the efficacy of decision-support tools within the South African property valuation context.

## **1.2 Background to the research**

Property is regarded as both a physical and a financial asset. In mature economies, the benefit and liabilities accruing from the ownership of real property underpins a major proportion of financial decisions for a wide range of stakeholders (Gilbertson & Preston, 2005). Real estate valuation is required for various reasons. Firstly, valuation serves as a major source of collateral for loans by various financial institutions. Scott and Judge (2000), citing Houlder (1992), for example, assert that three quarters of all United Kingdom bank lending is dependent on property valuations. Secondly, valuation is vital for business decisions relating to acquisitions, mergers and sales of businesses as investment property. Similarly, for home buyers, decisions to acquire or sell property are based on the market approach of a valuation. Besides, regular and correct valuation ensures that shareholders continue to benefit from investment in listed and unlisted companies.

In the property market, valuation is regarded as the estimation of property prices that will transact in the market at a particular date (Pagourtzi *et al.*, 2003). French and Gabrielli (2004) observe that valuation is a pricing model that reflects market sentiment based on both endogenous and exogenous factors. Amidu (2011) suggests that valuation is inherently a human activity and a judgemental process due to the heterogeneous nature of property and the lack of transaction information in the market. The author recognises that despite the development of a systematic and structured approach to facilitate consideration of implicit and explicit factors that could affect valuation outcomes, judgement bias is likely to occur throughout the valuation process.

In simple terms, valuation bias is an under- or overvaluation in relation to the target (Crosby, 2000). In the case of valuation accuracy, where the valuation basis is market value, valuation bias occurs when the valuation is under or over the sale price of the property. Similarly, in valuation variation studies, bias occurs when valuation produced by one valuer differs from those by other valuers based on the same information and time basis. Joslin (2005), through a questionnaire survey and valuer interviews, found that

uncertainty during a valuation affects the accuracy of valuation. The level of uncertainty arises from the quantity and quality of comparable evidence, the market condition, the characteristics of the subject property, client pressure and a valuer's subjective opinion (Joslin, 2005; Babawale & Omirin, 2012).

A literature review on appraisal bias by Yiu *et al.* (2006) classifies bias into two distinct types: random bias and systematic bias. Random bias is considered ubiquitous and largely produced by appraisal smoothing. Due to the imprecise science of property valuation, valuation timing and adaptive behaviour leads to appraisal smoothing of data (Scott & Judge, 2000).

On the other hand, systematic bias is found to be mainly related to behavioural contention. Hansz and Diaz (2001) citing Simon and Newell (1971) note that people use cognitive shortcuts called heuristics to resolve problems associated with short-term memory. The authors support that heuristic behaviour, which helps reduce complexity and cognitive effort, is recognised to lead to systematic bias in property valuation.

Yiu *et al.* (2006) identify anchoring bias and survival bias as the two sources of systematic bias. Chapman and Johnson (1999: 115) define anchoring as “a pervasive judgement bias in which decision makers are systematically influenced by random and uninformative starting points”. Scott and Lizieri (2012) support that anchoring behaviour arises when reference points are made and adjusted to yield a conclusion. However, the authors argue that while it is acceptable to use a reference point to achieve a conclusion, inadequacy of adjustment leads to the bias that affects the result. According to various studies, anchoring behaviour is prevalent in both the commercial and residential property markets (Diaz & Hansz, 2007; Tidwell & Gallimore, 2014).

Survival bias as coined by Kishore (2006) refers to client influence on valuation. Generally, the client appoints professional valuers or uses their services to provide an accurate and objective valuation. However, given the client's economic incentive relating to valuations, the client-valuer agency relationship may give rise to conflicts of interest. A common type of conflict of interest, as cited in the Barnard Report (1986), is the tendency of valuers to a “client advocacy appraising” in anticipation of future business (Whipple, 1991). Studies by Kinnard *et al.* (1997), Levy and Schuck (1999) and Bretten and Wyatt (2001), have proved the existence of client influence on valuations and observed that valuers are prepared to change their values to align with the client's expectations. Kishore (2006) argues that

survival bias should not be regarded as a cognitive behavioural bias because client influence to some extent affects the unethical behaviour of valuers.

Babawale and Omirin (2012), citing the RICS (1994) and the *Singer and Friedlander Ltd v. John D. Wood 7 Co* (1997) court case, observe and support Joslin's (2005) finding that 100% accuracy is impossible. While there is consensus among academia, the valuation profession and the courts that inaccuracy and uncertainty are inevitable in real estate valuation, various collapses in the financial and property markets can be traced back to inaccurate valuation (Babawale and Omirin, 2012). In the United Kingdom, subsequent to the 1970s' property crash, valuation standards and professional conduct were reviewed, with RICS publishing the 'Red Book' to provide a uniform valuation standard (Gilbertson and Preston, 2005). Similarly, the United States experienced its 'savings and loan' crisis in the late 1980s, leading to the appraisal standards and the licencing of valuers having to be improved in each state. Most recently, similar problems have also arisen, such as the 1994 "Schneider Affair" in Germany, the Asian financial crisis and the 2008 sub-prime crisis in the United States that have affected the world economy as well (Quentin, 2009).

Given that valuation plays a vital role in the financial and property markets, academia and professional communities have started to pay increased attention to the incidence and measurement of valuation accuracy (Babawale & Omirin, 2012). Most recently, with the advancement of technology, psychologists among others have been researching computer-aided solutions to mitigate and eliminate the effects of decision-making bias (George *et al.*, 2000). According to Tidwell and Gallimore (2014), the process that helps the decision-making process identify and examine the normative-descriptive gap to align with normative standards is termed "debiasing".

The three main debiasing techniques to improve decision performance are cognitive, motivational and technological strategies (Larrick, 2004). Firstly, cognitive strategies, acquired through education, training and experience, help shift the descriptive normative process into a prescriptive normative process. Secondly, motivational strategies in the form of incentives and accountability approaches may encourage decision makers to put additional effort into or be more responsible for producing better outcomes. Thirdly, the debiasing technique external to the decision-making approach uses decision-support tools and informational displays to improve information processing.

Among the various debiasing techniques, technological strategies are perceived to be more effective. It is argued that due to cognitive limitations, cognitive strategies are unlikely to achieve the prescribed normative standard (Gigerenzer, 2004, cited by Tidwell & Gallimore, 2014). Equally, Larrick (2004) contends that motivational strategies may even exacerbate justification-based decision biases. Payne *et al.*, (1999) suggest that the use of decision support aid reduces the search and processing cost of information. Recent studies by Tidwell and Gallimore (2014), and Lausberg and Dust (2015) show evidence that decision support systems help reduce property appraisal bias.

A review of the literature indicates, in the context of the South African property market, that no study has explored the influence of a decision support tool in real estate valuation. The correlation of anchoring behaviour and valuation in unfamiliar geographical locations is of particular interest (Tidwell & Gallimore, 2014). The purpose of this study, therefore, is to test the efficacy of the decision support systems in mitigating and reducing anchoring bias in the valuation process.

### **1.3 Research question**

The research question to be addressed in this study may be stated as:

*To what extent can the decision support systems help reduce or eliminate property appraisal bias?*

### **1.4 Problem statement**

The problem to be examined in this study is that:

*Little is known about South African property appraisal anchoring bias and the need for and use of decision support tools to counter this.*

### **1.5 Research hypotheses**

The research hypotheses to be tested in this study may be stated as:

#### **Main hypotheses:**

- (1) *The valuation variation is lower if the valuer is debiased and supported in his decisions.*
- (2) *The anchoring effect is reduced if the valuer is debiased and supported in his decisions.*

**Sub hypotheses:**

- (a) *Market rents have a lower variation with the DSS version.*
- (b) *Operating costs have a lower variation with the DSS version.*
- (c) *Capitalisation rates have a lower variation with the DSS version.*

**1.6 Research objectives**

The research objectives are as follows:

- (1) Determine valuation variations both with and without decision support systems.
- (2) Determine whether the anchoring effect is reduced where decision support systems are used.
- (3) Establish whether a valuer exhibits heuristic behaviour when operating in an unfamiliar area.

**1.7 Research method**

The above objectives will be achieved by adopting the following research methods:

- A literature review of material pertinent to this study.
- A controlled experimental study with experts and novices to determine the valuation variation and the effectiveness of the decision support tools.
- An analysis and interpretation of the data.
- Conclusions and recommendations based on findings.

**1.8 Limitations**

This study is subject to the following limitations:

- (1) The research will be limited to novices studying at the University of Cape Town (UCT) that have acquired the technical ability to complete a valuation and to professional valuers registered with the South African Council for the Property Valuers Profession (SACPVP).
- (2) An existing software previously used in a Germany study will be used and adapted for the South African market.
- (3) The study is based on a real-world case situation, but laboratory conditions have limited validity in practice.
- (4) The study primarily considers the anchoring effect and ignores other types of bias.

## 1.9 Structure of report

This report consists of five chapters:

The research topic is introduced in **Chapter One**. The chapter begins with an overview of the topic and then provides a background to the study that identifies the research question. The problem statement and hypotheses to be tested are then stated. The objectives of the research are identified, followed by the research methodology. A statement listing the study limitations is then given.

**Chapter Two** provides the theoretical framework on which the empirical study is carried out. This chapter presents a comprehensive literature review defining valuation, identifying the types of valuation bias and analysing the impact of valuation in the property and financial market. The use of decision support systems in the real estate market is also examined.

The research method adopted in this study, discussed in **Chapter Three**, involves a critical review of methods previously adopted by researchers in this field and a description of the research method to be used in this study, as well as a justification thereof.

**Chapter Four** reports on the administration of the valuation experiment, and presents the analysis and interpretation of the data collected through the survey instrument.

In **Chapter Five**, the hypothesis is affirmed or denied based on the research findings. Conclusions are then drawn, and recommendations for the implementation of decision support systems are made. Recommendations for further research are also offered.

## 1.10 Conclusions

This chapter laid the foundations for the research. It presented an introduction and background to the study, the research question, problem statement, hypotheses and objectives. The research methodology was then briefly described and the limitations given.

The next chapter provides a detailed description of the research. The literature review aims to build a theoretical foundation for the study.

## **CHAPTER 2 LITERATURE REVIEW**

### **2.1 Introduction**

This chapter reviews the literature pertinent to the research and presents the foundation that guides the study. The discussion starts with an overview of property valuation and judgement: it looks at issues of accuracy and variation in valuations, and focuses on behavioural contention leading to bias. Thereafter, literature related to anchoring and adjustment heuristics in valuations is reviewed, followed by a discussion on debiasing strategies available to decision-makers to mitigate or eliminate bias during the value judgement process. More specifically, the effectiveness of technological interventions on real estate valuations are addressed.

### **2.2 Property valuation and judgement**

Property valuation follows a structured, rational process involving the collection, analysis and interpretation of information to provide an opinion of the market (Tidwell & Gallimore, 2014). The valuation estimate is a “snapshot” (Joslin, 2005) that reflects the future benefits of what a defined interest in an asset can realise on an open market (Appraisal Institute, 2008). Amidu (2011) asserts that valuation decision making is usually characterised by human judgement, which itself is subjective in nature. Due to the subjective nature of opinion, a degree of inaccuracy and variation in valuations is arguably inevitable. Behavioural research highlights that due to limited processing capacity, people use cognitive shortcuts during the valuation process (Bretten & Wyatt, 2001).

#### *2.2.1 The valuation process*

The primary purpose of most valuation assignments is to provide an independent and objective opinion on the market (International Valuation Standards, 2011). Generally, valuers are required to follow the normative appraisal process model to provide coherent valuation advice to the client. The model, which provides the framework for developing an opinion of values, comprises a systematic procedure that leads to a well-supported value conclusion (Appraisal Institute, 2008). The valuation process, shown in Figure 1, incorporates eight steps valuers must accomplish to render an opinion on market value.

STEP 1							Identification of the Process						
Identify client and intended users		Identify the intended use		Identify the purpose of the assignment (type of value)		Identify the effective date of the opinion		Identify the relevant characteristics of the property		Assignment Conditions			
										Extraordinary Assumptions		Hypothetical Conditions	
STEP 2							Scope of Work Determination						
STEP 3							Data Collection and Property Description						
Market Area Data				Subject Property Data				Comparable Property Data					
General characteristics of region, city and neighbourhood				Subject characteristics of land use and improvements, personal property, business assets, etc.				Sales, listings, offerings, vacancies, cost and depreciation, income and expenses, capitalization rates, etc.					
STEP 4							Data Analysis						
Market Analysis				Highest and Best Use Analysis									
Demand Studies				Site as though vacant									
Supply studies				Ideal improvement									
Marketability studies				Property as improved									
STEP 5							Site Value Opinion						
STEP 6							Application of the Approaches to value						
Sales Comparison				Cost				Income Capitalization					
STEP 7							Reconciliation of Value Indications and Final Opinion of Value						
STEP 8							Report of Defined Value						

**Figure 1: The Appraisal Institute valuation process (2008: 131)**

Once the task is understood and the interrelationships among the principal forces and specific factors affecting the subject property value have been interpreted, valuers are required to use appropriate valuation methods to form their value judgement. The three traditional approaches to value – the sales comparison approach (or market approach), the cost approach and the income approach – are described below (Appraisal Institute, 2008).

- The **market approach** reflects the value of recent sales of comparable properties in the market. The value of the subject property is adjusted to reflect the correct transactional information, such as differences in legal, physical or economic characteristics of the asset.
- The **cost approach** represents the adjusted value (loss in value due to depreciation) a buyer pays when reproducing or replacing the improvements with a similar property.
- The **income approach** is based on the principle that value is indicated as the present worth of future benefits a property can generate. The income capitalisation (direct

capitalisation) and discounted cash flow (yield capitalisation) are two typical methods used for the income approach.

According to the International Valuation Standards (2011), the above approaches are based on the economic principles of price equilibrium of anticipation of benefits or substitution, and one or more valuation approaches may be used to produce credible assignment results. If more than one approach to value is used, the Appraisal Institute (2008) suggests that greater weight must be given to the income method in the final reconciliation of an opinion on the value of the income-producing property.

The income approach is market-derived, with market indicators, such as historical data in rent, sales price and vacancy rates, representing the set of market cues to be used in valuation (Jin & Gallimore, 2010). The income stream can be capitalised using the direct capitalisation or the discounted capitalisation method to form the market value that reflects the time cost of money, and the risks and rewards of ownership and investment (Appraisal Institute, 2008). While each method has its limitations, the simple direct capitalisation method is used in this study.

### *2.2.2 Accuracy and variation in valuation*

The issue of valuation accuracy has been the centre of much attention from academics, practitioners and the courts. Valuations, which provide the basis of property performance measurement, are important for professionals and investment analysts during the decision-making process related to implementing investment strategies (McAllister, 1995). The implications of inaccuracy in valuation threaten most players in the property market: investors and property owners, commercial lenders and financial institutions, valuation professionals and professional regulatory bodies, and the economy at large.

Tidwell and Gallimore (2014) contend that the wide dispersion of market value estimates stems from the inherent characteristics of real property. The inherent characteristics of property, such as its locational attributes, size and design, links with infrastructure, composition of rentable space (in the case of an income-generated property) and future redevelopment opportunities, affect the property's value (Janssen & Soderberg, 1999). In addition, in contrast to the stock and bond markets, property is often traded privately and market information is limited for valuers to use in forming value judgements during the decision-making process. Tidwell and Gallimore (2014) assert that the deficit of open market information forces valuers to use anecdotal or unsystematic information to gather

market information. In addition to the disparity in market information, behavioural contention within the valuation process may lead to valuation accuracy and variance.

Variance as defined by Havard (2001a) refers to a theoretical measurement of the reliability of valuations expressed by a frequency distribution towards the mean or median of the outcomes. The degree of variation is highlighted by the differences in values when different valuers undertake similar tasks under the same settings. Accuracy, on the other hand, refers to how close the result is to its target, which in the case of valuation refers to the market value of the subject property (Crosby, 2000). While professional bodies such as the Royal Institution of Chartered Surveyors and the Appraisal Institute have developed the normative valuation process to assist valuers complete a valuation task, guidance as to an acceptable level of variance or the level of accuracy to be achieved by valuers is not defined (Harvard, 2001a). In this study, the terms 'valuation accuracy' and 'valuation variation' are used interchangeably.

The debate initiated by Hager and Lord (1985) regarding valuers' ability to accurately discern market value, triggered the first stream of research in valuation accuracy and variation. Initially, a 5% variance was generally accepted until further debates and disputes on negligence in valuation led to the development of the margin of error principle (Crosby *et al.*, 1998). Despite debates disputing the legitimacy of the margin of error concept, studies undertaken by Adair *et al.* (1996) and Crosby *et al.* (1998) reveal that the levels of accuracy fall short of the 10% 'error' range advocated by expert witnesses in court. In fact, Crosby *et al.* (1998) show that the margin of error concept is fundamentally incorrect as the range of valuations put forward by property experts is overestimated.

Within the commercial real estate industry, studies support evidence that inaccuracy in valuation affects the investment performance measurement of properties. Cannon and Cole (2011) studied the accuracy of commercial real estate appraisals over the past 25 years and observed that commercial valuations were inaccurate. The findings revealed that on average the valuations were within a 12% range and supported that valuers lag true sale prices during the market cycle. A closer look at the data demonstrates that valuers generally undervalue during peak market and overvalue in cold market cycles.

Even in the property portfolio context, valuation inaccuracy leads to sub-optimal portfolio performance. Bowles *et al.* (2001) assert that property portfolio performance is based on valuation as a proxy for transaction price. Despite the general assumption that inaccuracy

in valuations is likely to cancel out, Bowles *et al.* (2001) and Cannon and Cole (2011) prove that the portfolio performance is under- or overvalued. In fact, Bowles *et al.* (2001) reinforce the argument that the aggregate performance of a property portfolio may not necessarily be due to its underlying investment performance. Rather, it is argued, aggregate performance depends on the level of valuation errors and their relationship with the magnitude of portfolio valuation tolerance level, the size of the portfolio and time period.

From the discussions above, there is a priori understanding that opinions of value differ between valuers and transaction prices of property. Of particular interest is variability of opinion – that two or more valuers assessing the same property under similar settings can produce different values. The systematic and consistent difference between valuations and transaction prices leads to bias in valuations (Crosby, 2000; McAllister, 1995). This divergence can be either under or overvalued in relation to actual values/prices (Bowles *et al.*, 2001). Bretten and Wyatt (2001) contend that value concept involves the judgement and views of individuals who are influenced by their inherent behaviour. Behavioural research into the valuation process highlights the non-rational behaviour of valuers and suggests that the heuristics approach is the most dominant contributor to negligence and variance in valuations (Bretten & Wyatt, 2001).

### *2.2.3 Decision-making, heuristics and behaviour*

Simon and Newell (1971), who pioneered the theory of human problem solving, found that due to limited processing capacity, people use heuristic methods to solve problems. According to the theory, the human information-processing system operates in a sequential order, with most processing activities occurring in the short-term memory. However, due to the limited capacity of short-term memories and the slow storage capacity in the long-term memories, humans adapt to cognitive shortcuts called heuristics. This adaptive approach is used unconsciously as an efficient way for individuals to reduce complex tasks to simpler judgemental operations. For valuations, the heuristic behaviour is of particular importance because human judgement is central to the process.

Following a detailed literature review of cognitive bias, Arnott (2002) identifies 37 possible types of bias arising from the heuristic adaption; of particular relevance for this research, however, are those identified by Tversky and Kahneman (1974) and Evans (1989). Drawing on findings by Simon and Newell (1971), Tversky and Kahneman (1974) identify three types of heuristics that people use regularly when forming judgements: the

representativeness, availability, and the anchoring and adjustment heuristics. Later, Evans (1989) addresses the positivity heuristic as the forth-common type of cognitive shortcuts used by decision makers.

The representativeness heuristic is a form of cognitive shortcut that categorises an event by another event based on its similarity of characteristics (Tversky & Kahneman, 1974). This type of heuristic is similar to stereotyping (Harvard, 2001a) and is generally associated with probability judgements. In property valuation, Diaz (2002) asserts that a valuer might use the representativeness approach when selecting comparable sales. During the stereotyping process, it is assumed that the subject property has the same qualities as the comparable group but other inherent characteristics of the subject property are ignored, which leads to biased results.

The availability heuristic is another mental shortcut that decision makers use when asked to assess the frequency of a class or the possibility of a situation. This form of judgemental heuristic relies on the problem solver's ability to retrieve readily available knowledge instead of studying other options or measures. In the context of valuations, Quan and Quigley (1991) assert that, in forming a price judgement, valuers use their knowledge to extract an estimate of market price from a set of comparative sale prices. This sale price is, however, subject to transaction and market-wide noise. In cases where there is large variability with market-wide noise, Quan and Quigley (1991) note that valuers are likely to rely more heavily on information acquired in previous periods. Harvard (2001b) contends that once essential components of tasks become familiar to decision-makers, they tend to solve the problem the way they perceive the solution to be. This adaptive behaviour is arguably difficult to reverse, resulting in bias.

The third heuristic identified by Tversky and Kahneman (1974) is the anchoring and adjustments heuristic. This type of cognitive shortcut is mainly employed in numerical predictions when a relevant value is available. According to the authors, judgements are made by using an available value as starting point which is then adjusted in a serial, deliberate and conscious manner to incorporate relevant information until a plausible estimate is reached. Chapman and Johnson (2002), citing Rottentreich and Tversky's (1997) study on judgement of a disjunctive event, Kruger's (1999) research of rating of one's ability to drive, and Griffin and Tversky's (1992) study of confidence judgements, suggest that people use an anchor-and-adjust strategy to solve estimation problems.

However, in all cases, due to insufficient adjustment, a biased judgement emerges as the final value remains biased in the direction of the original arbitrary anchor value.

Finally, Evans (1989) observes that the positivity heuristic is a tendency for humans to search for information that concurs with their current beliefs. It is noted that problem solvers usually adopt such cognitive shortcuts to support rather than refute their views. Havard (2001b) studied the relationship between heuristic behaviour and decision outcome emanating from the decision-making process in commercial valuation practice. The author observes that the commercial valuation process does not follow the linear process of a normative approach. Instead, the valuer adopts a strong initial opinion of value based on stored prior knowledge and experience. This initial opinion is then tested against information gathered from the market. However, in most cases, valuers are conditioned to seek confirmation evidence rather than challenge evidence. As a result, use of the positivity heuristic can lead to confirmation bias in judgement.

The subconscious use of cognitive shortcuts described above may lead to various forms of bias. In the context of property valuation, Yiu *et al.* (2006), through a desktop study of appraisal bias, identify the anchoring effect, appraisal smoothing and survival biases as common types of appraisal bias. Appraisal smoothing is classified as a random bias and arises from a tendency of appraisers to smooth their valuations by using historic data or anchoring their values to previous estimates. Survival bias, put forward by various studies (Kinnard *et al.*, 1997; Levy & Schuck 1999; Bretten & Wyatt, 2001; Hansz, 2004), relates to client influence on valuations. However, while this type of bias is more systematic in nature and can affect the result to greater extent, Kishore (2006) argues that survival bias is to some extent the result of unethical behaviour by valuers, and thus not necessarily due to cognitive shortcuts.

Of particular interest to the study is the anchoring effect, which may present as random or systematic bias. As shown in Figure 2, empirical studies support the occurrence of anchoring and adjustment heuristics in the form of anchoring to a previous estimate, to the asking price or to other references. The next section focuses on the anchoring effect.

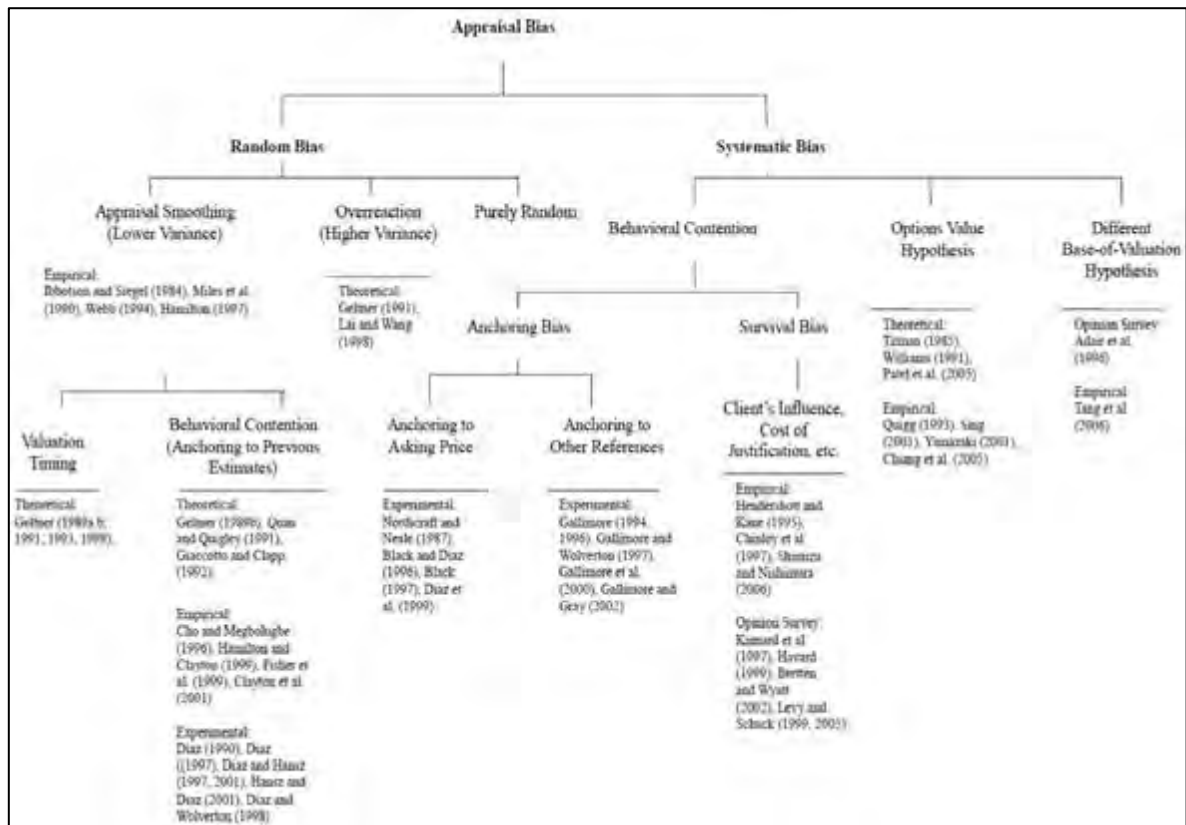


Figure 2: Appraisal bias according to Yiu *et al.* (2006)

## 2.3 Anchoring effects in valuations

Normatively, valuers should follow valuation procedures before forming a value judgement. The valuer's task is to evaluate property-specific and market information. However, psychological theory supports that valuers are also prone to mental shortcuts when carrying out a task. Anchoring effects have been observed to be prominent in valuations and the discussion that follows looks into this particular heuristic behaviour.

### 2.3.1 Types of anchoring effects

Before discussing various anchoring contentions in valuations, it is important to understand the two types of anchoring effects as distinguished by Epley (2004), who highlights that the anchoring effect covers almost every decision relating to the assimilation of an anchor value. The anchor value can be generated either by an external source or by decision makers themselves. "Externally provided" anchors and "self-generated" anchors respectively lead to accessibility-based anchoring and adjustment-based anchoring. Although the anchors produce effects of similar characteristics, they are observed to be psychologically different.

In the case of accessibility-based anchoring effects, the anchors are novel values that are based on an external source to answer a comparative judgement. Generally, the standard anchoring model consists of an initial comparative assessment, followed by an absolute decision. When an anchor value is based on an external source, the individual assumes that the anchor value is the plausible answer and generates evidence that is mostly consistent with the anchor information. The accessibility-based anchoring effects lead to important information specific to the task being overlooked. As such, under the standard anchoring paradigm, it is observed that the presence of anchoring effects is enhanced by accessibility of anchor-consistent information, rather than insufficient adjustment (Epley & Gilovich, 2005).

On the other hand, Epley and Gilovich (2005) assert that “self-generated” anchors are automatically generated values that are known to be wrong but close to a right answer, and for which deliberate and conscious adjustment is required. Unlike “externally provided” anchors that produce suboptimal result due to the inconsistent retrieval of anchor-related information, “self-generated” anchors lead to adjustment-based anchoring. This heuristic behaviour arises due to insufficient adjustment resulting from a lack of attention and a “satisficing” tendency (Epley & Gilovich, 2006). An empirical study by Epley and Gilovich (2006) supports the argument of Quattrone *et al.* (1981) that subjects stop adjusting once a plausible result is reached. In addition, the study finds evidence that adjustment is effortful and it is suggested that incentives to engage in effortful thought may diminish the adjustment-based anchoring effects.

As discussed above, the anchoring effects generated via the accessibility-based mechanism produce suboptimal results due to the inconsistent retrieval of anchor-consistent information rather than insufficient adjustment. The subconscious reasoning is self-determining with no need for attentional demand and deliberate adjustment procedures. However, when it comes to the anchoring and adjustment heuristic, it appears that a lack of adjustment of the “self-generated” reference point may lead to anchoring effects. Consequently, in the context of anchoring effects in valuations, the adjustment-based anchoring is the main subject under study.

### *2.3.2 Anchoring to asking price*

Northcraft and Neale (1987) first studied the anchoring effects on property pricing decisions and found that the decisional heuristics and biases were similar to decisions in a

previous laboratory setting. According to the authors, anchoring is particularly relevant to a sale transaction as the bargain setting of property values is influenced by the sellers' asking or listing price of a property. This asking or listing price is generally viewed as the seller's best estimate of the property value and is used as a starting point in the negotiation process. The empirical study reveals evidence that both novice and expert subjects, irrespective of sex, age and years, used the anchoring and adjustment estimation strategy. In their experimental study of overconfidence in estimation, Block and Harper (1991) also advocate Northcraft and Neale's (1987) observation that people are susceptible to supplied anchoring values.

Black and Diaz (1996) and Black (1997) examine the negotiation process in real property and support the existence of the anchoring and adjustment approach when an asking price is made available to the subject. It is acknowledged that price determination of a property asset is a pricing problem that falls within the concept of human problem solving theory. Normatively, it is suggested that after analysing property-specific and market information, problem solvers should provide an appropriate true price that deviates from an incongruous asking price. However, during the negotiation process, the study proves that both students and professionals cognitively devalue the property and market information when exposed to inconsistent asking price information. Interestingly, even in an information-rich and negotiation context, problem solvers are susceptible to anchoring their judgement when price specific information is available to them.

An extension of Black and Diaz's (1996) research by Diaz *et al.* (1999) to typify the real estate negotiation process, found that subjects exhibit the same heuristic behaviour despite providing a performance incentive. In a negotiation setting, reward is a function of negotiation outcomes. The potential gain or loss outcomes may influence negotiators' behaviour towards a superior performance, thereby forcing them to employ better cognitively demanding, property specific and market information. Despite the use of a reward system, the experiment revealed that anchoring on the asking price was evident and conclusive. In fact, a manipulated asking price with a performance incentive resulted in both biased outcomes and inferior rewarding results.

Findings from the literature show that anchoring is present in the real estate price negotiation process. Both novices and professionals are susceptible to the anchoring effect when price specific information is available to them. In addition to the strong anchoring impact observed in novices and experts, the anchoring effect does not dissipate as the

anchor became less reliable, which shows that anchoring may be subtler in the appraisal tasks.

### 2.3.3 *Anchoring to previous estimates*

Cole *et al.* (1986) examined the appraisal value and actual sales price of various commercial properties, and observed variances of almost 9%. Smith (1986) attributed such deviations to inconsistencies in valuation procedures and practice. Empirical studies undertaken by Diaz (1990) support the non-normative approach by appraisers. The process-tracing experiment of appraisal tasks in familiar and unfamiliar geographic areas reveals that experts are likely to reverse the appraisal process from general-to-specific to specific-to-general operations.

In the face of greater market uncertainty, Quan and Quigley (1991) contend that problem solvers are likely to rely more on previous value judgements than on actual market information. Valuation judgements are based on fundamental variables such as economic growth and inflation, and market information that includes market-wide noise and transaction noise (Geltner *et al.*, 2003). When the market-wide noise is inconsistent, whether because of lack of trades or secrecy, Quan and Quigley (1991) suggest that valuers follow an optimal updating strategy by rationally weighting previous price estimates heavily to form an opinion of the market. However, reliance on historic value leads to a phenomenon known as appraisal smoothing or ‘appraisal lag’. In addition to valuation timing as two other possible explanations of appraisal smoothing, Geltner (1989) reinforces the observation of Cole *et al.* (1986) and Quan and Quigley (1991) that a lack of confidence results in a reliance on past “acceptable” value estimates.

Based on the theoretical assumption of Quan and Quigley (1991) and Geltner (1989), various empirical studies were undertaken to examine the contention of anchoring behaviour by novice and expert valuers. Diaz (1997) used a two-factor experimental design to test the contention that apprentice and expert appraisers demonstrate anchoring behaviour when provided with the previous value estimate of an anonymous expert in a geographically familiar setting. The controlled experiment found no evidence of the anchoring behaviour contention by either apprentice or expert valuers. This finding contradicts previous studies by Northcraft and Neale (1987), Black and Diaz (1996) and Black (1997), which observed that apprentices rely on previous value judgements as valuation cues. Similarly, the most recent experiment undertaken by Havard (2001b) shows

that novices do in fact use knowledge of previous transaction prices when forming an opinion.

Using a modified real world appraisal settings version of Diaz's (1997) experimental task, Diaz and Hansz (1997) examine the behaviour contention of appraisers in geographically unfamiliar settings. The findings reveal that subjects are influenced by valuation opinions of anonymous experts. This result reinforces the observation of Quan and Quigley (1991) and Geltner (1989) that when faced by uncertainty, appraisers cognitively devalue market information and rely heavily on previous value estimates in making a new value judgement.

The appraisal process only sanctions the closed or completed transaction prices of comparable properties but valuers sometimes express the opinion that value opinions of other experts (unsanctioned reference point) or contract prices (implicitly sanctioned reference point) may be used in the valuation process to form an opinion (Diaz & Hansz, 2001). Initially, Ferguson (1988) investigated the after-sale evaluation of residential evaluation and found evidence of the behaviour contention towards appraising property according to contract prices. Later, Diaz and Hansz (2001) built upon Diaz and Hansz's (1997) work to examine the effect of unconventional reference points of the value opinions of other experts and unclosed contracts in the value judgement process. As suspected, the research reinforced a previous observation that when faced with increased uncertainty, valuers tend to rely heavily on other reference points. The degree of anchoring effect is observed to be in proportion to the normative appraisal procedures whereby valuers tend to be more influenced by unclosed contract prices on comparable properties, than on an unclosed contract price on the subject property, and least influenced by unsanctioned value opinions of other experts.

In addition to contract prices and value opinions of other experts, valuers are susceptible to being inappropriately influenced by their own previous value judgements. Diaz and Wolverton (1998) used a fixed effects experimental design whereby two randomly assigned participating subjects were asked to provide value estimates for a subject property at two different time intervals. The empirical experiment indicated that expert appraisers, who initially provided a value opinion, were likely to anchor to their previous value judgement and make insufficient temporal adjustment when providing a second-time appraisal. Similarly, in commercial property valuation, Clayton *et al.* (2001), and Hansz and Diaz (2001) observed the rational behaviour of valuers relied more heavily on older transaction price data than on uncertain information data. The general evidence of a

tendency to constructing or employing to one's own estimate leads to an anchoring effect in valuation that introduces the potential for bias.

This section highlighted the susceptibility of expert valuers to a variety of past estimates. When faced with uncertain situations, valuers appear to substitute market information for more reliable past information. However, whether the value opinion of other experts, unclosed contract prices or an own estimate is used, the lack of adjustment in the direction of the initial value leads to biased judgement.

#### *2.3.4 Anchoring to other references*

While previous behavioural studies mostly focus on the important role of information in the valuation process, aspects of information processing may also influence judgement in valuation. In addition to the notion of anchoring effects, the 'presentational' effects may distort the value judgement outcomes. The 'presentational' effects as formulated by Einhorn and Hogarth (1985) suggest that the order and mode in which information is presented may lead to biased judgement. "Recency" effects occur when people have a tendency to rely on the most recently available information but arrive at a different conclusion when the same information is given in a different order to two individuals. Moreover, dilution arises from the manner in which facts are displayed and the receiver accepting the new evidence without making major adjustments to the data. Generally, simultaneous presentation is known to have greater impact on judgement than sequential presentation.

Given that valuation is a function of information, the way in which valuers process information is critical in forming a value judgement. A study undertaken by Gallimore (1994) on the anchoring and 'presentational' effects on valuation judgement and choice revealed the presence of both anchoring and recency behavioural tendencies. The experiment, in its simplistic form, highlights that decision makers are susceptible to anchoring their judgement on the facts that were initially presented to them. For the "presentational" effects, the experiments revealed no dilution tendency but confirmed the existence of the recency effect. However, the extent of the recency effect could only be attributed to supporting evidence rather than challenging confirmation.

Subsequent to the previous study and findings of a tendency to look for positive evidence, Gallimore (1996) examined the confirmation bias to establish behavioural contention in valuation. Confirmation bias as observed in the recency experiment was an irrational

reasoning process of valuers making them inclined to seek and to adjust evidence that is supportive to existing views rather than to negative facts. The empirical study could not support the dominance of confirmation bias in the valuation process. However, when examining the findings in isolation, the survey revealed the presence of potential confirmation characteristics such as the likelihood to arrive at an early opinion and to limit the search of comparable information.

Another cause of anchoring bias in valuations is the use of unconventional sources of information in making value judgements. Baron (1985) perceives rationality as a thinking process that uses various methods and follows a set of rules to achieve an outcome. Whether the process outcome is right or wrong may not be regarded as irrational as the underlying concept is based on the way in which a decision maker gathers and interprets information to form a belief that is coherent with the evidence available. The rational formation of beliefs depends on prior knowledge which may inherently be inappropriate. In property valuations, it is also common for valuers to use pending sale price information to complete a task. However, when comparable sales selections do not align with the known pending sale price, the use of ill-structured evidence leads to anchoring bias (Gallimore & Wolverton, 1997). Gallimore and Wolverton's (1997) cross-cultural experiment shows that pending price knowledge induced suboptimal judgement in valuers in both the United States and the United Kingdom.

Other studies also led to the belief that real estate decision makers do not necessarily follow the normative model during the decision making process. Gallimore *et al.* (2000) found that decision makers in small property companies rely heavily on private, individual contacts as important sources of information. This adaptive behaviour, which could potentially lead to availability bias and overreaction, is mainly due to their active management activities to find opportunities in their local economies and a limited resource capacity to search for information. In addition to private contacts, Gallimore and Gray (2002) contend that property investors also turn to speculative market signals. While market sentiment is essentially used as alternative source of information to support inefficient market information, bias in the form of a representative heuristic is likely to develop.

In a similar vein, Cypher and Hansz (2003) examined the extent to which expert and non-expert valuers rely on assessed values when forming value judgements. Assessed value is used to determine the value of a property for tax purposes and is generated by using a

variety of mass valuation techniques. Generally, normative appraisal theory and training do not support using assessed values due to possible limitations in mass valuation techniques that cause value estimates to deviate from market values. The findings revealed that inexperienced subjects had a tendency to anchor to sanctioned or unsanctioned reference points. However, expert valuers needing content validity, did not exhibit anchoring behaviour towards assessed value. Cypher and Hansz (2003) assert that experts know assessed values are flawed market value indicators for using as legitimate anchors.

## **2.4 Countering the anchoring effect in property valuations**

The previous discussion shows that valuers do not follow the normative models of rational thinking which explain the process and product that rational thinking should meet. It is observed that due to the limited human processing capacity, valuers have the tendency to adopt descriptive behaviour when forming judgements. However, the normative-descriptive gap, which leads to systematic bias in valuations, has now drawn researchers' attention to find solutions to mitigate and eliminate this gap. The process that seeks techniques to align the decision-making process with normative standards is termed 'debiasing' (Tidwell & Gallimore, 2014).

### *2.4.1 Debiasing techniques*

Fischhoff (1982) contends that a productive questioning strategy is generally appropriate for questioning the robustness of behavioural phenomena. Based on the destructive testing principle, productive questioning strategy takes the form of debiasing efforts when applied to behavioural phenomena. According to the author, the philosophy is based on identifying the psychological processes that must be invoked or controlled in order to improve judgement. Sources of bias are found to be related to faulty tasks, misunderstanding of tasks, and mismatch between decision-making and tasks.

Among various strategies that attempt to improve the decision quality of decision makers, Fischhoff's (1982) debiasing strategy for perfecting individual judgement is of most interest to this study. According to this underlying assumption, it is suggested that the decision-maker is the main source of biased judgement, rather than the task itself. The strategy is based on an escalation design that aims to improve human performance through the following steps:

- (1) Warn the decision-maker of possible deviation without giving a description of the type of bias.
- (2) Describe the direction (positive or negative influence) and extent of the bias.
- (3) Provide feedback and relate back to the warning message.
- (4) Provide support with feedback, such as a programme of training and coaching that will help to overcome the bias effect.

Fischhoff's (1982) debiasing framework may be applied to a number of judgemental heuristics but with the exhaustive list of biases, the taxonomy of decision biases helps identify techniques that are suitable to counter maladaptive behaviour. Arkes (1991) supports the classification of the various causes of bias into three broad categories, namely psychophysically-based error, association-based error and strategy-based error. The author argues that adaptive behaviour is characterised by costs and benefits, which reflect a rational benefit-cost calculation in decision-making. Table 1 highlights the taxonomy of judgement behaviours caused by various adaptive irrational behaviours.

**Table 1: Taxonomy of Judgement behaviours by Arkes (1991)**

<b>Types of Judgement Behaviours</b>	<b>Psychophysically-based errors</b>	<b>Association-based judgement error</b>	<b>Strategy-based error</b>
<b>Definition</b>	Errors may be manifested when individuals make irrational decisions due to maladaptive behaviours	Error relates to individual cognitive association of items that are not relevant or counter-productive to judgemental accuracy	Error occurs when decision makers use of suboptimal strategies or inappropriate rule to make judgement; generally caused by motivational system and the task complexity
<b>Causes of Judgement bias</b>	<ul style="list-style-type: none"> <li>- Sunk cost effect</li> <li>- Psychophysics of spending</li> <li>- Reflection effect</li> <li>- Anchoring effects</li> </ul>	<ul style="list-style-type: none"> <li>- Explanation bias</li> <li>- Hindsight bias</li> <li>- Ignoring</li> <li>- Confirmation bias</li> <li>- Pseudodiagnosticity</li> <li>- Overconfidence</li> <li>- Representativeness</li> </ul>	<ul style="list-style-type: none"> <li>- Anchoring and adjustment effects</li> </ul>

Unlike psychophysically-based errors and associated-based judgement errors, which are regarded as associative, fast, automatic and effortless, strategy-based errors are slower, serially driven and require significant cognitive capacity (Stanovich & West, 2000). Kahneman (2003) contends that the first two adaptive behaviours are intuitive, whereas

strategy-based error is based on reasoning, which is consciously monitored and deliberately controlled.

Based on the taxonomy of judgement behaviour by Arkes (1991), Larrick (2004) identifies three main approaches to address bias. Motivational strategies in the form of incentives and accountability help improve decision performance in some cases. The incentive approach encompasses the principle that people possessing the necessary cognitive capital will apply additional effort to improve outcomes. Equally, accountability, based on the principle mechanism of pre-emptive self-criticism, improves decision making through the motivational effects of social benefits. However, responding to the incentives and accountability approaches may also produce opposite effects. For instance, Larrick (2004) argues that incentive strategies may lead to a ‘lost pilot’ effect where unnecessary evidence is used during the decision-making process. Similarly, accountability may lead to biased rationale-construction or the effect of exacerbating justification-based decision biases.

Another strategic approach is to adapt cognitive strategies in the form of “consider the opposite” and training. The “consider the opposite” approach relies on individuals to apply different views that address the ill-structured processes of associated-based error (Chapman & Johnson, 1999). Mussweiler *et al.* (2000) support this approach as it directs attention to alternative evidence that may not have been considered, overconfidence and accessibility-based anchoring effects. Larrick (2004), however, argues that an over-reliance on this technique may affect decision-making accuracy or cause decision makers to believe in such initial biased judgement. The other form of cognitive strategy is training to facilitate the learning and application of normative rules. Proper training can also help decision-makers understand heuristic behaviour and to develop the necessary skills to eliminate biased decisions.

Technological strategies in the forms of group decision-making, application of linear models and decision analysis can also improve the decision-making process. It is argued that while using the group decision system, synergies emerge from experts’ interaction and a system of error-checking improves the decision outcome. Similarly, using statistical techniques such as the multiple regression analysis is beneficial in assessing large data sets and analysing alternative outcomes where human processing capacity is limited. Of utmost importance is the use of computing technology to automate much of the decision analysis. Decision support systems are arguably much more efficient as the systems reduce the cost of efforts, which hence brings an effort-accuracy trade-off (Edwards & Fasolo, 2001).

For valuation tasks that are complex in nature, adopting a socially administered practice (motivational techniques) or an individually administered practice (cognitive strategies) is impractical (Larrick, 2004). Epley and Gilovich (2005) also argue that self-generated anchors using an arbitrary value are essential in forming a value judgement and that setting aside with cognitive strategies is counterproductive. While a systematic study of cognitive heuristics can provide normative recommendations, Gigerenzer (2004) contends that it will be difficult to know whether the solutions are feasible. As such, it is suggested that debiasing strategies should be geared towards refining the psychological processes (Epley & Gilovich, 2005). Technologists regard debiasing strategies, in the form of decision support systems, to be better at improving the psychological processes. Therefore, the next section examines the efficiency and effectiveness of decision support systems on real estate valuation.

#### *2.4.2 Decision support systems*

The notion of bounded rationality posits that human rational decision-making is limited by both knowledge and computational capacity (Simon, 1972). Gigerenzer and Selten (2001) point out that the model of bounded rationality suggests that information may be searched either within internal memory or externally. Information retrieved externally generally provides cues that help verify the internal order of beliefs or suggestion.

With the evolutionary advancement of information technology, computerised systems have developed from management information systems to decision support systems that attempt to improve the effectiveness of decision making (Arnott & Pervan, 2005). Among the various systems that have been developed to assist individual or group decision making are personal decision support systems, group support systems, executive information systems, online analytical platforms, processing systems, data warehousing and business intelligent systems. The aim of decision support tools is to provide an interactive platform whereby computerised systems provide assistance by automating the structured part of the problem while the individual deals with the complex unstructured elements of the decision (Silver, 1991). In fact, Todd and Benbasat (1999) view the technological tools as an additional support for decision makers to extend their bounds of rationality.

Decision support systems have various attributes that can be tailored to the type of decision-making environments they support. Silver (1988) undertook a descriptive analysis and classified the systems into three tiers: functional capabilities, user view of system

components and system attributes. The first two tiers represent the information processing capabilities and the system configuration that comprise DSS. The system attributes represent the collective statements and the component relationships in a DSS, and it is generally characterised by the types of system design. According to Silver, the system can be designed to restrict its users' decision-making processes (system restrictiveness), provide guidance in constructing and executing decision-making processes (system guidance) or provide specialised support for decision-making processes (system focus). These attributes determine the possible effect of the DSS on users decision-making processes – what users can and will do to the system.

Todd and Benbasat (1999) contend that DSS can be restricted and guide decision makers towards a normative approach. On one hand, the restricted design space can be structured to exclude certain information-processing activities, force users to employ only certain strategic approaches, restrict the execution of decision-making process or a promote a combination approach (Silver, 1990). However, the author argues that the degree of decision-making process restriction is a function of the relationship between system and user. On the other hand, the forms of guidance can be suggestive or informative in nature. Suggestive decision guidance provides decision makers with judgemental recommendations, while informative guidance provides relevant information that is important in forming a judgement (Silver, 1991).

Silver (1988) asserts that one of the fundamental concepts of DSS is its application and usefulness to the specific task settings. DSS are most effective when the particular system capabilities match the specific nature of task (Todd and Benbasat, 1999). As discussed above, the systems have various characteristics that can be tailored to support particular decision-making environments. DSS can be designed into system restrictiveness with some degree of decisional guidance. The more the systems are restricted, the lesser the opportunity for guidance, and vice-versa (Silver, 1990). With the advent of information technology, DSS have primarily focused on integrating technology into a system that supports the decisions. However, it is only recently that DSS research has realised the importance of human heuristic behaviour and its incidence on decision performance.

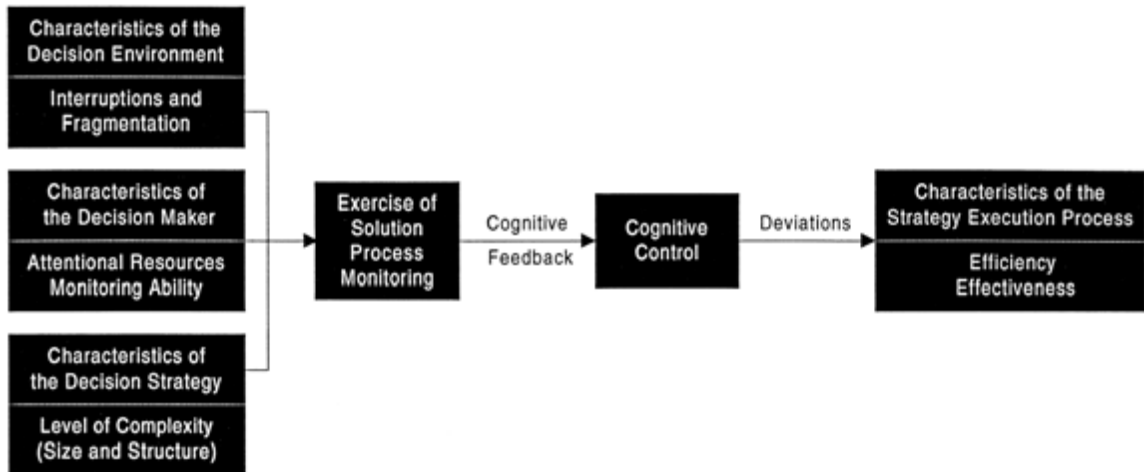
#### *2.4.3 Decision support systems with computerised cognitive aids*

The rapid advancement in information technology has brought various systems that are designed to enhance decision-making outcomes, although some pay little attention to

cognitive mechanisms. Hoch and Schkade (1996) observe that DSS research is technology-driven and mainly focuses on how decisions can be improved, while behavioural research focuses on the process of decision making. The lack of understanding of the psychological effect and the incorporation of contemporary behavioural decision-making research limits the application and usefulness of decision-support tools (Elam *et al.*, 1992 cited by Arnott, 2006).

Using the cognitive activity of pattern matching, Hoch and Schkade (1996) demonstrate that incorporating cognitive aids into a traditional decision support tools can effectively improve decisions. Pattern matching, also referred as pattern recognition, is the ability to retrieve archetypal information from the memory to match a current situation. While pattern matching can be regarded as a good strategy in a highly predictable environment, Tversky and Kahneman (1974) assert that individuals often combine pattern matching with the anchoring and adjustment heuristic when making judgement under uncertainty. The empirical study shows that in a low predictable environment, the traditional decision support systems, which support human information processing limitations via a database of historical information, produce less reliable outcomes. When combining cognitive model-based support systems with traditional decision support systems, the forecasting task in uncertain settings has better outcomes.

Similarly, Singh (1998) developed a conceptual framework to explore the efficacy of integrating aspects of cognitive aids into the technological tools for improving strategic execution. The conceptual model, shown in Figure 2, demonstrates the relationship of strategy execution and solution process monitoring to reach a successful strategy process. While strategy execution is characterised by the actual implementation of the information processing and problem solving, solution process monitoring is concerned with the vigorous monitoring and detection of potential deviation between an intended and actual activity to achieve a decision strategy. Decision-making processes are generally controlled and managed from cognitive feedback, a concept known as cognitive control. However, the author emphasises that the exercise of solution process monitoring depends upon three factors: the cognitive attributes of a decision maker (level of monitoring ability and attentional resources), the characteristics of the decision strategy (level of complexity in terms of size and structures) and the decision environment (barriers such as interruptions and delayed feedback). Unlike individual attributes, decision strategy and the decision environment are external factors that influence solution process monitoring



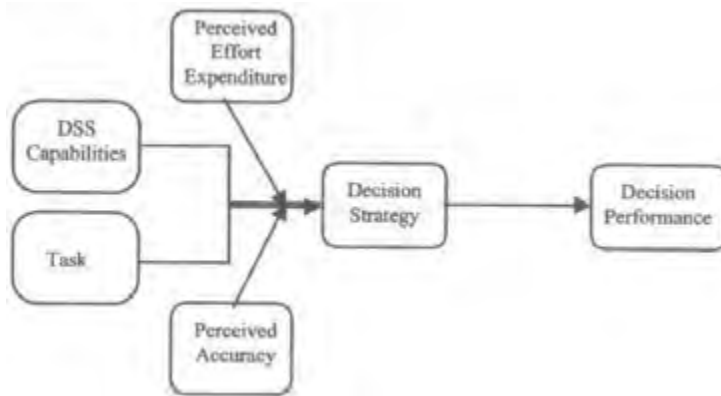
**Figure 3: Conceptual model by Singh (1998)**

Based on the above conceptual model, Singh (1998) developed two computerised cognitive support tools to compensate for the limitations of individual attributes. A memory support was designed to support attentional resources and a strategy support comprising graphic representation using a flowchart-type representation on the computer system was used to compensate for monitoring ability. The empirical study reinforces Hoch and Schkade's (1996) observation that combining computerised cognitive support can effectively improve the outcomes of dysfunctional behaviours.

#### *2.4.4 Decision support systems and the cost-benefit framework of cognition*

The theory behind the cost-benefit framework asserts that decision making is contingent upon the effort required to make a decision and the accuracy of the outcome (Beach & Mitchell, 1978; Payne, 1982). The trade-offs between accuracy and effort in decision making are largely supported by various empirical studies, simulation and conceptual studies (Todd & Benbasat, 1991). Todd and Benbasat (1999) developed a model to highlight the relationship of DSS and decision performance. The model (Figure 3) suggests that the nature of task and the degree of DSS capabilities influence the decision performance. However, the level of decision performance is likely to be influenced by the type of system design (restricted design space and decisional guidance), and the perceived effort expenditure and perceived accuracy. Previous empirical studies undertaken by Todd and Benbasat (1991, 1992, 1993, 1994a, 1994b) support the interrelationship of DSS capabilities, task, effort trade-off and decision strategy as shown in Figure 4. In fact, Todd

and Benbasat's (1999) findings support previous behavioural studies that effort is a major determinant of strategy selection.



**Figure 4: Model 1d – ‘The moderating effects of effort and accuracy’ by Todd and Benbasat (1999)**

Kleinmuntz and Schkade (1993) argue that information displays affect decision makers' choice processes through an adaptive mechanism of accuracy and effort trade-off. Visual representations are mainly characterised by the form, organisation and sequence of information, and are defined as follows:

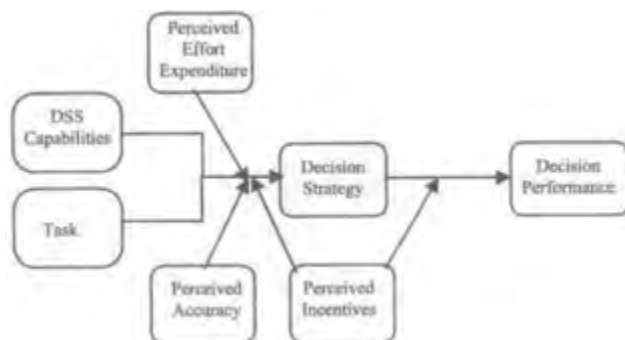
- *Form* relates to the way individual items of information are displayed (such as numerical, verbal or pictorial representations).
- *Organisation* refers to the way that individual items of information are shown in meaningful patterns or structures (e.g. table, matrices or list).
- *Sequence* denotes the order that individual items or group of items appear (e.g. alphabetical or chronological order).

A growing body of research into information presentation on decision making reveal that all three aspects of display influence the strategy choice of decision makers. Unlike previous studies that examined one feature of display at a time, Schkade and Kleinmuntz (1994) simultaneously manipulated the three features of information display. The authors found evidence of differential effects, and observed that organisation has the greatest influence on information acquisition. While form displays primarily influenced information combination and evaluation, organisation was noted as requiring the largest effort requisition by decision makers. Display sequence had fewer and smaller effects on acquisition processes.

Within the real estate literature, studies suggest that information presentation may influence decision maker perception. Havard (2001a) examines the effect of information display on heuristic bias in commercial valuation and observes that a tabulated display can reduce bias in valuation. Although the extent of its effectiveness is inconclusive, the simple fact that data presentation changes the outcome of the valuation task is highly significant for decision processes. Similarly, Jin and Gallimore (2010) observe that information display, when used to manipulate framing effects, can change an individual’s decision making processes.

Another cognitive effort trade-off is the cognitive incentive system arising from motivation. Selten (1990) observes that limits of rationality may be attributed to motivational limits, which lead to disjointed intuition and decisions. The motivational limits of rationality lead to a problem known as “acrasia” or “weakness of the will”, whereby a well-informed individual may not know the cause of action to be taken. Todd and Bebasat (1999) contend that incentives have the effect of motivating individuals to increased attention and intensified thought. The motivational effects of incentives presume that decision makers will focus more on accuracy despite the additional effort required.

Building on their previous model 1d (Figure 4), Todd and Bebasat (1999) developed model 1e (Figure 5) to argue that the role of incentives on decision performance may lead to a situation of “working harder” and “working smarter” as distinguished by Payne *et al.* (1993). As much as incentive may have a positive influence on strategy selection, the opposite may also happen. Testing the hypothesis of motivational effects of incentives, Todd and Bebasat (1999) found no evidence that incentives influence decision-makers towards the use of normative strategies. The observation was similar both with and without the decision support systems. This reinforces the cost-benefit framework of cognition that decision makers choose minimum effort over accuracy.



**Figure 5: Model 1e – Integrating the role of incentives by Todd and Benbasat (1999)**

Paradoxically, Epley and Gilovich (2005) found that incentives in the form of financial motivation and explicit forewarning of bias are effective in motivating people to put additional effort into adjusting “self-generated” anchoring. With the underlying concept that “self-generated” anchors are an effortful and deliberate process of adjusting, decision makers must be willing to go through effortful processes when provided with a financial option. Equally, since decision makers are conscious of the “self-generated” serial adjustment required, it is observed that forewarning has the effect of diminishing adjustment-based anchoring.

#### *2.4.5 Use of a decision support tool with real estate valuations*

Property valuation can be done at two levels: individual and mass appraisal. Mass valuation is commonly used to compute real estate tax. This valuation approach is applied to groups of properties having similar characteristics and it uses automated valuation models (AVM) (Kontrimas & Verikas, 2011). Unlike mass valuation, manual valuation software lacks the computational intelligence-based techniques. Lausberg and Dust (2015) contend that, other than leading software packages such as Argus or Cougar, which provide sophisticated information handling abilities, none of the usual manual valuation software provides the necessary support for decision-making. Hence, to determine a suitable tool for the study, the manual valuations tool used by recent research is discussed.

Using the same experimental concept undertaken by Northcraft and Neale (1987), George *et al.* (2000) built real estate appraisal decision support systems to examine the systems’ efficacy in mitigating and eliminating the anchoring and adjustment bias. Their findings reinforced Northcraft and Neale’s (1987) observation that subjects are susceptible to anchoring effects when exposed to an anchor value. Use of a computer-based DSS, however, did not support assumptions that with the assistance of an automated system, the strength of the anchoring and adjustment bias would be reduced. According to the authors, the speculative reason for anchoring and adjustment to remain robust lies within the design of the computer-based system. An understanding of the rationalisation of the process and better debiasing techniques are required for improvement.

Contrary to the findings of George *et al.* (2000), recent empirical studies by Tidwell and Gallimore (2014), and Lausberg and Dust (2015) show that a decision support tool can be effective in debiasing valuation judgement. Tidwell and Gallimore (2014) use an existing

proprietary tool, CoStar, to examine the efficacy of decision support tools in debiasing valuation judgements in relation to industrial vacant land. They use a two-factor randomised experiment comprising a previous expert's opinion and the introduction of a decision-support tool. Unlike the control group that had access to the software, the non-control group exhibited evidence of asymmetric and divergent results. The experiment supports evidence that use of a computer-based system may subdue the anchoring heuristic in the valuation task.

Another interesting finding by Tidwell and Gallimore (2014) is that decision support systems encourage extensive consideration of available market information during the judgement process. A previous study by Diaz *et al.* (2004) revealed that valuers operating in unfamiliar markets are unlikely to increase comparable sales search. The lack of sale search effort reinforces Simon and Newell's (1971) theory that people seek cognitive efficiency and reduce cognitive effort when faced with a complex situation. This observation, however, was made without the use of easily accessible external tools. With the decision support tool, Tidwell and Gallimore (2014) observe and support technologists' view that high informational search costs can potentially be reduced thereby encouraging subjects to use more comparable sales information during the valuation task.

Lausberg and Dust (2015) use an income approach and a self-written decision support tool to assess the market value of an office building, incorporating an MS Excel spreadsheet integrating features of decision processes effective in reducing the anchoring effects and other biases. Contrary to Tidwell and Gallimore (2014), who use a factorial experiment to measure the anchoring effect, the experiment mainly seeks to assess the reaction of subjects with the introduction of decision support tools. The software consists of three levels of intervention that differ in degree of support, namely:

- Standard (STD) version providing no support for identifying anchors
- Modified (MOD) version introducing a simple warning message and explanation of the anchoring effect so that test subjects can adjust their value opinion with a sliding switch
- Decision Support Systems (DSS), which is a full support system intending to produce more reliable outcomes.

The experiment shows that with a fully supported DSS, the anchoring effect and valuation variation can be reduced. The DSS version produced more accurate market values with less

dispersed results than the standard and modified versions. Lausberg and Dust (2015) assert that variability is reduced because users are required to follow normative procedures and are forced to spend more time on decision making. In fact, with the requirement to compare market data sources, readings and data input to make a rational opinion, it is observed that processing time is longer with DSS than MOD versions.

On the other hand, the results were less convincing using only the modified version; the frequency distribution graph shows a distribution with outliers. While Lausberg and Dust (2015) presume that the warning message may not have been explicit enough or may have caused confusion, a similar study by George *et al.* (2000) shows that use of a warning message only is not sufficient to address the anchoring effects.

Another interesting observation made under this study is that no significant difference was found between sample groups using the decision support tools. When exposed to the DSS, the results for both novices and experts were less dispersed than with the other versions. The Lausberg and Dust (2015) study clearly provides the necessary tool for further investigation to be undertaken.

## **2.5 Summary of literature**

Valuation decision making emerges from the literature as characterised by human judgement and a degree of inaccuracy, with variation in valuations being arguably inevitable. The systematic and consistent difference between valuations and transaction prices leads to bias in valuations. The implications of valuation inaccuracy affect most players in the property market and may lead to financial repercussions for the economy at large.

Of particular interest is variability of opinion in that two or more valuers assessing the same property under similar settings produce different values. From Tversky and Kahneman's (1974) early work, behavioural research reveals that due to limited processing capacity, humans use cognitive shortcuts during the valuation process. Generally, when market information is limited and the cost of effort is high, subconscious reasoning behaviour is triggered as a strategy to be cognitively efficient.

The tendency towards an anchoring and adjustment heuristic is prominent in real estate valuation. Epley and Gilovich (2006) contend that the anchoring and adjustment heuristic prompts different psychological processes that lead to conscious and deliberate processes,

but for which serial adjustment is slower and cognitively demanding (Stanovich & West, 2000). Various empirical studies demonstrate that subjects have a tendency to rely on asking price, previous estimate or other unconventional reference points when making value judgements. The anchoring effects resulted from a lack of adjustment of the original arbitrary anchor value.

In support of a set of internal beliefs, external decision support tools are regarded as effective in reducing search and processing costs. A growing body of research shows that technological strategies in the form of decision support systems may be effective in countering the anchoring and adjustment effect. However, the tools must be geared towards addressing the process of decision making, rather than the task. For valuation tasks, personal decision support systems should be designed to support information and guide decision-makers towards the normative approach. In light of the trade-off between accuracy and effort, information display and incentives can help improve decision performance.

## **CHAPTER 3    METHODOLOGY**

### **3.1    Introduction**

This chapter covers the research approach appropriate for addressing the research question posed in chapter one, namely:

*To what extent can the decision support systems help reduce or eliminate property appraisal bias?*

The discussion begins with a broad background of research methodologies leading to the research method adopted in this study. The research instrument is then explained in detail, followed by the empirical assumptions to be tested. Finally, the experimental procedures that test the hypotheses are described.

### **3.2    Outline of research methods**

To test the questions and hypotheses in a study, three research approaches are usually used: qualitative, quantitative, and mixed method research. Creswell (2014) states that qualitative research explores and forms an observation of individual's or group participant's social, beliefs, thoughts or perceptions. Such research generally looks at variables in their natural setting and provides an exploratory view of the problem.

Quantitative research is more concerned with testing objective theories by investigating the association among variables (Breakwell *et al.*, 2012). This approach examines observable phenomena using mathematical and statistical techniques to support or refute a hypothesis. Creswell (2014) contends that the quantitative approach is usually used to quantify and assess attitudes, opinions, behaviours and other defined variables before and after an experimental treatment.

Mixed method research (also called multiple methodology or multi-methodology research) involves a combination of philosophical assumptions and theoretical frameworks to form a comprehensive understanding of the problem (Creswell, 2014). In this case, both qualitative and quantitative techniques can be combined into sequential, concurrent, transformative or other variations of procedures.

The main objective of this study is to support or refute the theoretical argument that DSS can reduce or eliminate the anchoring and adjustment effect in property valuation. Previous

studies provide the necessary philosophical assumptions that behavioural contention in property valuation is mainly caused by the cognitive mechanism of anchoring and adjustment heuristics. Hence, to test the theoretical framework that the DSS improves the valuer decision performance, a quantitative research approach is appropriate for this study.

### **3.3 Justifying the experimental method**

Within quantitative methods, the survey or experimental design can be used to test relationships among theory variables. Creswell (2014) states that survey design provides researchers with a tool that helps draw conclusion relating to trends, attitudes or opinions of a population from an observed sample of that population. Experimental design, on the other hand, is mainly used to make ‘causal attributions’ (Abbott and McKinney, 2013), that is, manipulating the independent variable and measuring the effect of such manipulation on the dependent variable, while keeping other variables constant (Breakwell *et al.*, 2012). Diaz (1997) asserts that with control of extraneous factors, experimental design provides tight focus on the impact of independent variables upon dependent variables.

From chapter two, it emerges that most behavioural research in property valuation uses experimental design. Therefore, to test the efficacy and effectiveness of DSS on value judgements, the next section examines the experimental instrument used in this study.

#### *3.3.1 Overview of experimental methods*

Experimental research is a systematic approach that studies behaviours (dependent variables), when some factors (independent variables) are manipulated under the control of the experimenter, while other factors are held constant (extraneous variables) (Goodwin, 2009). Breakwell *et al.* (2012) contend that independent variables must have at least two levels of condition or situations that can be used to compare the intentional manipulation of variables. One group should comprise a treatment variable (experimental group) while the other group would have no treatment intervention (control group).

Within the experimental context, researchers recognise that experimental methods dealing directly with people may have ethical implications. Abbott and McKinney (2013) highlight three specific aspects of experiments that must be considered. First, experimenters must ensure that the paradox, manipulation of potential benefits and denial of potential, must not cause harm to subjects, whether they are part of a control or a treated group. Secondly, use of deception in a study with the intention of changing a subject’s expectation of the true

purpose of the study must be used such that the potential outweighs potential risks. Finally, it is suggested that experimenters must debrief subjects when deception is used in an experiment. Debriefing helps subjects understand the true purpose of the study.

Abbott and McKinney (2013) assert that experiments can be done in different settings, namely, laboratory, field, natural/disaster and survey experiments. In laboratory experiments, experimenters have the control required to study the relationship between independent and dependent variables, while eliminating exogenous factors that may contribute to some source of error. Field experiments are studies undertaken in natural settings (real life) where researchers can examine people's reactions to an experimental or control treatment. However, for experiments that cannot be engineered without causing disruption or unethical issues, field experiments lend themselves to the natural/disaster experiment. Simply stated, natural/disaster experiments are field experiments that prompt study only when a natural event occurs. Finally, survey experiments take place in the context of surveys where researchers use carefully selected words or phrases to measure the concept.

The laboratory method is of interest to behavioural research. Winkler and Murphy (1973) state that research into human behaviour in inferential and decision-making situations uses the laboratory setting to examine relationships among variables. Psychologists and others argue that controlled environments provide simple solutions for analysing and drawing specific conclusions on a typical subject. However, the criticism about the simplicity and artificiality of the instrument leading to generalising the results in a real-life setting is questionable.

Citing social psychologist, Elliot Aronson (2007), Goodwin (2010) highlights the difference between mundane and experimental realism. Mundane realism refers to experimental settings and procedures designed to mirror the physical and social characteristics of a particular real-life experience. Experimental realism, on the other hand, is the extent to which an experimental situation is realistic and by which participants are caught up in the experiment. According to Aronson (2007), the experimental realism approach is likely to encourage and force participants to produce outcomes close to reality (Goodwin, 2010, citing Aronson, 2007). In fact, Berkowitz and Donnerstein (1982) argue that many experimental social psychologists support the experimental realism approach over mundane realism as it captures the necessary theoretical variables that influence participant behaviour.

Another criticism of laboratory experimental methods is participants' reactivity threats that leads to biased outcomes. Goodwin (2009) contends that unlike naturalistic investigation, participants in laboratory experiments are likely to come with all sorts of preconceptions and form an expectation of the outcomes leading to a phenomenon known as the Hawthorne effect. Breakwell *et al.* (2012) assert that participant bias may occur in several ways and notorious threats include evaluation apprehension, the Pygmalion effect (also called the demand characteristic) and the John Henry effect. Evaluation apprehension refers to participants' inconsistent response to an experimental situation due to their knowledge and fear of being evaluated by the experimenter. Similarly, the Pygmalion effect arises from the experimenter's expectation and beliefs that cause participants to behave in a similar way as the experimenter hypothesises. The John Henry effect relates to bias response as a result of participant awareness of the type of conditions or situation they have been assigned to.

In order to deal with inconsistent responses, Goodwin (2009) suggests that demand characteristics must be reduced by way of deception or manipulation checks. Deception is generally used to induce subjects to behave more naturally while a manipulation check can be employed to identify and minimise demand characteristics. Alternatively, blind or double-blind procedures can be used to minimise participant bias (Breakwell *et al.*, 2012). The concept behind the blind procedure is ensuring that people involved in the study are unaware of the arrangement. A single-blind procedure limits participants' knowledge to their assigned group, while a double-blind procedure controls both participant and experimenter knowledge of the conditions assigned and administered during the experiment.

### *3.3.2 A review of the experimental instrument used in property valuation.*

Within the valuation field, early behavioural studies on the anchoring and adjustment heuristic in valuation widely used the experimental methods to support the cognitive mechanism employed by subjects. Northcraft and Neale (1987) initially used the field experiment combined with a questionnaire to examine pre-determined values (appraisal value, listing price, purchase price and lowest offer) on pricing decisions. The questionnaire was used to provide dependent measures for the study, while the independent variables consisted of four experimental conditions: low-priced, moderately low-priced, moderately high-priced and high-priced. In addition to supporting the presence of the

anchoring and adjustment heuristic, the study revealed that laboratory experiments may produce similar results to a “real world” experiment.

In a similar vein, Diaz *et al.* (1999) modified Black and Diaz’s (1996) experiments to include a system of performance incentives typifying real life negotiating settings. Diaz and Wolverton (1998) argue that an experimental setting that excludes financial incentives may dampen the real world setting as incentive may act as a motivation for an appraisal exercise. To test the hypothesis that laboratory setting produces similar outcomes as “real world” experiment, Diaz *et al.* (1999) incorporate a reward incentive mechanism in their experiment to compensate participants as their performance improves. With the expectation that a reward system is likely to motivate participants to follow the normative process, the modified experimental design reveals no change in attitude towards the anchoring and adjustment heuristic.

To test the efficacy of decision support systems on valuation performance, George *et al.* (2000), Tidwell and Gallimore (2014), and Lausberg and Dust (2015) adopted similar controlled experimental methods. George *et al.* (2000) used Visual Basic 4.0 software to examine the impact of DSS on participants. The design instrument was similar to Northcraft’s (1987) but with digital photographs forming part of the software. In addition to structuring information into a normatively sequential flow, a “warning” was introduced at four different points of the process. A two-by-two, full-factorial model was used, with independent factors being an anchor (either high or low) and the presence of a warning (either with or without). Cash prize incentives for motivational performance and a deception technique informing the participants that the purpose of the experiment was to test “*the possible effectiveness of the World Wide Web as a means of conducting a real estate transaction*” (George *et al.*, 2000: 201) were also used. Despite introducing elements that could potentially improve performance, the experiment was not conclusive as the anchoring and adjustment bias was still noticeable.

In a similar attempt to contextualise a real business problem into an automated technological system, Tidwell and Gallimore (2014) used a propriety software, CoStar. The experiment was a two-factor randomised experiment, with the reference point of a previous value judgement of an anonymous expert administered at three levels of treatment (high, low and no reference). Unlike George *et al.* (2000), the study comprised experts with no knowledge of the task settings. The result shows that, in thin market task settings, using DSS effectively influences the outcomes of the valuation exercise.

Lausberg and Dust (2015) undertook an improved version of a controlled experiment. The authors used the MS Excel package to administer the experiment to two broad groups (control and treatment group). Similar to the two previous experimental designs, the self-written valuation software, typically used by most South African valuers, comprises three sheets, namely:

- A cover page with some basic information
- A working sheet, consisting of data entry and a calculation sheet
- A questionnaire used to collect personal data.

In lieu of using the asking or listing price (George *et al.*, 2000) or the previous value judgement of an anonymous expert (Tidwell & Gallimore, 2014), Lausberg and Dust (2015) use the book value of the property as an anchor value. To avoid biased results, the anchor administered was purposely set low as a previous study by Hansz and Diaz (2001) demonstrated a natural tendency to anchor towards higher values. The experimental treatment comprises three degrees of decision support interventions: standard, modified and decision support systems.

The standard version provided no support and displayed mandatory fields to calculate the market value of the subject property. The modified version comprised some aspects of support to provide warning and explanation of the anchoring bias – in this case, subjects could adjust their values with a sliding switch. Finally, the DSS version consisted of a fully supported system that, for instance, offered subjects an opportunity to evaluate quality of information and provide graphical presentation for performing the valuation task.

### *3.3.3 Conclusions*

An overview of recent studies shows that Lausberg and Dust's (2015) research methods are appropriate for this research. Their approach provides a simple focus to measure the impact of independent variables (the degree of decision support systems) on dependent variables. Besides, the self-written program is convenient to use as most South African valuers use MS Excel software to complete independent valuation tasks.

### **3.4 The research instrument**

This section describes in detail the research instrument used to collect data for the study. The experimental design is extensively based on the Lausberg and Dust (2015) design, with some modification to suit the South African property valuation context.

#### *3.4.1 The sample*

The sample group consists of both expert valuers and novices. Registered professional valuers from the SACPVP were designated as expert participants. The SACPVP members were selected because of their high level of accomplishment in the South African valuation industry and their rigorous educational and experience competencies complying with the normative procedure for a value judgement. The other group consisted of final-year undergraduate and postgraduate students studying construction studies, property studies and quantity surveying degrees at the University of Cape Town (UCT), and who have acquired the technical ability to complete a valuation.

Unlike the Lausberg and Dust (2015) experimental study, which uses three levels of categorical variable, this study only uses the standard (STD) and DSS software versions. It was observed that under the previous study, use of modified versions did not produce conclusive results. The modified version produced a higher variation coefficient than the other two versions, which meant that a simple warning message was not sufficient to reduce valuation variation. Hence, omitting the modified version should provide a better sample group for the experiment, which in turn is likely to produce better results for determining the effectiveness of DSS on valuation quality.

To increase response rates, an incentive approach was implemented. Participants of the study were informed of the possibility of winning an iPad or one of three iPods via a random draw. In addition to the prize, an hour of continuing education and training, approved by the SACPVP, was granted to all expert participants.

#### *3.4.2 The subject property*

For the property valuation exercise, a senior property valuer with 25 years' experience in the Cape Town office market provided information on the subject property and market data. To avoid unwanted bias, care was taken to provide information related to a real-world

case valuation scenario. The subject property is an office property in Cape Town CBD with the following specific features:

- Type of property: office building
- Size: five units with a lettable area of 1,368 sqm
- Age of building: 10 years' old
- Different lease outlet: a vacant unit and four units with lease terms between one and nine years
- Tenancy information: law firms with a good credit record
- Locational attributes: within the Cape Town CBD and in close proximity to the high court
- Other attributes: noise level and visibility aligned with law firm particular use
- Other information: current expenses and 10 outdoor parking spaces.

The subject property was assumed to have a high rental ability, normal maintenance costs and a long useful life. This scenario was necessary to avoid misjudgement by subjects, hence avoiding systematic error.

To prevent results being distorted due to difference in market knowledge, a memorandum containing all information related to the subject property and the market area data was issued to subjects (Appendix A). The memorandum contained the following information relating to the subject property:

- General information
- Location and site description
- Minutes from the site visit and the briefing by the owner
- Market information comprising:
  - Comparable rental data of properties located within the area and from various sources
  - General office market outlook
  - Comparable parking rents from Rode's publication.
  - Operating expenses from South African Property Owners Association (SAPOA) publications.
  - Capitalisation rate from Rode's and SAPOA publications.

Unlike Lausberg and Dust (2015) who used book value as an anchor value, this study uses a value from an alleged property valuer and the pending sale price. In the South African property market, book value is not a good proxy for transaction price as it refers to the net worth of a property according to its financial statements. Similarly, assessed values, used to determine the value of a property for tax purposes, are inappropriate to be used as an anchor value for the study (Cypher & Hansz, 2003). Therefore, to create some content validity for subjects to use the reference value, the memorandum refers to the anchor value as the owner pending sale price and unsanctioned expert valuation opinion of eleven million rand. Similar to Lausberg and Dust (2015), a low anchor value was used.

### 3.4.3 The software

The software is an adaptation of Lausberg and Dust's (2015) experimental MS Excel design but with information relevant to the South African property market. The assessment programs comprise a standard version (STD) and the DSS version. When the Excel version is activated, the first page (Appendix B) provides general information and instructions to start the experiment. The second page provides an interface for calculating market value and the last page (Appendix C) collects statistical data. Figure 6 indicates the calculation interface for both the STD and DSS versions.

<b>INCOME APPROACH</b>			
	Potential Gross Income		
	Rental Income	<--- Decisions	[Sub-Hypothesis No 1]
	Other Income (parking lots)	<--- Decisions	
-	Vacancy and Collection Losses	<--- Decisions	
=	<b>Effective Gross Income</b>		
-	Operating Expenses	<--- Decisions	[Sub-Hypothesis No 2]
	Rates and taxes		
	Insurance		
	Cleaning & Security		
	Leasing commissions		
	Maintenance allowance		
	Property management		
=	<b>Net Operating Income</b>		
x	Capitalization Rate	<--- Decisions	[Sub-Hypothesis No 3]
=	<b>Provisional Market Value</b>		
+/-	Adjustments	<--- Decisions	
=	<b>Market Value</b>		

Figure 6: Calculation core for the STD and DSS versions

In the standard version, the second interface (Appendix D) provides a basic set up with mandatory fields for calculating market value. The participant enters figures from the

documents into the software once data has been interpreted and analysed. In this version, decisions arising at various level of the decision-making process are not supported by the program.

The decision support tool provides various features of decision support systems within the basic spreadsheet (Appendix E). To avoid deviation from the normative approach, the DSS version provides a process orientated procedure, highlighting each step to be undertaken to complete the valuation tasks. Various graphical displays, emoticons, comparable tables, explanations and data analysis features provide subjects with necessary support to evaluate the quality of market data. Besides, warning messages and plausibility checks were incorporated into the software for attentional and correctional measures for data input that seems inappropriate. In addition to the decision supports provided at various decision levels, the DSS version included a “final sanity” check feature that explains the anchoring effects and allows subjects to adjust their estimate using a slider.

### **3.5 Hypotheses and objectives**

The hypotheses to be tested are summarised as follows:

#### **Main hypotheses**

- (1) The valuation variation is lower if the valuer is debiased and supported in his decisions
  - H1: Variation  $MV_{STD} \leq$  Variation  $MV_{DSS}$
  - H0: Variation  $MV_{STD} \geq$  Variation  $MV_{DSS}$
- (2) The anchoring effect is reduced if the valuer is debiased and supported in his decisions
  - H1: Mean Unadjusted  $MV_{STD} <$  Mean Adjusted  $MV_{DSS}$
  - H0: Mean Unadjusted  $MV_{STD} >$  Mean Adjusted  $MV_{DSS}$

#### **Sub hypotheses**

- (a) Market rents have lower variation with the DSS version.
  - H1: Variation  $MR_{DSS} >$  Variation  $MR_{STD}$
  - H0: Variation  $MR_{DSS} <$  Variation  $MR_{STD}$

- (b) Operating costs have a lower variation with the DSS version.
- H1: Variation  $OPTCOST_{DSS} > Variation OPTCOST_{STD}$
  - H0: Variation  $OPTCOST_{DSS} \leq Variation OPTCOST_{STD}$
- (c) Capitalisation rates have a lower variation with the DSS version.
- H1: Variation  $CAP.R_{DSS} > Variation CAP.R_{STD}$
  - H0: Variation  $CAP.R_{DSS} \leq Variation CAP.R_{STD}$

### 3.6 The empirical procedure

To ensure that the experiment is valid and free from error, a test run was done with random subjects from the built environment professions. In addition to gaining feedback on the software, the trial check helps determine whether the specific MS Excel software is compatible for PC and Mac computers. It also ensures that the tools will perform well in various environments such as PC/Mac, desktop/tablet or small/large screen resolution. From this exercise, it was noted that some subjects struggled to start the program or the mailing option did not work properly. In both cases, additional instructions were provided to participants to (1) ensure they enable all contents and macros once the MS Excel file was opened and (2) save and email the file directly to us for debugging of data.

For the formal experimental stage, a random sampling method was used to distribute one of the two versions of the valuation tool to treatment groups. The random selection method ensures that no systematic errors occur in the data collection as every member has equal probability of being selected. Both the STD and DSS versions were issued equally to treatment groups. For novices where the sample size was known, a list of participants was drawn up and number one and two assigned equally to them. Participants with an even number received the standard version, the others received the DSS version. To reach expert participants, the South African Institute of Valuers (SAIV) was contacted. Unlike novices, contact details for expert participants are confidential. The SAIV was asked to help divide members' registration numbers into two groups, with instructions then given to participants to select a link associated with their registration number to download the test treatment from the Dropbox website.

Data was either received from the supervisor's mailing address or through Google drive. On a daily basis, the raw data was debugged and updated into a master MS Excel file. Where data was similar, due to participants issuing the file both online and via the mailing

option, one of the files was marked and removed from the next step. Then, a plausibility check exercise was carried out to identify and eliminate extreme outlier data or data with obvious input errors. The data cleaning processes help exclude systematic errors for the data analysis stage.

### **3.7 Chapter summary**

Chapter three described and supported the research instrument for the study. It first outlined the three types of research methods. Then the research method to be implemented was critically reviewed and discussed within the property valuation research context. It also provided the empirical procedure applied to solve the main problems and sub problems of the research objectives. The following chapter presents and discusses the data gathered during the experiments.

## **CHAPTER 4 ANALYSIS OF DATA**

### **4.1 Introduction**

This chapter reports on the findings of the experimental study outlined in Chapter 3. It begins with a description of the data collection method and reports on the response rate received. The data is then examined and statistical tests relevant to the research hypotheses are described.

#### **Main hypotheses**

- (1) The valuation variation is lower if the valuer is debiased and supported in his decisions.
- (2) The anchoring effect is reduced if the valuer is debiased and supported in his decisions.

#### **Sub hypotheses**

- (a) Market rents have lower variation with the DSS version.
- (b) Operating costs have a lower variation with the DSS version.
- (c) Capitalisation rates have a lower variation with the DSS version

### **4.2 Method of data collection**

Most participants were contacted via email using the UCT VULA website or through SAIV. The Professional and Projects register 2010, and direct telephonic contacts were also used to identify additional contacts, to whom information was sent.

The information pack consisted of a covering letter, an instruction document, an MS Excel file and a memorandum containing information about the subject property and the market. Novices could access the information by downloading the files from their VULA project tab; experts could download the files from a link issued in the email sent by SAIV. Weekly follow ups and direct assistance were provided during the experimental period.

The study took place over a period of 3 months for experts and 4 months for the novice treatment group. A total of 1 345 property valuers and 183 students were officially invited to the study. Ninety-three data sets were received of which 44 were from experts (3.20% rate) and 49 were from novices (26.78% rate). After the data cleaning processes, two data

sets for experts and three data sets for novices were eliminated due to repetitive data submission and obvious input errors, which led to extreme outlier market values.

Table 2 shows that 42 experts (= 3.12% response rate) and 46 novices (= 25.14% response rate) were considered valid data sets. The distribution within sub-groups was fairly balanced with 52.27% being students and 47.73% being experts. The response rate for the experts proved relatively difficult to generate a large reaction, however, one would have expected a higher response rate from students group. The main reason for achieving only a 25% response rate was the end of academic year protest that disrupted the data collection process. At the start of the new academic year, an additional 55% of the student group was added to the sub sample.

**Table 2: Number of valid participants**

	<b>Standard</b>	<b>DSS</b>	<b>Total</b>
<b>Students</b>	26	20	46
<b>Experts</b>	21	21	42
<b>Total</b>	<b>47</b>	<b>41</b>	<b>88</b>

### **4.3 Analysis of the data**

The quantitative data was analysed using the MS Excel software, statistical software package SPSS Version 23 and R Studio. Three simple variation measures were used to assess the effectiveness of the decision support tools: range, standard deviation and variation coefficient. A frequency distribution chart was also used to show the distribution of values in the sample.

To test the equality of variances, normality for the data sets is tested first. The Jarque-Bera test (jbtest) was used to measure the skewness (S) and kurtosis (K) of the sample for goodness-of-fit of a normal distribution (Bai and NG, 2015). Under normality, the skewness and kurtosis values are 0 and 3 respectively. Thadewald and Büning (2007) support that the jbtest is robust because it has good statistical power for small samples. A p-value exceeding 0.05 means that the data is almost normally distributed.

The Levene test of homogeneity of variance is performed for normally distributed data. For non-Gaussian distribution, the skewness and kurtosis are examined to determine the appropriate inferential procedure to employ. Either the modified robust Levene-type test

or the modified robust Brown-Forsythe Levene-type test from the median with modified correction-method zero can be applied.

Unlike the Levene test, which uses the mean, the modified robust Levene-test uses either the trimmed mean or the median. Brown and Forsythe (1974) observe that for heavily skewed distribution, the median performs best, whereas for leptokurtosis distribution, it is best to use the trimmed mean. Monte Carlo studies performed by Conover *et al.* (1981), Carroll and Schneider (1985) and Lim and Loh (1996) also support that the Brown-Forsythe test provides better power and robustness against non-normality.

However, for unequal and small sample sizes, the modified robust Brown-Forsythe Levene-type test from the median with modified correction-method zero is preferred. This test is the Brown-Forsythe test adjusted using Noguchi and Gel's (2010) method, which uses a combined correctional factor with modified Hines-Hines structural zero removal method that applies a scaling factor of two.

For the assumption of homogeneity of variance not to be violated, a significance level of greater than 0.05 must be achieved ( $H_0: \text{Var}_{\text{STD}} = \text{Var}_{\text{DSS}}, p\text{-value} \geq 0.05$ ). However, the present study hopes to demonstrate that the decision support tool is more beneficial than standard tools. Hence, at the 5% significance level, the null hypothesis should be rejected and it can be concluded that there are statistically significant differences in variances between the observed groups.

#### *4.3.1 Demographic profile of respondents*

The demographic profile of respondents is outlined in Table 3. The experts group comprised people mostly under 50 years old (62%,  $n=26$ ) with up to 10 years' real estate industry experience. The majority of respondents had completed property-academic studies (93%,  $n=39$ ) and worked on their own assessments in real estate valuation (74%,  $n=31$ ).

Having primarily studied property-related subjects, the student group was on average younger than the experts group. About 76% ( $n=35$ ) were younger than 30 years old; 9% ( $n=4$ ) were in the 31–40 age group, 4% ( $n=2$ ) in the 41–50 age group, 4% ( $n=2$ ) in the 51–60 age group, and 7% ( $n=3$ ) were over 60 years old. The distribution of age also aligned with their level of experience in the real estate industry (93%, none to up to 5 years' experience) and work experience in real estate valuation (74%, none). Only 26% ( $n=12$ ) of respondents had some experience in doing their own valuation.

Understandably, novices have less knowledge of the office property market (74%, n=34) with particular reference to the Cape Town real estate market. On the other hand, expert participants have more significant experience of the office property market (64%, n=27) and a fair knowledge of the Cape Town real estate market.

**Table 3: Demographic profile of respondents**

	Experts		Students		Total	
	Quantity	Share	Quantity	Share	Quantity	Share
<b>1 Age (Years)</b>						
up to 30	9	21%	35	76%	44	50%
up to 40	6	14%	4	9%	10	11%
up to 50	11	26%	2	4%	13	15%
up to 60	8	19%	2	4%	10	11%
60+	8	19%	3	7%	11	13%
-	0	0%	0	0%	0	0%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>2 Work Experience in real estate industry (Years)</b>						
None	2	5%	29	63%	31	35%
up to 5	5	12%	14	30%	19	22%
up to 10	9	21%	2	4%	11	13%
up to 20	9	21%	1	2%	10	11%
20+	17	40%	0	0%	17	19%
-	0	0%	0	0%	0	0%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>3 Work Experience in real estate valuation (Own assessment)</b>						
None	2	5%	34	74%	36	41%
	2	5%	10	22%	12	14%
	7	17%	2	4%	9	10%
	13	31%	0	0%	13	15%
Professional valuer	18	43%	0	0%	18	20%
-	0	0%	0	0%	0	0%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>4 Knowledge of the real estate market in Cape Town</b>						
None	8	19%	6	13%	14	16%
	12	29%	9	20%	21	24%
	5	12%	16	35%	21	24%
	8	19%	15	33%	23	26%
High	9	21%	0	0%	9	10%
-	0	0%	0	0%	0	0%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>5 Knowledge of the market for office properties</b>						
None	0	0%	6	13%	6	7%
	6	14%	12	26%	18	20%
	9	21%	16	35%	25	28%
	16	38%	12	26%	28	32%
High	11	26%	0	0%	11	13%
-		0%		0%	0	0%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>6 Real estate education, training or qualification</b>						
None*	3	7%	7	15%	10	11%
Ndip Real Estate Valuations	24	57%	5	10%	29	33%
BSc (Hons) Property Studies	6	14%	18	38%	24	27%
MSc Property Studies	8	19%	15	31%	23	26%
MRICS or similar professional qualification	6	14%	3	6%	9	10%
-		0%		0%	0	0%
<b>Total</b>	<b>47</b>	<b>112%</b>	<b>48</b>	<b>100%</b>	<b>95</b>	<b>108%</b>
<i>*None refers to students with an undergrad degree in Construction Studies or Property Studies</i>						

### 4.3.2 Testing of first main hypothesis

The first hypothesis states that the valuation variation is lower if the valuer is debiased and supported in his decisions.

$$H_0: \text{Variation } MV_{\text{STD}} \geq \text{Variation } MV_{\text{DSS}}$$

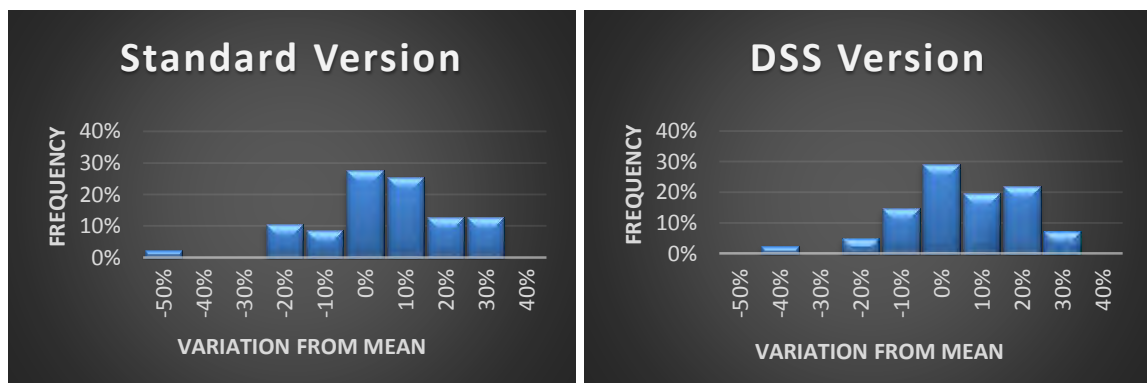
#### Testing the overall sample group

Using three variation measures, the null hypothesis should be rejected if the majority of the measures show a higher variation for DSS than for STD. Table 4 demonstrates the variation measures under the two different software versions. The market values under the STD version range from R9.82 million to R21.57 million (=120%) and are higher than the DSS version which ranges from R9.41 million to R18.9 million (=101%). Similarly, the standard deviation is slightly higher for the STD version (=2.16) than the DSS version (=1.98) and is confirmed by the variation coefficient.

**Table 4: Variation measures**

	<b>STD</b>	<b>DSS</b>
<b>n</b>	47	41
<b>Mean</b>	13.91	13.37
<b>Range (min/max/%)</b>	9.82 /21.57 /120 %	9.41 /18.9 /101 %
<b>Standard deviation</b>	2.16	1.98
<b>Variation coefficient</b>	15.6%	14.8%

Graphically, Figure 7 depicts the variation from the mean for each tool. The DSS version produced more accurate market figures than the STD version. With the exception of the outliers, the values for the DSS version were less dispersed and quite often closer to the mean. Based on the frequency distributions chart (Figure 7), there is some evidence that the decision support system can help reduce valuation variation.



**Figure 7: Frequency distribution of outcomes for market values**

To test the significance level of the results, the jbstest test was used to examine the normality of the data. The observed asymptotic p-value for the overall sample, DSS tool and STD tool, is summarised in Table 5. Interestingly, the DSS version was normally distributed, while the STD data and the overall sample were far from Gaussian distribution.

**Table 5: Normality test**

<b>Subsets</b>	<b>JB-Test p-value</b>	<b>Kurtosis</b>	<b>Skewness</b>
<b>Overall Sample</b>	0.002	1.577	0.621
<b>STD versions</b>	0.003	2.203	0.795
<b>DSS versions</b>	0.632	0.566	0.333

Using the MS Excel formula to calculate excess kurtosis and skewness, it was observed that all three subsets were fat-tailed and skewed to the right (Table 5). Given the unbalanced and small sample sizes of the data, the modified robust Brown-Forsythe Levene-type test from the median with modified correction-method zero was applied (Table 6). At the 0.05 level of significance, the null hypothesis cannot be rejected (p-value =0.885) and it can be concluded that there is no statistically significant difference of variance between the two groups.

**Table 6: Modified Robust Brown-Forsythe Levene-type test**

<b>Hypothesis</b>	<b>Test-Statistic</b>	<b>p-value</b>
H <sub>1</sub> : Var <sub>STD</sub> = Var <sub>DSS</sub>	0.0212	0.885

### **Testing the sub-sample**

The same variation measures and test for significance level were used to test the effectiveness of the DSS version within the expert and student sub-samples. As shown in Table 7, the variation measures for both groups were higher under the STD version than under the DSS version.

For the experts group, the market values ranged from R14.52 million to R21.57 million (=78%) with the STD version, and ranging from R11.5 million to R18.9 million (=64%) under the DSS version. The variation coefficient indicates that the spread under the STD version was higher than for the DSS version.

The market values for students were slightly lower than those in the experts group. The values ranged between R9.82 million and R16.83 million (=71%), and R9.41 million and R15.12 million (=61%) for the STD and DSS versions respectively. The variation coefficient was also greater under the STD version, indicating a higher spread of outcomes than for the DSS version.

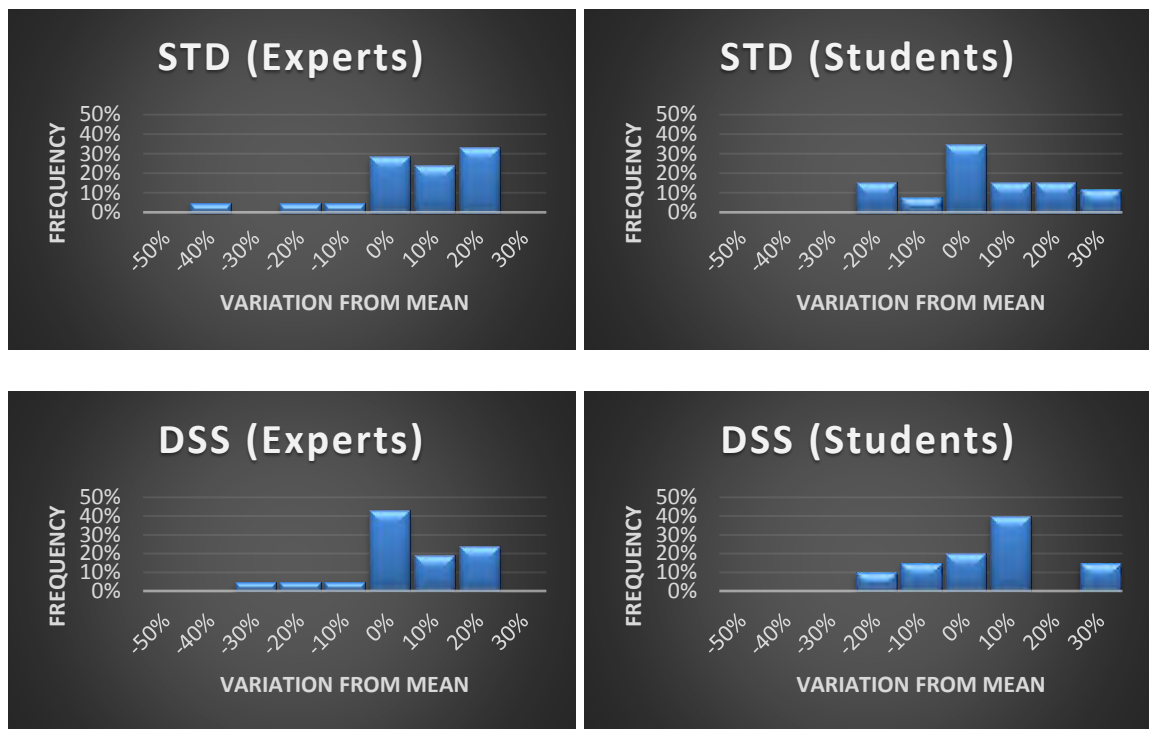
**Table 7: Variation measures for Sub-sample**

	EXPERTS		STUDENTS	
	STD	DSS	STD	DSS
<b>n</b>	21	21	26	20
<b>Mean</b>	14.52	14.30	13.41	12.40
<b>Range (min/max/%)</b>	12.09 /21.57 /78 %	11.5 /18.9 /64 %	9.82 /16.83 /71 %	9.41 /15.12 /61 %
<b>Standard deviation</b>	2.17	1.85	2.06	1.65
<b>Variation coefficient</b>	14.97%	12.94%	15.37%	13.30%

The box plots (Figure 8) and frequency distribution graph (Figure 9) illustrate a similar result. The DSS version produced fewer valuation variation values, and outliers in the expert groups were less frequently extreme than with the standard versions.



**Figure 8: Boxplots comparing DSS vs STD for sub samples**



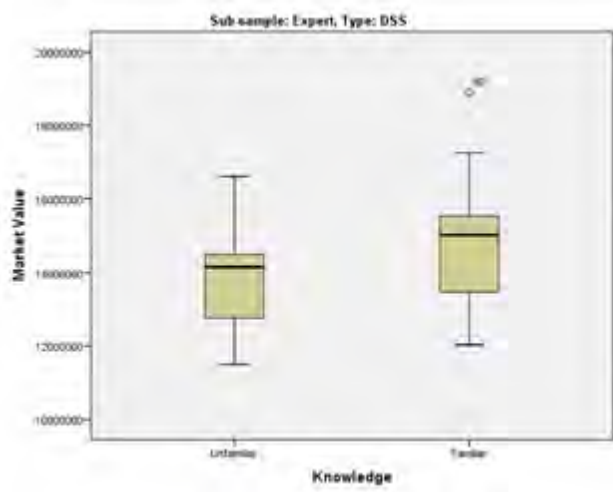
**Figure 9: Frequency distribution of outcomes for market values (sub-sample)**

The modified robust Brown-Forsythe Levene-type test from the median with modified correction-method zero, as shown in table 8 below, produced similar statistical results to the overall groups. At the 0.05 level of significance, the null hypothesis cannot be rejected, which means that there is no statistically significant difference between the two variance groups.

**Table 8: Modified Robust Brown-Forsythe Levene-type test for sub-sample**

Group	Test-Statistic	p-value
Experts	0.102	0.751
Students	0.964	0.332

Furthermore, the DSS tool was tested on its effectiveness for experts with little knowledge of the Cape Town market. In this case, on a Likert scale of 1 to 5, experts who indicated a value of 1 and 2 were considered to have less knowledge of the geographical area. The boxplots as indicated in Figure 10 shows that the DSS was more beneficial to experts with little knowledge of the area. Experts with geographical knowledge produced wider market values.



**Figure 10: The effect of DSS tool on expert groups with different knowledge**

As shown in table 9, the evaluation of the significant test yielded a p-value of 0.517 for experts with unfamiliar knowledge compared to experts with superior knowledge ( $p=0.976$ ). Although the result was not statistically significant, there was some indication that the DSS could be beneficial for experts with unfamiliar knowledge.

**Table 9: Significance test for expert groups with different geographical knowledge**

Expert Group	Hypothesis	Test-Statistic	p-value
Unfamiliar	$H_0: \text{Var}_{\text{STD}} = \text{Var}_{\text{DSS}}$	0.434	0.517
Familiar	$H_0: \text{Var}_{\text{STD}} = \text{Var}_{\text{DSS}}$	0.001	0.976

#### 4.3.3 Testing of the second main hypothesis

The second hypothesis states that the anchoring effect is reduced if the valuer is debiased and supported in his decision.

$$H_0: \text{Mean Unadjusted } MV_{\text{STD}} \geq \text{Mean Adjusted } MV_{\text{DSS}}$$

Table 10 shows the effect of the decision support tool on market values after a warning notice was issued to participants. In the 41 DSS version, 3 experts (=7%) and 13 novices ( $n=32$ ) adjusted the market value. This represents a 39% ( $n=16$ ) adjustment when test subjects are supported in their decision. Further observations show that in nine cases (=56%), the values were negatively adjusted towards the anchor value. Similar to Lausberg and Dust's (2015) observation, the illogical adjustment could be because the warning message was not clear enough and it may have confused the reader.

After adjusting the outcomes for valuation with positive or no adjustment, it was observed that only 7 participants (=22%) adjusted the market value positively. The mean adjusting market value was 1.37% higher than the unadjusted market values. The results were slightly higher than the study undertaken by Lausberg and Dust (2015). In a similar vein, it can be concluded that some members of the test groups were susceptible to the anchoring and adjustment effect.

**Table 10: Adjustment of market values with the DSS version**

		Mean market value (R)		Adjustment	
		unadjusted	adjusted	Magnitude (% of the MV)	Number and % of all valuation
All valuations	Experts	14 350 106	14 297 111	-0.37%	3(7%)
	Students	12 448 464	12 398 557	-0.40%	13(32%)
	DSS	13 422 476	13 370 987	-0.38%	16(39%)
Only valuations with positive or no adjustment	Experts	14 082 557	14 104 662	0.16%	1(3%)
	Students	12 351 241	12 770 715	3.40%	6(19%)
	DSS	13 379 210	13 562 746	1.37%	7 (22%)

#### 4.3.4 Testing of sub hypotheses

Several decisions are required during the valuation process. Figure 11 indicates the necessary decisions levels during the income approach exercise. Three further hypotheses are examined and discussed.

INCOME APPROACH			
	Potential Gross Income		
	Rental Income	<--- Decisions	[Sub-Hypothesis No 1]
	Other Income (parking lots)	<--- Decisions	
-	Vacancy and Collection Losses	<--- Decisions	
=	<b>Effective Gross Income</b>		
-	Operating Expenses	<--- Decisions	[Sub-Hypothesis No 2]
	Rates and taxes		
	Insurance		
	Cleaning & Security		
	Leasing commissions		
	Maintenance allowance		
	Property management		
=	<b>Net Operating Income</b>		
x	Capitalization Rate	<--- Decisions	[Sub-Hypothesis No 3]
=	<b>Provisional Market Value</b>		
+/-	Adjustments	<--- Decisions	
=	<b>Market Value</b>		

**Figure 11: Decisions levels of the income approach**

- (1) Market rents have lower variation with the DSS version
  - H3: Variation  $MR_{DSS} \leq$  Variation  $MR_{STD}$
- (2) Operating costs have lower variation with the DSS version
  - H4: Variation  $OPTCOST_{DSS} \leq$  Variation  $OPTCOST_{STD}$
- (3) Capitalisation rates have lower variation with the DSS version
  - H5: Variation  $CAP.R_{DSS} \leq$  Variation  $CAP.R_{STD}$

**Sub hypothesis 1: Market rents show lower variation with the DSS version**

The first sub hypothesis states that the variation of market rents is lower using the decision support system.

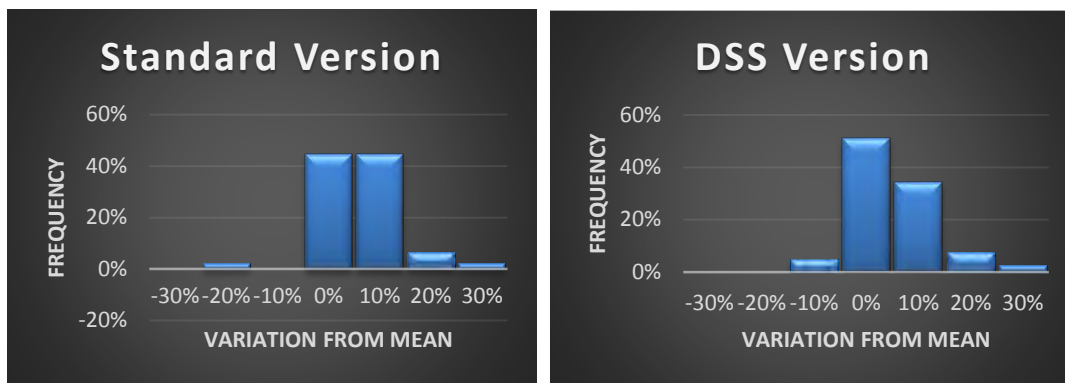
$$H3: \text{Variation } MR_{DSS} \leq \text{Variation } MR_{STD}$$

The market rents ranged from R91 to R150 (=65%), with a mean rent of R115.68 for the standard version. The DSS version produced slightly less variation values and ranges between R80 and R130 (=63%). In comparison, the standard deviation and variation coefficient as depicted in Table 11 confirmed that the variation with the standard version was relatively higher than under the DSS version.

**Table 11: Variation measures for market rents**

	<b>STD</b>	<b>DSS</b>
<b>n</b>	47	41
<b>Mean</b>	115.68	112.24
<b>Range (min/max/%)</b>	91 /150/65 %	80 /130/63 %
<b>Standard deviation</b>	9.56	8.24
<b>Variation coefficient</b>	8.3%	7.3%

The frequency distribution chart in Figure 12 shows that the market rents were less dispersed and the values were more often closer to the mean with the DSS version. A possible interpretation of the outcome relates the normative features that require the experimenter to assess the information before making a decision.



**Figure 12: Frequency distribution of outcomes for market rents**

Figure 13 shows the views of participants regarding the objectivity, ‘current-ness’ and relevance of source data provided in the study. The overall group indicates that they found source 1 (own research) and source 2 (SAPOA) to be the most beneficial market data source to determine the adequate market rent. The SAPOA source was perceived to be more objective, followed closely by the Rode report. Own research was observed to be the most up to date and relevant market data source matching the valuation property.

Within the professional group, experts relied heavily on their own research as a source of data to determine the adequate market rent. The SAPOA source scored 54%, while the JLL/Baker Street and Rode market data source scored only 31%. Interestingly, the majority of experts do not perceive Property24.com as an objective, up to date and relevant source of market data for the valuation process (score= -15%).

For the novice group, SAPOA was believed to be the most appropriate market source of data (overall score=80%). Similar to the experts group, the Property24.com source was considered to the least important source for market information. In terms of objectivity, they considered the SAPOA and Rode sources to be most objective, followed closely by JLL/Baker Street and Property24.com. Own research, however, was considered the least objective source of data. This is illogical and may be explained by a lack of experience and an over reliance on SAPOA and Rode as sources for obtaining market data for academic studies.

	Overall Sample Group			
	Objectivity	Currentness	Relevance	Score
Source 1: Own Research	73%	90%	92%	70%
Source 2: SAPOA	83%	83%	85%	67%
Source 3: Property24.com	46%	65%	41%	2%
Source 4: JLL/Baker Street	73%	55%	70%	32%
Source 5: Rode	80%	55%	88%	49%
	Expert Sample Group			
	Objectivity	Currentness	Relevance	Score
Source 1: Own Research	90%	90%	95%	84%
Source 2: SAPOA	70%	81%	80%	54%
Source 3: Property24.com	24%	60%	45%	-15%
Source 4: JLL/Baker Street	62%	70%	65%	31%
Source 5: Rode	67%	55%	75%	31%
	Student Sample Group			
	Objectivity	Currentness	Relevance	Score
Source 1: Own Research	55%	89%	89%	55%
Source 2: SAPOA	95%	85%	89%	80%
Source 3: Property24.com	70%	70%	37%	19%
Source 4: JLL/Baker Street	85%	40%	75%	33%
Source 5: Rode	95%	55%	100%	67%

**Figure 13: Degree of consensus regarding data sources**

As indicated in Table 12, the significance test for the market rents indicated that there was no statistically significant difference of variances between the two groups ( $p=0.174$ ). Thus, the null hypothesis that the variances are homogenous is violated at the 0.05 level of significance.

Within the sub-sample, it was observed that the p-values for students and experts were 0.826 and 0.076 respectively (Table 12). At the 0.1 level of significance, there is some evidence that the decision support tool was more beneficial for experts than for students.

**Table 12: Modified Robust Brown-Forsythe Levene-type test for market rent**

Group	Test-Statistic	p-value
All	1.878	0.174
Experts	3.287	0.076
Students	0.049	0.826

### **Sub hypothesis 2: Operating costs have lower variation with the DSS version**

The second sub hypothesis states that the variation of operating cost is lower with the decision support system.

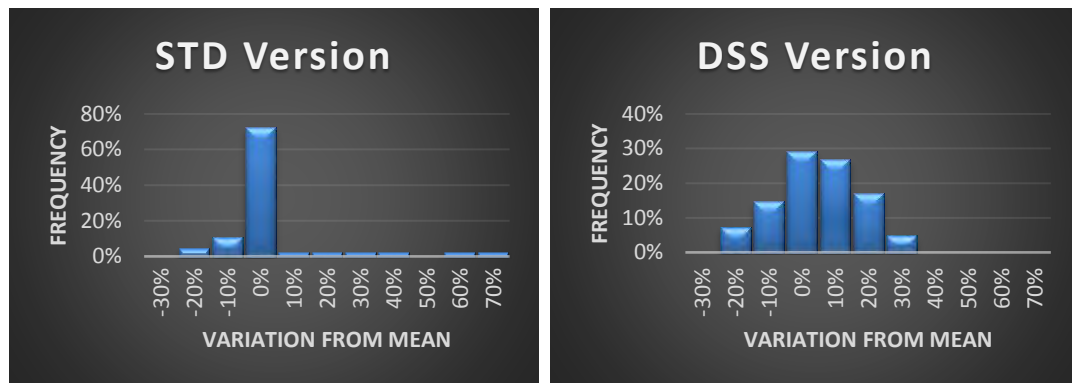
$$H_4: \text{Variation OPTCOST}_{DSS} \leq \text{Variation OPTCOST}_{STD}$$

It was observed (see Table 13) that operating costs varied much more under the STD version (= 301%) than the DSS version (= 65%). Test subjects using the STD version produced values between R152 000 and R610 000, whereby the DSS version produced values between R422 000 and R598 000. The variation coefficient supports this observation with the STD version being 16.1% and the DSS version being 12.1%.

**Table 13: Variation measures for operating costs**

	STD	DSS
<b>n</b>	47	41
<b>Mean</b>	486.38	553.75
<b>Range (min/max/%)</b>	152 /610/301 %	422.78 /598.54/65 %
<b>Standard deviation</b>	78.53	66.79
<b>Variation coefficient</b>	16.1%	12.1%

The frequency distribution chart as shown in Figure 14 also indicates the non-normality distribution of the STD version.



**Figure 14: Frequency distribution of outcomes for operating costs**

As shown in Table 14, at the 0.05 level of significance, there was no statistically significant difference of variances between the two tools ( $p=0.059$ ). However, within the expert groups, there was statistical evidence that the DSS tools was useful for them ( $p\text{-value}=0.045$ ).

**Table 14: Modified Robust Brown-Forsythe Levene-type test for Operating costs**

<b>Group</b>	<b>Test-Statistic</b>	<b>p-value</b>
<b>All</b>	3.650	0.059
<b>Experts</b>	4.249	0.045
<b>Students</b>	0.619	0.436

**Sub hypothesis 3: Capitalisation rates have the lower variation with the DSS version**

The third sub hypothesis suggests that the variation of capitalisation rate is lower with the decision support system.

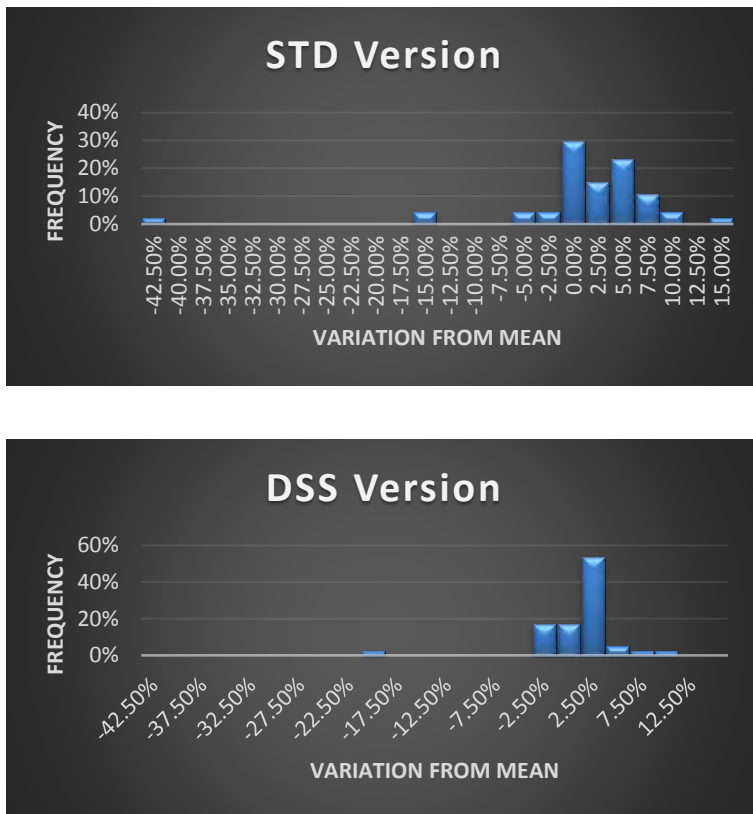
$$H_5: \text{Variation CAP.R}_{DSS} \leq \text{Variation CAP.R}_{STD}$$

As shown in Table 15, the capitalisation rate under the standard software ranged from 8% to 13.5% (=69%), which was higher than under the DSS version (=33%). The variation coefficient supports these findings.

**Table 15: Variation measures for capitalisation rate**

	<b>STD</b>	<b>DSS</b>
<b>n</b>	47	41
<b>Mean</b>	9.39	9.14
<b>Range (min/max/%)</b>	8 /13.5/69 %	8.3 /11/33 %
<b>Standard deviation</b>	0.80	0.39
<b>Variation coefficient</b>	8.6%	4.3%

The frequency graph as shown in Figure 15 indicates that the dispersion is less and the outliers fewer with the decision support tools than the standard version.



**Figure 15: Frequency distribution of outcomes for capitalisation rate**

When comparing the entire sample group, the null hypothesis for homogeneity of variances must be rejected at the 0.05 level of significance (Table 16). There was some statistical evidence that the DSS and STD version produced different results by subject groups. However, this was not the case when observing the expert and student groups in isolation.

**Table 16: Modified Robust Brown-Forsythe Levene-type test for capitalisation rate**

Group	Test-Statistic	p-value
All	4.122	0.045
Experts	1.516	0.226
Students	2.492	0.122

#### 4.3.5 Evaluation of the tools by participants

Finally, the tools were evaluated from the participants' experience. Table 17 presents the statistical information collected at the end of the experiment. In general, most respondents were confident that their market value was correct (n=76, 86%). There was also a general agreement that the software provided enough support for them to complete the valuation exercise (n=76, 86%). When looking at the tools in isolation, subjects acknowledged that

both software systems provided enough support (DSS=88%; STD=85%). This is interesting, as subjects were expected to weight the DSS version more highly than the STD version. Possibly the control group assumed that the calculation template in the STD version provided sufficient support for them to complete the valuation tasks.

Moreover, about 41% (n=36) of respondents acknowledged that they had been influenced in a certain way by the value that did not relate to the market value (very strongly to fairly). With the possible lack of knowledge, 58% of respondents confirmed that they were not aware of the anchoring and adjustment heuristics.

**Table 17: Evaluations of experiment by respondents**

	Experts		Students		Total	
	Quantity	Share	Quantity	Share	Quantity	Share
<b>1 How Confident is the market price</b>						
very sure	9	21%	3	7%	12	14%
	24	57%	19	41%	43	49%
	4	10%	17	37%	21	24%
	4	10%	7	15%	11	13%
very unsure	1	2%	0	0%	1	1%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>2 Level of Support with the valuation software</b>						
very good	9	21%	11	24%	20	23%
	11	26%	21	46%	32	36%
	13	31%	11	24%	24	27%
	7	17%	0	0%	7	8%
not at all	2	5%	3	7%	5	6%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>2a Standard Tools</b>						
very good	5	24%	5	19%	10	21%
	6	29%	11	42%	17	36%
	6	29%	7	27%	13	28%
	2	10%	0	0%	2	4%
not at all	2	10%	3	12%	5	11%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>26</b>	<b>100%</b>	<b>47</b>	<b>100%</b>
<b>2b DSS Tools</b>						
very good	4	19%	6	30%	10	24%
	5	24%	10	50%	15	37%
	7	33%	4	20%	11	27%
	5	24%	0	0%	5	12%
not at all	0	0%	0	0%	0	0%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>20</b>	<b>100%</b>	<b>41</b>	<b>100%</b>
<b>3 Anchoring</b>						
very strongly	0	0%	5	11%	5	6%
	0	0%	20	43%	20	23%
	4	10%	7	15%	11	13%
	14	33%	9	20%	23	26%
not at all	24	57%	5	11%	29	33%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>
<b>4 Knowledge of the Anchoring effects</b>						
yes	13	31%	24	52%	37	42%
no	29	69%	22	48%	51	58%
<b>Total</b>	<b>42</b>	<b>100%</b>	<b>46</b>	<b>100%</b>	<b>88</b>	<b>100%</b>

## **Expert groups**

As shown in Table 17, almost all the experts were confident in their market values (n=37, 88%). Although 69% of the test persons did not know about the anchoring effects, only 10% (n=4) of them admitted to having been influenced by the arbitrary value. In terms of support from the different software, 48% of the expert members generally thought that they had received good to very good support during the experiment. The STD version scored 52%, compared to the DSS version which scored slightly less (43%).

Figure 16 presents feedback gathered from expert groups on their experience during the experiment. The general comments regarding the standard version was that the software was simple and easy to use. One of the respondents even stated that the standard version was similar to the one currently being used for valuation purposes. However, one subject did not support the desktop approach and inflexibility on changing data. Suggestions for improving the software to provide better support to calculate expenses were also made.

Feedback for the DSS version was two-pronged. Some regarded the support as beneficial, especially the way information was displayed. Others, however, were critical of the software being not explicit enough regarding the cost inclusiveness of the gross rental. Another respondent commented that the software should rather be used for mass valuation. It is possible that because some experts would prefer to have simple, easy and flexible software for their valuation tasks, experts ranked the standard tool slightly higher than the DSS version.

Standard Version (Experts)
The software assisted in provided an accurate valuation figure by leaving no room for error other than incorrect input data.
Not enough background information is given in order to make an informed decision regarding the variables applied to the valuation. Also it is not user-friendly in that the expenses have to be entered as annual amounts, rather than as R/m <sup>2</sup> /month per item or as a % of income. It is not possible to make an adjustment to the final value with no information on the property in respect of leases, etc.
It would be nice to see percentage and rates per square metre values, especially considering expenses and final result.
I thought the software was easy to use with clearly defined data input areas
It was great and easy to use. Quite simple. Just concerned as to how it will work with more complex buildings.
Problems with the links . Confusion with regards to op costs (utilities and cleaning&security
The software is very easy to understand and apply. The experiment was an excellent way to learn more about the property market for offices in Cape Town. The software made it easy to apply the income approach to valuation of real estate.
very good exercise. Will it be possible to havethe correct Value?
Very user friendly - easy to follow and quick.
I do like the software and similar to one I currently use to calculate valuations
DSS Version (Experts)
The "Total" rental quoted for the subject building is effectively the Gross Rental. In practice rental comparisons are mostly by Gross Rentals, however the worksheet appears to only consider a non-gross rental (e.g. without rates recoveries) and therefore is inconsistent. Considering this and having played with the worksheet, I assumed (correctly or not?) that the the expenses provided for the property are nett of the recoveries made? This Gross Rental vs Rental is an important aspect of valuation that perhaps requires re-evaluation? I therefore applied the lower non-gross rental for the purposes of this exercise (although the comparables should be Gross). Or maybe you got me with the Appraisal Bias - influence of the software support?
Interesting and informative exercise
The market range is to broad from some of the sources use and limited market information regarding property expenses and how property expenses were actually calculated such as rates, on what municipal value is this based and when is the next rates implemented?
This type of valuation is good for mass valuations and also as a guide in determining a valuation required for financial purposes. However, it would not meet the creteria for expropriation and/orlitigation purposes
I am very impressed with the layout and strucure of the excel macros. Well done. The data was also concise and to the point.
It does not address the impact of existing lease income for which a significant adjustment may be required depending on terms of leases. Neither does it deal properly with gross rental on basis that it is cost inclusive or not. It deals with cost on a percentage basis which is not accurate but a very broad brush, where much more analyses on this is required. Neither does it provide actual yields from the market which is unacceptable. The cap rates of SAPOA, etc. are not true proxies and the use of these will have severe consequences

**Figure 16: Comments from experts regarding the experiment**

### **Student groups**

Similar to the experts' reactions, novices also had a high percentage of confidence in their values, with 85% of students believing that they were fairly to very certain that their market value was the probable attainable market price (Table 17). However, unlike the experts, the novices admitted that they had to some degree been influenced by the unsanctioned market value (n=32, 70%). This can be explained by the fact that most of them were unaware of the so-called anchoring effect (no=66%).

Seventy percent of students (n=32) concurred that the two valuation software systems provided good to very good support. Interestingly, more novices confirmed that the DSS version (n=16, 80%) provided more support than the STD version (n=16, 62%).

Figure 17 below highlights students' feedback with regards to the experiment. Like the experts' comments, students found the standard version was simple and easy to use. The DSS version was also seen as beneficial for the valuation tasks, with one exception that the information seemed scattered and difficult to read.

Standard Version
User friendly
I am not sure if market rentals include recoveries or not?
Good. Just lack a small description
The software compliments the experiment very well and I believe it will assist in determining the effect of bias in the property industry.
As an estate agent, I would most likely advise a discounted price, to enable an investor to buy at a CAP rate that is more favourable than the market CAP.
Nicely set up, great layout and colour scheme.
Tried to change my Cap Rate but did not have the option to go back.
DSS Version
The experiment was good however the information was difficult to read through as it seemed to be scattered.
Very interesting. Hope I can use it again with a property I know to see what estimated value I arrive at.
Helps to see how relative costs and income affect your valuation
very interesting and a very good study. Very useful. I only wish I had more knowledge within the area of study to provide a more detailed feedback.

**Figure 17: Comments from students regarding the experiment**

## 4.4 Conclusions

This chapter presented the findings emanating from the controlled experimental study. The three simple variation measures and frequency graph showed that the decision support tool can be beneficial in reducing valuation variations. However, statistical tests did not support the hypothesis that the DSS version can effectively reduce valuation variations. The experimental data exhibited a similar conclusion for individual subject groups. Figure 18 summarises the statistical observations of the overall and segmented sample group during the valuation tasks process.

	INCOME APPROACH			Experts	Students	All
	Potential Gross Income					
	Rental Income	<---	Decisions [Sub-Hypothesis No 1]	0.076	0.826	0.174
	Other Income (parking lots)	<---	Decisions			
-	Vacancy and Collection Losses	<---	Decisions			
=	<b>Effective Gross Income</b>					
-	Operating Expenses	<---	Decisions [Sub-Hypothesis No 2]	0.045	0.436	0.059
	Rates and taxes					
	Insurance					
	Cleaning & Security					
	Leasing commissions					
	Maintenance allowance					
	Property management					
=	<b>Net Operating Income</b>					
x	Capitalization Rate	<---	Decisions [Sub-Hypothesis No 3]	0.226	0.122	0.045
=	<b>Provisional Market Value</b>					
+/-	Adjustments	<---	Decisions			
=	<b>Market Value</b>			p=0.751	p=0.332	0.885

**Figure 18: Statistical observations at various decision levels of the valuation process**

The next chapter discusses the findings arising from the experimental data. Conclusions are then drawn and recommendations made.

## **CHAPTER 5 CONCLUSIONS AND IMPLICATIONS**

### **5.1 Introduction**

Theories of memory suggest that due to limited processing capacity, people use heuristic methods to solve problems (Simon & Newell, 1971). This heuristic behaviour is developed subconsciously as an efficient way for an individual to reduce complex tasks to simpler judgemental operations. The valuation task, which involves human judgement, is susceptible to the cognitive shortcuts mechanism during the valuation process. Hence, this study examines the efficacy and effectiveness of decision support systems to help reduce or eliminate property bias in valuation.

This chapter discusses the findings presented in Chapter 4 and relate them to the research question and the problem statement raised in Chapter 1. Conclusions on the implications for both theory and practice are then drawn, followed by recommendations for future research.

### **5.2 Discussion of the results**

The research experiment highlights that opinions of value differ among subjects assessing the same property under similar settings. The values produced by test groups were within an absolute 26.8% range for novices and 48.5% range for experts. More particularly, the higher variance within the experts group supports the observations of Adair *et al.* (1996) and Crosby *et al.* (1998) that the “margin of error” principle of plus and minus 10% is fundamentally flawed.

The employment of heuristic behaviour in valuation tasks is well documented in real estate literature. Various behavioural studies have shown that valuers’ non-rational behaviour is due to the deficit of information, insufficient investigation and market uncertainty. The anchoring and adjustment heuristic, which is commonly employed in numeral judgements (Tversky & Kahneman, 1974), is of particular interest for this study.

In the context of this study, an anchor value from an unsanctioned anonymous expert was used because previous studies reveal a reliance on past value estimates as valuation cues when making a new value judgement (Northcraft & Neale, 1987; Black & Diaz, 1996; Black, 1997, Havard. 2001b, Diaz & Hansz, 1997; Diaz & Hansz, 2001). The lack of

adjustment to the initial reference value is arguably the cause of systematic bias in valuation estimates (Yiu *et al.*, 2006).

The use of a decision support tool is examined to determine whether property appraisal bias can be reduced or eliminated. The DSS MS Excel version incorporates fundamental concepts as theorised by Fischhoff (1982) to address the psychological processes for better judgement. Therefore, in examining the effectiveness of the DSS tool, the anchoring effects and valuation variations should be reduced or eliminated.

The experiment revealed that some test persons were susceptible to the anchoring and adjustment heuristic (Table 10 above). The results obtained from the DSS tool show that about 39% of test groups adjusted their values once the anchoring effects warning message was displayed. After eliminating inconsistent adjustments, 22% of test subjects showed their susceptibility to the anchoring and adjustment effects. Of interest, novices were the most prone group to show an anchoring behaviour (n=6, 19% of the 22%). As highlighted by Havard (2001b), novices, who do not have experience, use the anchoring and adjustment heuristic as a shortcut to simplify complex decision environments.

The behavioural contention research of Diaz and Hansz (1997) and Havard (2001b) supports the theory, put forward by Quan and Quigly (1991) and Geltner (1993), that appraisers of unfamiliar settings use unsanctioned reference points as an optimal updating strategy when faced with uncertainty. However, in this study, there was no indication that experts with 'no' to 'low' market knowledge were prone to using the anchor value. In fact, the finding in chapter 4 (Table 10) revealed that the expert (n=1, 3%), who adjusted the values when the anchoring heuristic message was displayed, was not from expert group with no familiar market knowledge.

The other hypothesis states that using a DSS tool produces valuation variations less dispersed than when a standard tool is used. When comparing the tools, descriptive statistics showed that the spread was more frequent in the STD version than the DSS version. Similar observations were made for individual groups, and for experts both with and without market knowledge.

Statistical test shows no significance level at the 0.5 level that the valuation variations would be reduced with a DSS tool. Similar observation, at the 0.05 level of significance, was made under Lausberg and Dust's (2015) experimental research. However, unlike the German study that demonstrated some evidence of the beneficial of the DSS tool at the

1% level of significance, this study could not support similar results. This can be explained by the fact that, unlike the previous study, which shows German valuers were unaware of making decisions during valuation tasks (Lausberg & Dust, 2015), in the present situation, South African test subjects were possibly more conscious when providing value judgement.

When examining outcomes at various decision levels in the valuation process, some interesting findings were observed in section 4.3.4. Basic descriptive statistical measurements showed that market rents, operating expenses and capitalisation rate outcomes were less dispersed with the DSS tool. Interestingly, at the 5%, 10% and 20% level, there was statistical evidence that the DSS tool was effective when forming judgement for the capitalisation rate, operating expenses and rental income (Figure 18).

Further study of the individual treatment groups revealed that the experts group produced less dispersed values for operating expenses and for market rents at the 5% and 10% significance level (Figure 18). The reduced variation at these two decision levels could be attributed to the debiasing tool requiring more reading and additional data inputs. The DSS features, which align the valuer's decision process with the normative procedure, require subjects to evaluate market data sources before making an explicit judgement. In fact, Lausberg and Dust (2015) demonstrated that the average processing time was higher with the DSS than with STD tools.

Based on the above discussions, basic descriptive statistical measurements show some evidence that the decision support tools can help debias decisions. Although the significance test did not fully support the efficacy of the DSS tool, it is observed that at various decision levels of the valuation process, a decision support system can produce better outcomes than the standard tool. There was also evidence of the anchoring and adjustment heuristics, and it was observed that the computerised system can help counteract the cognitive mechanism generated by inexperienced decision makers.

### **5.3 Conclusions on the research question and hypotheses**

The following conclusions regarding the research question and hypotheses are drawn:

#### *5.3.1 The research question findings*

*To what extent can the decision support systems help reduce or eliminate property appraisal bias?*

The findings of the controlled experiment did not provide robust results regarding the effectiveness of the decision support tool in relation to removing or eliminating property appraisal bias. However, the study revealed some evidence that the computerised tool can help counteract the cognitive mechanism generated during valuation tasks. In particular, the warning feature, which helps identify the psychological processes of the anchoring effect, was more beneficial for novices.

Using simple descriptive statistic measurement, the experiment also demonstrated that the decision support tool can be effective in reducing valuation variations. Of particular note is the effectiveness of the system at producing better outcomes at various decision levels in the valuation process. The computerised cognitive support tool, which combines normative procedure and cognitive feedback, produced lesser spread for market rent, operating expenses and capitalisation rate than a normal tool would provide.

#### *5.3.2 The research hypotheses*

The main hypotheses are outlined below:

*(1) The valuation variation is lower if the valuer is debiased and supported in his decision*

The significance test did not support the hypothesis that the valuation variation is lower when the valuer is debiased and supported in his decision. However, some evidence indicated that the decision support tool produces less dispersed valuation values than the normal tools.

*The anchoring effect is reduced if the valuer is debiased and supported in his decisions*

The experimental study demonstrated that some test subjects are susceptible to the anchoring effects and that the DSS can effectively help counter the anchoring and adjustment bias. The tool was more beneficial for novices than experts in eliminating an anchor value from an unsanctioned source.

From the findings of this research, the following conclusions are drawn in relation to the sub hypotheses:

*(a) Lower variation of market rents with the decision support systems*

The findings revealed no significant difference at the 5% level for the sample groups (p-value=0.174). Within subgroups, the DSS tool was more beneficial for the experts group as there was evidence at the 1% significance level (p-value=0.076).

*(b) Lower variation of operating costs with the decision support systems*

Similar to market rents, the operating expenses values were not significantly different at the 5% level for the sample groups (p-value=0.059). However, within individual treatment groups, there was clear evidence that the DSS tool was effective for the experts group as the outcomes showed a lesser spread (p-value= 0.045).

*(c) Lower variation of capitalisation rates with the decision support systems*

Unlike with the previous two sub hypotheses, there was clear evidence at the 5% significance level that the computerised support tool was efficient at reducing valuation variations for the combined treatment groups (p-value=0.045). However, significance tests at the 0.05 level did not support the efficacy of the DSS tool to subdue valuation variations within the novice and expert groups.

## **5.4 Achievement of the research objectives**

The research objectives were to:

- (1) determine valuation variations both with and without decision support systems.
- (2) determine whether the anchoring effect was reduced when decision support systems were used.
- (3) establish whether valuers exhibited heuristic behaviour when operating in an unfamiliar area.

The objectives have been addressed through a review of literature relevant for this study and through the controlled experimental study. The experimental study helped determine valuation variations produced by treatment groups when using standard Excel software or Excel software that incorporated decision support systems. The second and third objectives were achieved through the use of decision support software that measured adjustment of values when a warning of anchoring effects was issued to subjects.

## **5.5 Conclusions on the research problem**

*Little is known about South African property appraisal anchoring bias and the need for and use of decision support tools to counter this.*

From the findings of the controlled experiment, inferences can be drawn regarding valuation outcomes in South Africa. The observed variances produced by treatment groups were generally higher than the “margin of error” rules. Research on valuation has highlighted the incidence of accuracy and variations on players in the property market and in the economy at large. The South African market is thus not immune to the effects of bias valuations on the sector and the economy.

While some variance among valuers is understandably inevitable, behavioural research contends that the psychological processes contribute to the high variance in valuation tasks. Various studies, as mentioned in Chapter 2, support that valuers generally exhibit characteristics of anchoring and adjustment behaviour in experimental situations. The findings in this study demonstrated that the South African test subjects were also susceptible to adopting anchoring behaviour. In particular, it was observed that novices were more prone than experts to consciously anchor to the value of an unsanctioned valuer. The study was unable, however, to find evidence that experts with market uncertainty were also susceptible to adopt this heuristic approach.

The use of decision support tools to evoke or control psychological processes in valuation tasks was also examined. Generally, although the results were not robust, there was evidence that the computerised supporting cognitive system helped to produce less dispersed valuation variations than the normal software. This was observed both within treatment groups and at various decision levels in the valuation process. Hence, an opportunity exists for the South African property market to incorporate decision support systems into the valuation process to help reduce property appraisal bias.

## 5.6 Implications for further research

The use of technological strategies to improve the psychological processes associated with valuation tasks is still at an early stage. The experimental tool Lausberg and Dust (2015) developed has demonstrated that small alterations incorporating a cognitive support system in a simple MS Excel spreadsheet can to some degree improve the valuation variations outcome. There is therefore room for the software to be improved.

Firstly, the current software only incorporates anchor values from an external source. Behavioural studies undertaken by Diaz and Wolverton (1998), Clayton *et al.* (2001), Havard (2001b) and Hansz and Diaz (2001), however, have shown that experts rely heavily on their personal knowledge and experience when forming a value judgement. The internally derived value opinion is observed as being a strong determinant of the final value decision. Thus, by incorporating a section for valuers to provide an indication of an initial value opinion, the cognitive features of the DSS software could weigh the final value outcome for possible anchoring effects.

Secondly, the warning messages need to be more explicit, and statistical analysis of market data and risk valuation, as identified by Lausberg and Dust (2015), should be incorporated into the decision support tool. Furthermore, comments as highlighted under figure 16 by experts must be incorporated in the software.

Thirdly, the experiment needs to focus on expert groups with various levels of experience and expertise, replicated for other types of properties and using different valuation methods. Other forms of heuristics, such as the representativeness, availability and positive cognitive mechanisms, must be incorporated in the experiment to establish their psychological impact on valuation outcomes.

Finally, the foundation of valuation decision-making processes must be reinforced. Behavioural contentions that have recently been addressed in the real estate property literature must be discussed and presented both to students and to experts at large. Amidu (2011) highlights the needs for property valuation education, improvement in professional standards, a code of conduct and accountability to help counteract and possibly overcome dysfunctional behaviour in value judgement tasks.

## REFERENCES

- Abbott, M. & McKinney, J. (2013). Understanding and applying research design. John Wiley & Sons.
- Adair, A., Berry, J. & McGreal, S. (1996). Valuation of residential property: analysis of participant behaviour. *Journal of Property Valuation & Investment*. 14(1), 20-35.
- Adair, A., Hutchison, N., MacGregor, B., McGreal, S. & Nanthakumaran, N. (1996). An analysis of valuation variation in the UK commercial property market: Hager and Lord revisited. *Journal of Property Valuation & Investment*. 14(5), 34-47.
- Amidu, A.R. (2011). Research in Valuation Decision Making Processes: Educational Insights and Perspectives. *Journal of Real Estate Practice and Education*. 14(1), 19-33.
- Appraisal Institute (2008). The appraisal of real estate. 13<sup>th</sup> Eds. Chicago, IL.
- Arkes, H. (1991). Costs and Benefits of Judgement Errors: Implications for Debiasing. *Psychological Bulletin*. 110(3), 486-498.
- Arnott, D. & Pervan, G. (2005). A critical analysis of decision support systems research. *Journal of Information Technology*. 20, 67-87.
- Babawale, G.K. & Omirin, M. (2012). An Assessment of the relative impact of factors influencing inaccuracy in valuation. *International Journal of Housing Markets and Analysis*. 5(2), 145-160.
- Bai, J. & NG, S. (2005). Tests for skewness, kurtosis, and normality for time series data. *Journal of Business & Economic Statistics*, 23(1), 49-80.
- Baron, J. (2005). Rationality and intelligence. Cambridge University Press.
- Beach, L. & Mitchell, T. (1978). A contingency model for selection of decision strategies. *The Academy of Management Review*, 3(3), 85-112.
- Berkowitz, L. & Donnerstein. (1982). External validity is more than skin deep: some answers to criticisms of laboratory experiments. *American Psychologist*, 37(3), 245-257.

- Black, R.T., Brown, M.G., Diaz, J., Gibler, K.M., & Grissom, T.V. (2003). Behavioural research in real estate: A search for the boundaries. *Journal of Real Estate Practice and Education*, 6(1), 85-112.
- Black, R.T. (1997). Expert property negotiators and pricing information, revisited. *Journal of Property Valuation and Investment*, 15(3), 274-281.
- Black, R.T. & Diaz, J.III (1996). The use of information versus asking price in the real property negotiation process. *Journal of Property Research*, 13, 287-297.
- Block, R.A. & Harper, D.R. (1991). Overconfidence in Estimation: Testing the Anchoring-and-Adjustment Hypothesis. *Organizational Behavior and Human Decision Processes*, 49, 188-207.
- Bowles, G., McAllister, P. & Tarbert, H. (2001). An assessment of the impact of valuation error on property investment performance measurement. *Journal of Property Investment & Finance*, 19(2), 139-155.
- Breakwell, G., Smith, J. & Wright, D (2012). Research methods in psychology. London, Sage: Sage Publications. Ltd.
- Bretten, J. & Wyatt, P. (2001). Variance in commercial property valuations for lending purposes: an empirical study. *Journal of Property Investment & Finance*, 19(3), 267-282.
- Brown, G. (1985). Property investment and performance measurement: a reply. *Journal of valuation*, 4(1), 33-44.
- Brown, M. & Forsythe, A. (1974). Tests for the equality of variances. *Journal of the American Statistical Association*, 69(346), 364-367.
- Cannon, S.E. & Cole, R.A. (2011). How Accurate Are Commercial Real Estate Appraisals? Evidence from 25 Years of NCREIF Sales Data. *The Journal of Portfolio Management*, 25.
- Carroll, R.J. & Schneider, H., 1985. A note on Levene's tests for equality of variances. *Statistics & probability letters*, 3(4), 191-194.
- Chapman, G. & Johnson, E. (1999). Anchoring, Activation, and the Construction of Values. *Organizational Behavior and Human Decision Processes*, 79(2), 115-153.

- Chapman, G. & Johnson, E. (2002). Incorporating the irrelevant: Anchors in judgements of belief and value. In *heuristics and biases: The psychology of intuitive judgement*. T. Gilovich, D. Griffin & D. Kahneman, Eds. New York: Cambridge University Press. 120-138.
- Clayton, J., Geltner, D. & Hamilton, W. (2001). Smoothing in commercial property valuations: Evidence from individual appraisals. *Real Estate Economics*, 29(3), 337-360.
- Cole, R., Guilkey, D. & Miles, M. (1986). Toward an Assessment of the Reliability of Commercial Appraisals. *The Appraisal Journal*, July, 422-432.
- Conover, J., Johnson, M.E. & Johnson, M.M. (1981). A comparative study of tests for homogeneity of variance, with applications to the outer continental shelf bidding data. *Technometrics*, 23(4), 351-361.
- Creswell, J. (2014). Qualitative, Quantitative and Mixed Methods Approaches. In *Research Design*. Eds. Dorchester, Sage: Sage Publications. Inc.
- Crosby, N. (2000). Valuation accuracy, variation and bias in the context of standards and expectations. *Journal of Property Investment & Finance*, 18(2), 130-161.
- Crosby, N., Lavers, A. & Murdoch, J. (1998). Property valuation and the 'margin of error' in the UK. *Journal of Property Research*, 15(4), 305-330.
- Cypher, M. & Hansz, J. (2003). Does assessed value influence market value judgements? *Journal of Property Research*, 20(4), 305-318.
- Diaz, J. III (1990). How appraisers do their work: a test of the appraisal process and the development of a descriptive model. *The Journal of Real Estate Research*, 5(1), 1-15.
- Diaz, J. III (1997). An investigation into the impact of previous expert value estimates on appraisal judgement. *Journal of Real Estate Research*, 13(1), 57-66.
- Diaz, J. III (2002). Behavioural research in appraisal and some perspectives on implications for practice. *RICS Foundation Research Review Series*.
- Diaz, J. III & Hansz, A. (1997). How valuers use the value opinions of others. *Journal of Property Valuation & Investment*, 15(3), 256-260.

- Diaz, J. III & Hansz, A. (2001). The use of reference points in valuation judgement. *Journal of Property Research*, 18(2), 141-148.
- Diaz, J. III & Hansz, A. (2007). Understanding the behavioural paradigm in property research. *Pacific Rim Property Research Journal*, 13(1), 16-34.
- Diaz, J. III & Hansz, A. (2010). A taxonomic field investigation into induced bias in residential real estate appraisals. *International Journal of Strategic Property Management*, 14, 3-17.
- Diaz, J. III, & Wolverton, M. (1998). A Longitudinal Examination of the Appraisal Smoothing Hypothesis. *Real Estate Economics*, 26(2), 349-358
- Diaz, J. III, Gallimore, P. & Levy, D. (2004). Multicultural examination of valuation behaviour. *Journal of Property Investment & Finance*, 22(4), 339-346.
- Diaz, J. III, Zhao, R. & Black, R. (1999). Does contingent reward reduce negotiation anchoring? *Journal of Property Investment & Finance*, 17(4), 374-379.
- Edwards, W. & Fasolo, B. (2001). Decision Technology. *Annual Review of Psychology*, 52(1), 581-606
- Einhorn, H.J. & Hogarth, R.M. (1985). Ambiguity and uncertainty in probabilistic inference. *Psychological review*, 92(4), 433-461.
- Elam, J., Jarvenpaa, S. & Schkade, D. (1992). Behavioral Decision Theory and DSS: New Opportunities for Collaborative Research. In *Information Systems and Decision Processes*. E. Stohr & B. Konsynski, Eds. Los Alamitos, CA: IEEE Computer Science Press.
- Epley, N. (2004). A Tale of Turned Decks? Anchoring as Accessibility and Anchoring as Adjustment. In: Koehler & Harvey, ed. *Blackwell Handbook of Judgement & Decision Making*. USA: Blackwell, 240-257
- Epley, N. & Gilovich, T. (2005). When effortful thinking influences judgemental anchoring: Differential effects of Forewarning and Incentives on self-generated and externally provided anchors. *Journal of Behavioural Decision Making*, 18, 199-212.
- Epley, N. & Gilovich, T. (2006). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. *Association for Psychological Services*, 17(4), 311-318.

- Evans, J.S.B. (1989). Bias in human reasoning: Causes and consequences. *Lawrence Erlbaum Associates, Inc.*
- Ferguson, J. (1988). After-Sale Evaluations: Appraisals or Justifications. *The Journal of Real Estate Research*, 3(1), 19-26.
- Fischhoff, B. (1982). Debiasing. In *Judgement under uncertainty: Heuristics and biases*. D. Kahneman, P. Slovic & A. Tversky, Eds. New York: Cambridge University Press. 422-444.
- French, N. (2001). Decision Theory and Real Estate Investment: an analysis of the decision-making processes of real estate investment fund managers. *Managerial and Decision Economics*, 22, 399-410.
- French, N. & Gabrielli (2004). The uncertainty of valuation. *Journal of Property Investment & Finance*, 22(6), 484-500.
- Furnham, A. & Bob, H.C. (2011). A literature review of the anchoring effect. *The Journal of Socio-Economics*, 40, 35-42.
- Gallimore, P. (1994). Aspects of information processing in valuation judgement and choice. *Journal of Property Research*, 11, 97-110.
- Gallimore, P. (1996). Confirmation bias in the valuation process: a test for corroborating evidence. *Journal of Property Research*, 13, 261-273.
- Gallimore, P. & Gray, A. (2002). The role of investor sentiment in property investment decisions. *Journal of Property Research*, 19(2), 111-120.
- Gallimore, P. & Wolverson, M. (1997). Price-knowledge-induced bias: a cross-cultural comparison. *Journal of Property Valuation & Investment*, 15(3), 261-273.
- Gallimore, P. & Wolverson, M. (2000). The objective in valuation: a study of the influence of client feedback. *Journal of Property Research*, 17(1), 47-57.
- Geltner, D. (1989). Bias in appraisal-based returns. *Journal of the American Real Estate and Urban Economics Association*, 17(3), 338-352.
- Geltner, D. (1993). Estimating Market Values from Appraised Values without Assuming an Efficient Market. *The Journal of Real Estate Research*, 8(3), 325-345.

- Geltner, D., MacGregor, B. & Schwann, G. (2003). Appraisal Smoothing and Price Discovery in Real Estate Markets. *Urban Studies*, 40(5-6), 1047-1064
- George, J.F., Duffy, K. & Ahuja, M. (2000). Countering the anchoring and adjustment bias with decision support systems. *Decision Support Systems*, 29, 195-206.
- Gigerenzer, G. (2004). Fast & Frugal Heuristics: The Tools of Bounded Rationality. In: Koehler & Harvey, ed. *Blackwell Handbook of Judgement & Decision Making*. USA: Blackwell, 62-88
- Gigerenzer, G. & Selten, R. (Eds.) (2001). Bounded rationality: The adaptive toolbox. Cambridge/MA: MIT Press, 37-50
- Gilbertson, B. & Preston, D. (2005). A vision for valuation. *Journal of Property Investment & Finance*, 23(2), 123-140.
- Goodwin, C.J. (2009). Research in psychology: Methods and design. John Wiley & Sons.
- Hager, D.P. & Lord, D.J. (1985). The property market, property valuations and property performance measurement. *Journal of the Institute of Actuaries*, 112(1), 19-60.
- Hansz, J.A. (2004). The use of a pending mortgage reference point in valuation judgement. *Journal of Property Investment & Finance*, 22(3), 259-268.
- Hansz, J.A. & Diaz, J.III. (2001). Valuation Bias in Commercial Appraisal: A Transaction Price Feedback Experiment. *Real Estate Economics*, 29, 553-565.
- Havard, T.M (2001a). An examination of the relationship between anchoring and adjustment heuristic and variance in commercial property. *Paper presented at the RICS 'Cutting Edge' Conference*
- Havard, T.M (2001b). Valuation reliability and valuer behaviour. *RICS Foundation Research Papers*.
- Havard, T.M. (1999). Do valuers have a greater tendency to adjust a previous valuation upwards or downwards. *Journal of Property Investment & Finance*, 17(4), 365-373.
- Hoch, S. & Schkade, D. (1996). A Psychological Approach to Decision Support Systems. *Management Science*, 42(1), 54-64.

- International Valuation Standards Council (2011). International Valuation Standards 2011. *International Valuation Standards Council*. Available at [http://iopcg.me/images/IVS\\_2011.pdf](http://iopcg.me/images/IVS_2011.pdf) [Accessed on 3 March 2015]
- Janssen, C. & Söderberg, B. (1999). Estimating Market Prices and Assessed Values for Income Properties. *Urban Studies* 36(2), 359-376.
- Jin, C. & Gallimore, P. (2010). The effects of information presentation on real estate market perceptions. *Journal of Property Research*, 27(3), 239-246.
- Joslin, A. (2005). An investigation into the expression of uncertainty in property valuations. *Journal of Property investment & Finance*, 23(3), 269-285.
- Kahneman, D. (2003). A perspective on judgement and choice: Mapping bounded rationality. *American Psychologist*, 58(9), 697-720.
- Kinnard, W., Lenk, M. & Worzala, E. (1997). Client pressure in the commercial appraisal industry: how prevalent is it? *Journal of Property valuation and investment*, 15(3), 233-244.
- Kishore, R. (2006). Theory of Behavioral Finance and its Application of Property Market: A Change in Paradigm. Paper presented at the 12<sup>th</sup> Pacific Rim Real Estate Society Conference, Auckland, New Zealand, January 22-25.
- Kleinmuntz, N. & Schkade, D. (1993). Displays and Decision Processes. *Psychological Science*, 4(4), 221-227.
- Kontrimas, V. & Verikas, A. (2011). The mass appraisal of the real estate by computational intelligence. *Applied Soft Computing*, 11, 443-448.
- Larrick, R.P. (2004). Debiasing. *Blackwell Handbook of Judgement and Decision Making*. D. J. Koehler & N. Harvey (Eds.), 316-337
- Lausberg, C. & Dust, A. (2015). Reducing the Appraisal Bias in Manual Valuations with Decision Support Systems. *Springer-Verlag Berlin Heidelberg*.
- Levy, D. & Schuck, E. (1999). The influence of clients on valuations. *Journal of Property Investment & Finance*, 17(4), 380-400.
- Lim, T.S. & Loh, W.Y. (1996). A comparison of tests of equality of variances. *Computational Statistics & Data Analysis*, 22(3), 287-301.

- McAllister, P. (1995). Valuation accuracy: a contribution to the debate. *Journal of Property Research*, 12(3), 203-216.
- Mussweiler, T., Strack, F. & Pfeiffer, T. (2000). Overcoming the inevitable anchoring effect: considering the opposite compensates for selective accessibility. *The Society for Personality and Social Psychology*, 26(9), 1142-1150.
- Noguchi, K. & Gel, Y.R. (2010). Combination of Levene-type tests and a finite-intersection method for testing equality of variances against ordered alternatives. *Journal of Nonparametric Statistics*, 22(7), 897-913.
- 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, 84-97.
- Pagourtzi, E., Assimakopoulos, V., Hatzichristos, T. & French, N. (2003). Real estate appraisal: a review of valuation methods. *Journal Property Investment & Finance*, 21(4), 383–401.
- Payne, J. (1982). Contingent Decision Behavior. *Psychological Bulletin*, 92(2), 382–402.
- Payne, J., Bettman, J. & Schkade, D. (1999). Measuring Constructed Preferences: Towards a Building Code. *Journal of Risk and Uncertainty*, 19(1), 243–270.
- Quan, D.C. & Quigley, J.M. (1991). Price formation and the appraisal function in real estate markets. *The Journal of Real Estate Finance and Economics*, 4(2), 127-146
- Quentin, J. (2009). The Subprime Crisis – Implications for Property Valuation? The Revival of Mortgage Lending Value. *International appraising*, 4(2), 127-146
- Schkade, D.A. & Kleinmuntz, D.N., 1994. Information displays and choice processes: Differential effects of organization, form, and sequence. *Organizational Behavior and Human Decision Processes*, 57(3), 319-337.
- Scott, P. & Judge, G. (2000). Cycles and steps in British commercial property values. *Applied Economics*, 32, 1287-1297.
- Scott, P.J. & Lizieri, C. (2012). Consumer house price judgements: new evidence of anchoring and arbitrary coherence. *Journal of Property Research*, 29(1), 49-68.

- Selten, R. (1990). Bounded Rationality. *Journal of Institutional and Theoretical Economics*, 146(4), 649-658.
- Shim, J.P., Warkentin, M., Courtney, J.F., Power, D.J., Sharda, R., & Calsson, C. (2002). Past, present, and future of decision support technology. *Decision Support Systems*, 33, 111-126.
- Silver, M. (1988). Descriptive Analysis for Computer-Based Decision Support. *Operational Research*, 36(6), 904-916.
- Silver, M. (1990). Decisional Support Systems: Directed and Nondirected Change. *Information Systems Research*, 1(1), 47-70.
- Silver, M. (1991). Decisional Guidance for Computer-Based Decision Support. *MIS Quarterly*, 15(1), 105-122.
- Simon, H. A. (1972). Theories of bounded rationality. In: McGuire & Radner, eds. *Decision and Organization*. North-Holland Publishing Company, 160-176
- Simon, H. A. & Newell, A. (1971). Human problem solving: The state of the theory in 1970. *American Psychologist*, 26(2), 145-159.
- Singh, D. (1998). Incorporating cognitive aids into decision support systems: the case of the strategy execution process. *Decision Support Systems*, 24, 145-163.
- Smith, H. (1986). Inconsistencies in Appraisal Theory and Practice. *The Journal of Real Estate Research*, 1(1), 1-17.
- Stanovich, K. & West, R. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23, 645-726.
- Thadewald, T. & Büning (2007). Jarque-Bera Test and its competitors for testing normality – A power comparison. *Journal of Applied Statistics*, 34(1), 87-105.
- Tidwell, O.A. (2011). An investigation into appraisal bias: the role of decision support tools in debiasing valuation judgements. Ph.D. Thesis. Georgia State University.
- Tidwell, O.A. & Gallimore, P. (2014). The influence of a decision support tool on real estate valuation. *Journal of Property Research*, 31(1), 45-63.

- Todd, P. & Benbasat, I. (1991). An experimental investigation of the impact of computer based decision aids on decision making strategies. *Information Systems Research*, 2(2), 87-115.
- Todd, P. & Benbasat, I. (1992). The Use of Information in Decision Making: An Experimental Investigation of the Impact of Computer-Based Decision Aids. *MIS Quarterly*, 16(3), 373-393.
- Todd, P. & Benbasat, I. (1999). Evaluating the Impact of DSS, Cognitive Effort, and Incentives on Strategy Selection. *Information Systems Research*, 10(4), 356-374.
- Tversky, A. & Kahneman, D. (1974). Judgement under uncertainty: heuristic and biases. *Science*, 185, 1124-1131.
- Whipple, R.T.M. (1991). Valuations: A Problem-Solving Imperative. *Journal of Property Valuation and Investment*, 9(4), 325-343.
- Winkler, R. & Murphy, A (1973). Experiments in the laboratory and the real world. *Organizational Behavior and Human Performance*, 10, 252-270.
- Yiu, C.Y., Tang, B.S., Chiang, Y.H. & Choy, L.H.T. (2006) Alternative Theories of Appraisal Bias. *Journal of Real Estate Literature*, 14(3), 321-344.

## APPENDICES

### Appendix A – Memorandum

*For this memorandum we have used various properties, so it is in effect a realistic, but purely fictitious valuation. For our experiment it is important that you use only the information provided here and not, for instance, your own knowledge of the market rent in a particular area of Cape Town. However, it is desirable that you use your own experience when you have to choose between different sources of data or a value within a given range.*

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## 1) General Information

In preparation of an upcoming sale you are asked by the owner of the following property for a valuation using the income approach.

The office building is located in the center of Cape Town, with some 3.7 million inhabitants South Africa's second largest city.

The owner indicated that he is willing to sell the property for Rand 11 million, allegedly that was the result of a recent valuation by another valuer.

Owner: Legals Inc  
 Name of the property: "Office 41"  
 Address: 41 Keerom St, Cape Town  
 Year of construction: 2004  
 Valuation date: August 1, 2015  
 Erf size: 400 sqm

At the moment four of the five rental units are leased to law firms. The unit on the third floor is currently vacant.

### Current Rents and Expenses

Offices: Area per floor			Rental & Recoveries (per sqm, per month)			Lease Expiry
			Rental	Rates, taxes etc.	Total	
Level 4	280	Sqm	111.67	16.96	128.63	06/2016
3	280	Sqm	vacant			vacant
2	280	Sqm	110.00	15.00	125.00	08/2024
1	280	Sqm	114.27	9.36	123.63	08/2020
Ground Level	248	Sqm	114.27	9.36	123.63	08/2018
	1,368	Sqm				

Parking Bays			Rental (per bay, per month)
Tenant 1	6	Bays	850.00
Tenant 2	2	Bays	900.00
Tenant 3	2	Bays	900.00
	10	Bays	

Expenses	Actual annual
Rates and taxes	201,000
Insurance	12,000
Cleaning & security	48,000
Leasing commissions	70,000
Maintenance allowance	65,000
Property management	102,000
	498,000

## 2) Location and Site Description

Photographs of the area and the building:



**Ground floor**



**1<sup>st</sup> to 4<sup>th</sup> floor**



The property is on the north west side of Keerom Street in the "legal district" on the western periphery of the Cape Town CBD and in close proximity to the High Court.

It may be assumed that the Deed of Title does not contain any unduly onerous conditions that could adversely affect value.

The dominant type of use in the neighborhood is commercial offices and shops.

Approximate Distances (in minutes)

On foot

Public transport: ..... 4  
Shops, etc.: ..... 3  
Magistrates and Supreme Courts: ... 1 to 4

By car

City exit route: ..... 2  
Main arterial routes: ..... 10

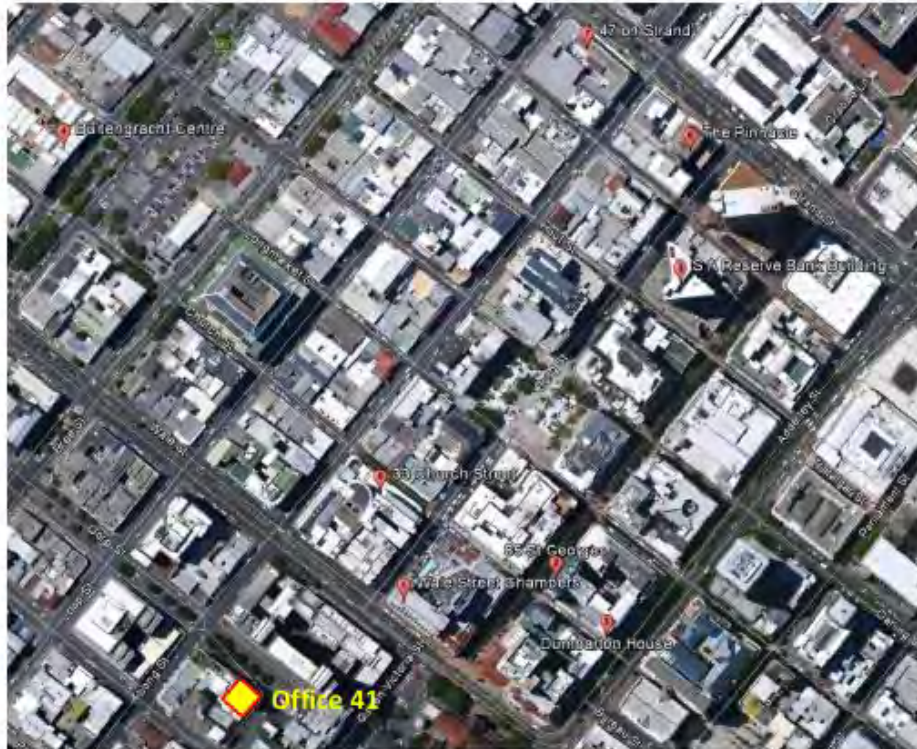
**3) Minutes from the site visit and the briefing by the owner on 2nd July, 2015**

- Valuation date: 1<sup>st</sup> August 2015
- According to Mr. Richards, CEO of Legals Inc, a valuer recently appraised the property and came up with a market value of around R 11,000,000; that's the minimum price he wants to achieve
- Vacant unit: currently lease negotiations with another law firm; anticipate a new 10-year lease contract starting 1<sup>st</sup> October at R120/sqm/month (incl. recoveries)
- Property apparently well maintained
- The building is considered energy efficient with retro-fitted energy saving lighting, low water usage technologies and time switch operated hot water and after hours lighting
- The building has air-conditioning, a flexible floor plan and is suitable for use by handicapped people
- The building has several features of an A-grade building. However, security appears to be below the required standard, the lifts are slow and the building is under parked.
- The location of the building is within an area where the dominant use is offices for legal firms, noise levels and visibility is aligned with this particular use
- According to Mr. Richards no problems with the creditworthiness of the current tenants has been experienced, there are no outstanding amounts due or any legal matters pending

#### 4) Market Information

Your assistant has already compiled rentals and recoveries in other buildings in the locality as well as general market information for you.

##### a) Asking Rentals in B+ Grade Buildings in the Locality



	Property	Area	Asking rental	Parking	Comments
1	Wale Street Chambers	852.22	R105-110/m <sup>2</sup>	Available	Similar space
2	85 St Georges	366m <sup>2</sup>	R94/m <sup>2</sup>	R1,025/bay	Recently refurbished space
3	SA Reserve Bank Building	1,880m <sup>2</sup>	R75/m <sup>2</sup>	Available	Good quality, small pockets of space
4	Dumbarton House	Various	R40-50/m <sup>2</sup>	None on site	Poorer quality space
5	Buitengracht Centre	680m <sup>2</sup>	R80-85/m <sup>2</sup>	Available	Similar standard, central location
6	Pinnacle, 2 Burg St	5,664m <sup>2</sup>	R75/m <sup>2</sup>	Available	Similar space – vacancies have increased significantly here, and asking rentals have reduced.
7	33 Church Street	416m <sup>2</sup>	R115/m <sup>2</sup>	Limited	Similar
8	33 Church Street	22.36 – 34.01m <sup>2</sup>	R150-160/m <sup>2</sup>	Limited	Premium being asked for very small suites.
9	47 on Strand	21m <sup>2</sup> - 560m <sup>2</sup>	R70/m <sup>2</sup>	Single at R770/bay	B grade office space, central location

**b) Office Rents (Source: SAPOA Research)**

Below is an extract from the July 2015 SAPOA office vacancy survey for Cape Town CBD:

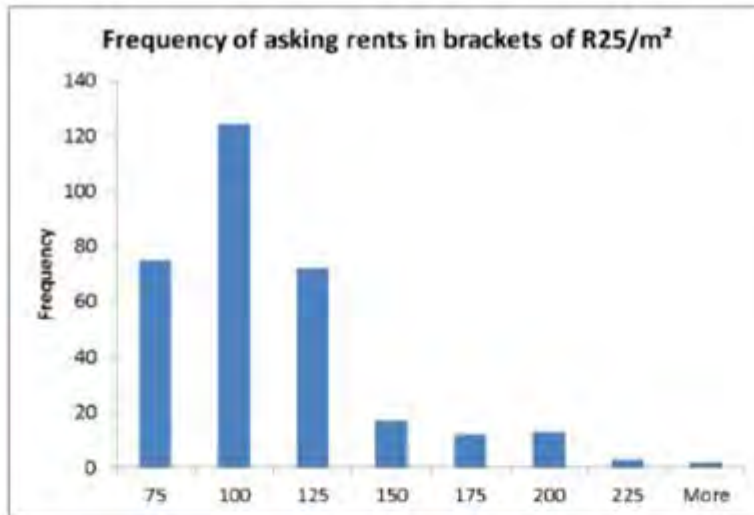
Office grade	Total rentable	Area available to lease	Current %	Previous months in %			Gross asking rentals R/m <sup>2</sup>		
				3	6	9	Min	Max	Med
P	52,000	16,000	30.8	34.6	36.5	36.5	185	185	185
A	287,487	24,938	8.7	9.9	10.6	10.0	85	175	120
B	521,835	47,375	9.1	11.0	10.4	10.2	75	125	95
C	145,178	29,758	20.5	21.9	21.8	26.3	50	127	75
<b>Total</b>	<b>1,006,500</b>	<b>118,071</b>	<b>11.7</b>	<b>13.4</b>	<b>13.4</b>	<b>13.7</b>			

**c) Asking rents on www.property24.com**



**Statistical Information**

number of properties	318
maximum	R 250
mean	R 102
minimum	R 50



Note: These are asking rentals only, and there is often some leeway between these and actual rentals signed. The current market is seen as a tenants market due to the amount of space available, and landlords are having to work hard to secure tenants. Parking rentals are also under pressure.

#### d) Cape Town Office Market Outlook Q1-2015 (Source: Jones Lang Lasalle & Baker Street Properties)

### Supply

Total leasable area in Cape Town showed a slight 3.2% y/q increase to 3,435,165m<sup>2</sup> in Q1 2015. Although conditions are not at their most favourable for landlords, there are a number of developments currently underway, which will see overall stock increasing further over the year ahead. The most notable is the 35,000m<sup>2</sup> under construction in Century City. This includes a 18,000m<sup>2</sup> office development Stage Park due for completion in July 2015. With the flat trend in commercial property demand, the additional accommodation is likely to pose a concern for vacancies in this node over the short term.

### Vacancies

The overall vacancy rate in Cape Town remained stable at 5.3% in Q1 2015. Although a marginal change, the Waterfront showed a slight increase in the vacancy rate from 1.5% in Q4 2014 to 2.2% in Q1 2015. The Waterfront is a prime node in Cape Town and boasts the highest rental rates in the city. However, higher

### Rental Performance

rental rates may be difficult to maintain, when occupiers are looking at accommodation which is cost effective. According to SAPOA, the vacancy rate in Grade F accommodation increased to 15.4% in Q1 2015, which compares to a zero rate in Q1 2014. This is as a result of the new Portside office stock which came on stream during 2014. In contrast, both Grade A and B properties recorded only marginal changes in their respective vacancy rates (see figure 2).

The growing preference for competitively priced properties is also evident in the trend of rental rates. On average, grade F accommodation recorded a marginal 1.7% y/q increase in rates to R153/m<sup>2</sup>. This contrasts to a 3.8% rise in Grade A properties and an even stronger 5.4% rise in Grade B buildings. Whilst all remaining office inflation. The stronger increases in the Grade B and A properties are

### Figure 2: Cape Town Office Vacancies

Grade	Q1 2014	Q1 2015
Grade F	0.0%	15.4%
Grade A	2.8%	3.8%
Grade B	4.9%	5.4%

### Figure 3: Rental performance by Unit type

Unit Type	Q1 2014	Q1 2015	Q1 2015
Average Grade F	0	154	154
Average Grade A	118	128	128
Average Grade B	81	91	91

### Outlook

While there has been slight growth in office rents this is still a tenants market. Whilst the city's vacancy rate is stabilising, landlords are likely to make every effort to retain current tenants as a result of the low demand environment.

Although rental rates are likely to increase from the current levels, it may be some time before one sees the pick-up.

The substantial increase in Grade F property vacancies, coupled with the muted growth in rental rates, should be a concern for landlords.

This is further exacerbated by the anticipated increase in quality stock with the completion of new developments over the short to medium term. Although Grade A and B accommodation is showing more significant rental growth, the gap between Grade F and Grade A rentals remains substantial enough for businesses to prefer the lower grade F price as a priority for the occupier. Hence Grade F rentals may have to decline in order to regain attention.

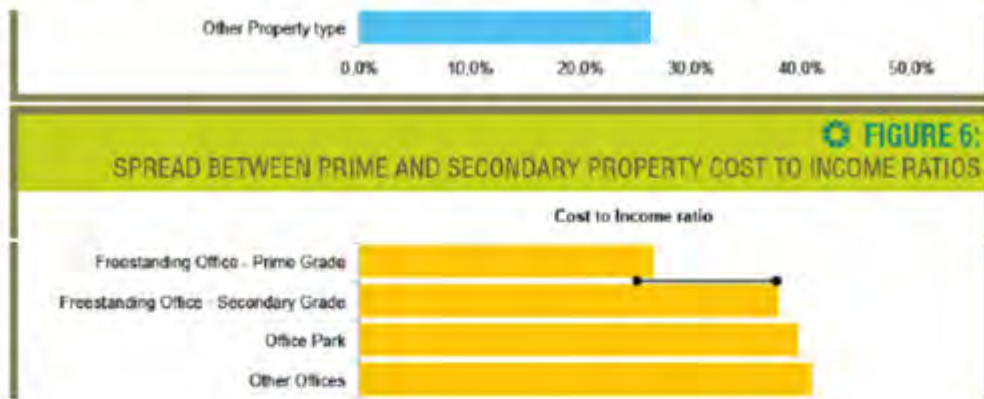
**e) Office Rents (Source: Rode's Report)**

Table 5.2 (continued)					
Market rental rates for office buildings					
Quarter 2015:1					
Rands per rentable m <sup>2</sup> per month, gross leases (excl VAT)					
	Grade A* mean	Grade A mean	Grade B mean	Grade C mean	Broker contributor codes
Cape Town CBD	156,67	121,25	98,33	67,50	FLP, GB, HP, ZB

**f) Parking Rents (Source: Rode's Report)**

Table 5.5 (continued)						
Market parking rentals						
Monthly parking rands per bay per month (excl VAT)						
As in quarter 2015:1						
	Covered reserved parking				Under shade net	Open- air parking
	Gr A*	Gr A	Gr B	Gr C		
Cape Town CBD	1.250	1.070	1.100	900	675	425

**g) Expenses (Source: SAPOA Operating Expenses Report May 2015)**



**h) Capitalization and Discount Rate Survey (Source: SAPOA Research)**

Below is an extract from the May 2015 SAPOA cap and discount rate survey for Cape Town CBD:

	Min	Max	Med	Ave
Market Discount Rate	14.0	14.9	14.5	14.4
Market Capitalisation Rate	8.1	10.6	8.9	8.6
Market Rental Growth	5.0	5.5	5.2	5.2
Operating Cost Growth	6.2	6.8	6.4	6.3
Exit Capitalisation Rate	9.5	11.7	9.8	9.8


**i) Capitalization rates (Source: Rode's Report)**

**Table 2.1**  
Survey of capitalization rates (%)  
Office buildings  
Means for quarter 2015:1

Best Location	Grade A: Multi-tenant			Grade A: Leaseback			Grade B: Multi-tenant			Grade C: Multi-tenant		
	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	n
Cape Town CBD	8,9	0,6	4	8,5	0,3	4	9,5	0,3	4	10,5	0,8	3
Bellville CBD	-	-	-	9,4	0,2	2	9,8	0,6	4	11,0	1,0	3
Bellville Tyger Valley	9,3	0,4	3	8,8	0,3	3	9,8	0,3	3	10,8	1,1	2
Century City	8,5	0,0	2	8,8	0,4	2	9,5	0,7	2	-	-	0
Westlake	8,6	0,2	2	8,9	0,2	2	9,0	-	1	-	-	0
Claremont	8,7	0,3	2	8,8	0,4	2	9,5	-	1	-	-	0

## Appendix B – First page of the valuation tools

Contact: Kathleen Evans  
Phone: 021 650 2449  
Mail: [kathleen.evans@uct.ac.za](mailto:kathleen.evans@uct.ac.za)



### Experiment for the improvement of property valuation software

On this page structure and usage of the software are explained. On the second page you can enter the data from the information package and calculate the market value of the property. The third page collects some statistical data.

Instructions:

- 1) **Activation of macros.** Normally you have to click on a warning notice which appears on top of the page under the menu bar saying: "safety warning .... ". If the security settings on your computer do not allow macros, please change them or request a macro free version.
- 2) **Zoom factor setting.** Font size and page width are chosen to fit in most screens. You can change the zoom factor under the menu item "view" to see the entire width of the page, if necessary.
- 3) **Click "Start"** to begin the valuation!

[Request help](#)

[Start](#)

## Appendix C – Third page of the valuation tools

**Thanks for your submission. To conclude we would like to have your evaluation and some statistical information.**

How sure are you that your calculated value equates the probable attainable market price?	very sure ←————→ very unsure <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
How good is the support you are receiving through this valuation software?	very good ←————→ not at all <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
How strongly were you influenced by figures which don't relate to the market value, e.g., the alleged value of an anonymous appraiser?	very strongly ←————→ not at all <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Do you know the so called "anchoring effect"? (also called "anchoring heuristic" or "appraisal bias")	yes <input type="radio"/> no <input type="radio"/>
Comments regarding the software or the experiment: <i>Please write in this field!</i>	
<b>Statistical information</b>	
Knowledge of the real estate market in Cape Town?	none ←————→ high <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Knowledge of the market for office properties?	none ←————→ high <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Age group? [years]	up to 30 up to 40 up to 50 up to 60 60+ <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Work experience in the real estate industry? [years]	none up to 5 up to 10 up to 20 20+ <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Work experience in real estate valuation? [own assessment]	none ←————→ professional valuer <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Real estate education, training or qualification? [multiple selection]	<input type="checkbox"/> none <input type="checkbox"/> NDip Real Estate Valuations <input type="checkbox"/> BSc (Hons) Property Studies <input type="checkbox"/> MSc Property Studies <input type="checkbox"/> MRICS or similar professional qualification
<b>Many thanks for your contribution!</b>	
Now you have two possibilities to send your results:	
(1) If you would like to win an Apple iPad or one of three Apple iPods...	<b>Use mailing program</b>
<i>If this doesn't work, please fill in your e-mail address, press &lt;Enter&gt; and proceed to number (2)</i>	
	<input type="text" value="e-mail address"/>
(2) If you would like to stay anonymous ...	<b>Send anonymously</b>
<i>If you are not connected to the internet, please ...</i>	
- Save the file to your hard disk.	
- When you are reconnected, please click on:	
	<b>Send anonymously (alternative)</b>
- Afterwards please click on the following link: <a href="https://docs.google.com/forms/d/1Do">https://docs.google.com/forms/d/1Do</a>	

## Appendix D – Second page for the Standard program

Please enter your values in the **dark green** fields. The **light green** fields are already filled for your convenience.

### Calculation of market value as of August 1, 2015

#### Data und assumptions

##### Building

Rentable area:	1 368 m <sup>2</sup>
Parking:	10 bays

##### Income

Market rent office space:		R/m <sup>2</sup> /month
Market rent parking space:		R/bay/month
Vacancies and loss collection:		%
Capitalization rate:		%

##### Expenses

Rates and taxes:		R/year
Insurance:		R/year
Utilities:		R/year
Leasing commissions:		R/year
Maintenance allowance:		R/year
Property management:		R/year

#### Calculation (Income Approach)

<b>Potential Gross Income</b>		<b>R 0</b>
Rental income (offices):	0.00 * 1,368 * 12 =	0
Other income (parking lots):	0.00 * 10 * 12 =	0
		0
<b>- Vacancy and Collection Losses</b>	% * 0 =	<b>R 0</b>
<b>= Effective Gross Income</b>		<b>R 0</b>
<b>- Operating Expenses</b>		<b>R 0</b>
Rates and taxes:	0	
Insurance:	0	
Utilities:	0	
Leasing commissions:	0	
Maintenance allowance:	0	
Property management:	0	
		0
<b>= Net Operating Income</b>		<b>R 0</b>
÷ Capitalization Rate	0.00 %	
<b>= Provisional Market Value</b>		<b>R 0</b>
<b>+/- Adjustments</b>		<b>R 0</b>
<b>= Market Value</b>		<b>R 0</b>

When you have filled in all the data and if you are satisfied with the result of the calculation please click on "End" to finish the valuation.

End

# Appendix E – Second page for the DSS programme

Please enter your values in the dark green fields. The light green fields are already filled for your convenience.

## Calculation of market value as of August 1, 2015

### 1) Data and assumptions

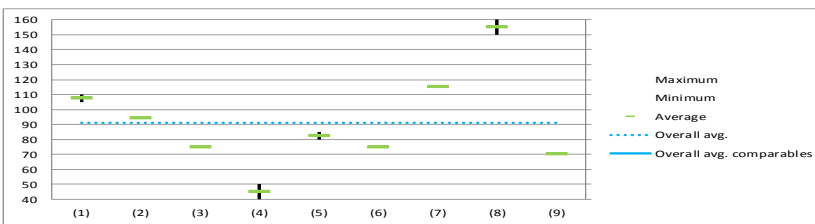
In this section the program supports your data entry and calculation of market rents and other factors.

#### 1a) Income

At first please decide which properties in the vicinity are truly comparable. Details are provided in the text. Please check the box of all properties you regard as comparables.

No.	Properties in the vicinity	Minimum (R/m <sup>2</sup> )	Maximum (R/m <sup>2</sup> )	Average (R/m <sup>2</sup> )	Comparable?
1	Wale Street Chambers	105	110	107.5	<input type="checkbox"/>
2	85 St Georges	94	94	94	<input type="checkbox"/>
3	SA Reserve Bank Building	75	75	75	<input type="checkbox"/>
4	Dumbarton House	40	50	45	<input type="checkbox"/>
5	Buitengracht Centre	80	85	82.5	<input type="checkbox"/>
6	Pinnacle, 2 Burg St	75	75	75	<input type="checkbox"/>
7	33 Church Street	115	115	115	<input type="checkbox"/>
8	33 Church Street	150	160	155	<input type="checkbox"/>
9	47 on Strand	70	70	70	<input type="checkbox"/>
Overall average				91	

Please check at least one box!



Legend  
maximum  
average  
minimum

#### Analysis:

- The diagram shows the range of the asking prices for 9 properties in the vicinity as a vertical black line, the average as a horizontal green line. The overall arithmetic average is depicted as a dotted blue line.  
- You regard 0 of these buildings as comparables. They are included in the overall average of comps (solid blue line). The other properties (in brackets) were excluded.

#### Quality of market data

For the next step please have a look at the market data provided in the text. You will then be asked to evaluate the different sources regarding three criteria:

- Objectivity = Is the source of information an estate agent or a neutral observer?
- Up-to-dateness = Is the data up to date or outdated?
- Relevance = Does the market data match the valuation property?

Source	Description	from R/m <sup>2</sup>	up to R/m <sup>2</sup>	avg R/m <sup>2</sup>
Own research	asking rents (B+ grade; in the vicinity; Aug. 2015)	40	160	
SAPOA	asking rents (A/B grades; whole CBD; July 2015)	80	150	108
property24.com	asking rents (all grades; whole CBD; Aug. 2015)	50	250	102
JLL/Baker Street	actual rents (grade B, whole CBD; Q1/2015)			101
Rode	actual rents (grade B, whole CBD; Q2/2015)			98
Overall average		57	187	102

Source	Objectivity	Currentness	Relevance	Score
Own research	☹️	☹️	☹️	0
SAPOA	☹️	☹️	☹️	0
property24.com	☹️	☹️	☹️	0
JLL/Baker Street	☹️	☹️	☹️	0
Rode	☹️	☹️	☹️	0

Please score all sources regarding objectivity, currentness, and relevance!

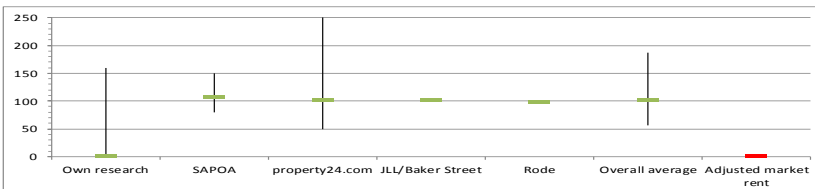
#### Quality of property

In addition you can now evaluate the property in comparison to the market on a 5-stage scale. Criteria:  
- tenant quality: personal and material creditworthiness, reliability, timeliness of lease payments  
- building quality: interior, condition, equipment, flexibility, architecture, energy efficiency, etc.  
- location quality: traffic accessibility, infrastructure, emissions, image, specific location advantages, etc.

	☹️	←	→	☺️	score
tenant	○	○	○	○	○
building	○	○	○	○	○
location	○	○	○	○	○

#### Analysis:

- The rents mentioned in market reports range between 57 and 187 R/m<sup>2</sup> on average with outliers between 40 and 250 R/m<sup>2</sup>. The overall arithmetic average is 102 R/m<sup>2</sup>.



Legend  
maximum  
arithmetic average  
minimum

Based on this analysis, please determine the adequate market rent.

**Adjusted market rent:**  R/m<sup>2</sup>/month

Average contract rent (for the sake of comparison):  R/m<sup>2</sup>/month

Next, please estimate the market rent for the parking bays.

**Market rent for parking:**  R/bay/month

Average contract rent (for the sake of comparison):  R/bay/month

### 1b) Vacancy and collection losses

Now please estimate vacancy and collection losses as a percentage of gross rental income.

Own estimate

### 1c) Operating expenses

In the next step the software helps you to calculate the operating expenses. At first please estimate the total expenses with the help of a cost-to-income ratio. After that you can allocate that sum to the individual

**1c) Operating expenses**

In the next step the software helps you to calculate the operating expenses. At first please estimate the total expenses with the help of a cost-to-income ratio. After that you can allocate that sum to the individual expenses.

**Cost-to-income ratio (based on estimated market rent for a fully-let property and actual expenses):**

Rental income per year  
 Office: R 0 \* 1,368 m<sup>2</sup> \* 12 months = 0 R/year  
 Parking: R 0 \* 10 bays \* 12 months = 0 R/year

Actual expenses per year 498 000 R/year

Comparison		
Actual ratio		
Market data	low	27.0%
	high	38.0%
Own estimate		

Estimated expenses per year 498 000 R/year

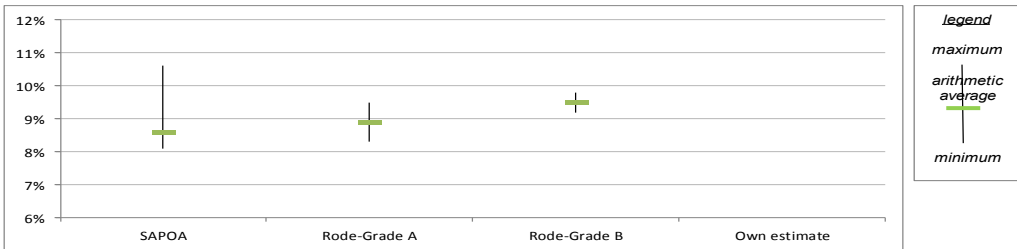
Now please allocate the total expenses to the various expense items by overwriting the percentage figures in the dark green boxes. If you feel that the current portions are ok you can leave them as they are. In any case the sum must equal 100%.

	Rand actual	Portion actual	Rand estimated	Portion estimated
Rates and taxes:	201 000	40%	201 000	40%
Insurance:	12 000	2%	12 000	2%
Cleaning & security:	48 000	10%	48 000	10%
Leasing commissions:	70 000	14%	70 000	14%
Maintenance allowance:	65 000	13%	65 000	13%
Property management:	102 000	20%	102 000	20%
<b>Total</b>	<b>498 000</b>	<b>100%</b>	<b>498 000</b>	<b>100%</b>

**1d) Capitalization rate**

From the information given in the documents please estimate the cap rate.

Source	Description	from	up to	average
SAPOA	office buildings, Cape Town CBD	8.10%	10.60%	8.60%
Rode-Grade A	office buildings, Cape Town CBD, grade A	8.30%	9.50%	8.90%
Rode-Grade B	office buildings, Cape Town CBD, grade B	9.20%	9.80%	9.50%
	Own estimate			



**2) Calculation (Income Approach)**

<b>Potential Gross Income</b>		<b>R 0</b>
Rental income (offices):	R 0 * 1,368 m <sup>2</sup> * 12 months =	0
Other income (parking lots):	R 0 * 10 bays * 12 months =	0
		0
<b>- Vacancy and Collection Losses</b>	0% * 0 =	<b>R 0</b>
<b>= Effective Gross Income</b>		<b>R 0</b>
<b>- Operating Expenses</b>		<b>-R 498 000</b>
Rates and taxes:	201 000	
Insurance:	12 000	
Cleaning & security:	48 000	
Leasing commissions:	70 000	
Maintenance allowance:	65 000	
Property management:	102 000	
	498 000	
<b>= Net Operating Income</b>		<b>-R 498 000</b>
<b>÷ Capitalization Rate</b>	0.00%	
<b>= Provisional Market Value</b>		<b>R 0</b>
<b>+/- Adjustments</b>		
<b>= Market Value</b>		<b>R 0</b>

When you have filled in all the data and if you are satisfied with the result please click on "Continue".

**Continue**

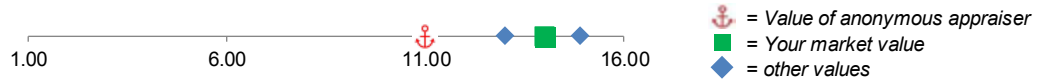
### 3) Plausibility check

In the next paragraph the valuation software helps you to perform a final "sanity check".

#### Comparison

Values in million Rand

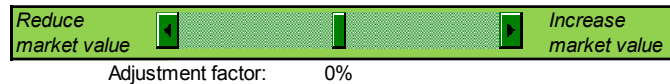
Alleged value of an anonymous appraiser (method and data not specified):	11.0
Rough estimate of replacement costs (based on statistics of costs, deterioration, and land value):	13.0
Market value according to your valuation:	14.0
Rough estimate (gross income * gross multiplier) based on your data input:	14.9



The range of the various values is about 36%. The lowest value was mentioned by the owner and could not be verified; experience of the appraiser, valuation method, data used, etc., are unknown. The highest value was calculated by the valuation software on the basis of your data input.

**Caution: Previous valuations, price expectations of the owner, market rumors, etc., should not affect a valuation. They cannot be verified, may be outdated or based on other assumptions. However, psychologists have found out that valuers are unconsciously influenced by them. This is called the "anchoring effect" because such a value acts as an anchor and prevents an objective valuation.**

Therefore please check your valuation again. If you think that the anchor value has unduly influenced you, you now have the opportunity to correct your valuation. With the help of the slider, move your value to the RIGHT, AWAY from the anchor.



Adjusted market value:

**R 14 000 000**

When you are satisfied with the result, please click on "End" to finish your valuation.

**End**

## **Appendix F – Ethics Clearance**

### EBE Faculty: Assessment of Ethics in Research Projects

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee; submit to Ms Zakiya Chikte ([Zakiya.chikte@uct.ac.za](mailto:Zakiya.chikte@uct.ac.za)); New EBE Building, Ph 021 650 5739). Students must include a copy of the completed form with the dissertation/thesis when it is submitted for examination.

Name of Principal Researcher/Student: Jesse Sui Sang How Department: CEM

If a Student: Degree: MSc Property Studies Supervisor: Ms Kathleen Evans

If a Research Contract indicate source of funding/sponsorship: —

Research Project Title: *Reducing the Property Appraisal Bias with Decision Support Systems: An Experimental investigation of SA Property Market.*

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?		NO
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	YES	
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.		NO
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.		NO

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	Jesse Sui Sang How	30 September 2015

This application is approved by:

Supervisor (if applicable):	Kathleen Evans	30 September 2015
HOD (or delegated nominee): Final authority for all assessments with NO to all questions and for all undergraduate research.		17 November 2015
Chair: Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.		NA

**ADDENDUM 1:**

Please append a copy of the research proposal here, as well as any interview schedules or questionnaires:

**ADDENDUM 2:** To be completed if you answered YES to Question 2:

It is assumed that you have read the UCT Code for Research involving Human Subjects (available at <http://web.uct.ac.za/depts/educate/download/uctcodeforresearchinvolvinghumansubjects.pdf>) in order to be able to answer the questions in this addendum.

2.1 Does the research discriminate against participation by individuals, or differentiate between participants, on the grounds of gender, race or ethnic group, age range, religion, income, handicap, illness or any similar classification?		NO
2.2 Does the research require the participation of socially or physically vulnerable people (children, aged, disabled, etc) or legally restricted groups?		NO
2.3 Will you not be able to secure the informed consent of all participants in the research? (In the case of children, will you not be able to obtain the consent of their guardians or parents?)		NO
2.4 Will any confidential data be collected or will identifiable records of individuals be kept?		NO
2.5 In reporting on this research is there any possibility that you will not be able to keep the identities of the individuals involved anonymous?		NO
2.6 Are there any foreseeable risks of physical, psychological or social harm to participants that might occur in the course of the research?		NO
2.7 Does the research include making payments or giving gifts to any participants?	YES	

If you have answered YES to any of these questions, please describe how you plan to address these issues (append to form):

**ADDENDUM 3:** To be completed if you answered YES to Question 3:

3.1 Is the community expected to make decisions for, during or based on the research?		NO
3.2 At the end of the research will any economic or social process be terminated or left unsupported, or equipment or facilities used in the research be recovered from the participants or community?		NO
3.3 Will any service be provided at a level below the generally accepted standards?		NO

If you have answered YES to any of these questions, please describe how you plan to address these issues (append to form)

**ADDENDUM 4:** To be completed if you answered YES to Question 4

4.1 Is there any existing or potential conflict of interest between a research sponsor, academic supervisor, other researchers or participants?		NO
4.2 Will information that reveals the identity of participants be supplied to a research sponsor, other than with the permission of the individuals?		NO
4.3 Does the proposed research potentially conflict with the research of any other individual or group within the University?		NO

If you have answered YES to any of these questions, please describe how you plan to address these issues(append to form)

**ADDENDUM NO 1: COPY OF RESEARCH PROPOSAL**

---

**UNIVERSITY OF CAPE TOWN**

**DEPARTMENT OF CONSTRUCTION ECONOMICS**

**&**

**MANAGEMENT**



**REDUCING THE PROPERTY APPRAISAL BIAS WITH  
DECISION SUPPORT SYSTEMS:**

**AN EXPERIMENTAL INVESTIGATION OF SOUTH  
AFRICAN PROPERTY MARKET**

A research report presented in partial fulfilment of the requirements for  
the degree of  
MSc in Property Studies

Prepared by: Sui Sang How, Jesse  
Student number: SSNJES001

Date: 3 NOVEMBER 2014

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# CHAPTER ONE:

## BACKGROUND TO THE RESEARCH STUDY

---

### 1.1 Introduction

Research on the “margin of error” and behavioural issues of valuation have dominated the early stages of real estate literatures. With the advent of new technology and findings derived from computer science, psychology and other fields, interest to use computer aided technology to improve decision-making behaviour has become the centre of much attention. Decision support systems (DSS) are computer-based information systems that have been developed to provide decision makers with a set of support solution for efficient and effective decision making outcomes (Shim, Warkentin, Courtney, Power, Sharda and Calsson, 2002).

Behaviourists and researchers assert that valuation is a discipline of social science and is viewed as “an art not a science” (French and Gabrielli 2004; Diaz and Hansz 2007). In order to form a value judgment for the property valuation, Amidu (2011) supports that human judgement is central and prevalent in the process. Given that valuation is a human activity, judgement bias may occur in the form of random and systematic error (Yiu, Tang, Chiang, and Choy 2006). The authors state that, unlike random bias, systematic bias is regarded to have greater effect on investor’s decision. Hansz and Diaz (2001) also highlight that while random bias tends to diversify away in large portfolios, systematic bias does not dissipate in diversification.

Tidwell and Gallimore (2013) recognise the time-demanding and cognitive challenging process of the prescribed appraisal model in practice. Due to the limited capabilities to resolve problem in the human short-term memory, human uses cognitive shortcuts called heuristics (Newell and Simon 1972; and Simon 1978 cited by Tidwell and Gallimore 2013). Amongst the various types of systematic bias identified, anchoring was observed to be most robust in psychological literature (Scott and Lizieri 2011 citing Kahneman, Ritov, and Schkade 1974).

In order to mitigate or eliminate the effects of decision-making biases, the decision support systems have been designed to assist in human decision-making processes. When faced with a problem, Kleinmuntz and Schkade (1993) state that decision-makers switch to a decision strategy, namely a cognitive cost-benefit system. With an improved informational display, informational

search and reduced processing cost, the decision support systems provide a cognitive incentive system that enhances the decision-making process and helps reducing systematic bias. Tidwell and Gallimore (2013) found that the decision support technology has the potential to reduce anchoring bias on real estate valuations. While the study has revealed the existence of anchor behaviour, it has also shown that computer-based system can be used to improve the appraisal judgement. Therefore, there is clearly an opportunity to research the efficacy of a decision support tool within the South African property valuation context.

## **1.2 Background to the study**

Property is regarded as both a physical and financial asset. In mature economies, the benefit and liabilities accruing from the ownership of real property underpins a major proportion of financial decisions for a wide range of stakeholders (Gilbertson and Preston 2005). The valuation of real estate is required for various reasons. Firstly, valuation serves as a major source of collateral for loans by various financial institutions. Scott and Judge (2000), citing Houlder (1992), support that three quarters of all UK banks' lending is dependent on property. Secondly, valuation is vital for business decisions for the acquisitions, mergers and sales of businesses as investment property. Similarly, for home buyers, decision for the acquisition and sales of the property is based on the market approach of a valuation. Besides, regular and correct valuation ensures that shareholders continue to benefit from the investment in listed and unlisted companies.

In the property market, valuation is regarded as the estimation of property prices that will transact in the market at a particular date (Pagourtzi, Assimakopoulos, Hatzichristos and French 2003). French and Gabrielli (2004) observe that valuation is a pricing model that reflects the market sentiment based on endogenous and exogenous factors. Amidu (2011) supports that valuation is inherently a human activity and a judgemental process due to the heterogeneous nature of property and the lack of transaction information in the market. While a systematic and structured approach is used by valuers to facilitate the consideration of the implicit and explicit factors that could affect the valuation outcomes, the author recognises that judgement bias is likely to occur throughout the valuation process.

In simple terms, valuation bias is an under or overvalue of a valuation in relation to the target (Crosby 2000). In the case of valuation accuracy, where the valuation basis is market value, valuation bias occurs when the valuation is under or over the sale price of the property. Similarly,

in valuation variation studies, bias occurs when valuation produced by one valuer differs from other valuers based on the same information and time basis. Joslin (2005), through a questionnaire survey and interviews of valuers, found that uncertainty during a valuation affects the accuracy of valuation. The level of uncertainty arise due to the quantity and quality of comparable evidence, the market condition, the characteristic of the subject property, client pressure and valuer's subjective opinion (Joslin 2005; and Babawale and Omirin 2012)

A literature review on appraisal bias by Yiu *et al.* (2006) classifies biases into two distinctively types, random bias and systematic bias. Random bias is said to be ubiquitous and is mainly produced by appraisal smoothing. Due to the imprecise science of property valuation, valuation timing and adaptive behaviour leads to an appraisal smoothing of data (Judge, G. and Scott, P., 2000). Various studies on random bias revealed that the margin of error between sale price and appraisal value range from 5% to 10% (Matysiak and Wang 1995; Hutchison *et al.*, 1996; and Brown, G.R. and *et al.*, 1998). In order to determine any negligence in a valuation, the UK courts normally use the 'margin of error' principle to determine variance from the 'true value'. However, while the judges generally rely on the 10-15% accuracy, Crosby, Lavers and Murdoch (1998) found that the 'margin of error' concept is fundamentally flawed and that its application in court has no rational basis. The authors presume that in addition to a lack of integrity and incompetence by expert witness, the empirical studies of the margin of error bracket was based on a too rigorous a standard that would discourage further research above the 'bracket'.

On the other hand, systematic bias is found to be mainly related to behavioural contention. Hansz and Diaz (2001) citing Newell and Simon (1972) and Simon (1978), note that human uses cognitive shortcuts called heuristics to resolve problem in the short-term memory. The authors support that heuristic behaviour, which helps reducing the complexity and cognitive effort, is recognized to lead to systematic bias in property valuation.

Yiu *et al.* (2006) identify anchoring bias and survival bias as the two sources of systematic bias. Johnson and Chapman (1999: 115) define anchoring as "*a pervasive judgement bias in which decision makers are systematically influenced by random and uninformative starting points*". Scott and Lizieri (2012) support that anchoring behaviour arise when reference points are made and adjusted to yield a final conclusion. However, the authors argue that while it is acceptable to use a reference point to achieve a final conclusion, inadequacy of adjustment leads to bias that

affect the end result. And according to various studies, anchoring behaviour is prevalent in both the commercial and residential property (Diaz and Hansz 2007; Tidwell and Gallimore 2013).

Survival bias as coined by Kishore (2006) refers to clientele influence on valuation. Generally, professional valuers are commissioned by the client for their services to provide an accurate and objectives valuation. However, given the clients' economic incentive in valuations, the clients and valuers agency relationship may give rise to conflicts of interest. While various studies have proved the existence of client influence on valuations (Kinnard, Lenk and Worzala 1997; Levy and Schuck 1999; and Bretten and Wyatt 2001), Kishore (2006) argues that the survival bias should not be seen as a cognitive behavioural bias as client influence to some extent affects the unethical behaviour of valuers.

Babawale and Omirin (2012), citing the RICS (1994) and the *Singer and Friedlander Ltd v. John D. Wood 7 Co* (1997) court case, observe and support Joslin (2005) finding that a 100% accuracy is impossible. While there is general consensus amongst the academia, the valuation profession and the courts that inaccuracy and uncertainty are inevitable in real estate valuation, various collapse of the financial and property markets could be traced back to inaccurate valuation (Babawale and Omirin 2012). In the UK, subsequent to the 1970s property crash, the standards of valuation and professional conduct were reviewed, with RICS publishing the Red book to provide a uniform valuation standard (Gilbertson and Preston 2005). Similarly the USA experienced the 'savings and loan' crisis in the late 1980s, and the appraisal standards and the licencing of valuers in each state had to be improved. In other parts of the world, similar problems arise such as the 1994 "Schneider affair" in Germany, the Asian financial crisis and most recent 2008 sub-prime crisis (Quentin 2009).

Given that valuation plays a vital role in the financial and property markets, academia and professional communities are paying growing attention on the incidence and measurement of valuation accuracy (Babawale and Omirin 2012). Most recently, with the advancement of technology, psychologists and others have been researching computer aided solution to mitigate and eliminate the effects of decision-making bias (George, Duffy and Ahuja 2000). According to Tidwell and Gallimore (2013), the process that helps decision-making process to identify and examine the normative-descriptive gap to align with normative standards is termed 'debiasing'.

The two primary types of debiasing strategies are cognitive strategies and techniques external to the decision-making (Tidwell and Gallimore 2013). The authors argue that through education, training and experience, cognitive strategies can be improved from a descriptive normative process to a prescriptive normative process. However, it is suggested that due to the cognitive limitations, cognitive strategies are unlikely to achieve the prescribed normative standard (Gigerenzer 2004 cited by Tidwell and Gallimore 2013). The second debiasing technique external to the decision-making approach uses decision support tools and informational displays to improve information processing. Payne, Bettman and Schkade (1999) suggest that the use of decision support aid reduces the search and processing cost of information. A recent study by Tidwell and Gallimore (2013) showed evidence that decision support systems help reducing the anchoring bias.

A review of the literature indicates that, in the context of the South African property market, no study has explored the influence of a decision support tool in the real estate valuation. The correlation between anchoring behaviour and valuation in unfamiliar geographical location is of particular interest (Tidwell and Gallimore 2013). The purpose of this study is to therefore test the efficacy of the decision support systems to mitigating and reducing the anchoring bias in the appraisal process.

### **1.3 Research Question**

The research question to be addressed in this study may be stated as:

*To what extent can the decision support systems help reducing or eliminating the anchoring behaviour in the appraisal process.*

### **1.4 Problem statement**

The problem to be examined in this study is that:

*Little is known about debiasing with the decision support system in South Africa*

## **1.5 Research hypothesis**

The research hypothesis to be tested in this study may be stated as:

- (1) The valuation variation is lower if the valuer is debiased and supported in his decision*
- (2) The anchoring effect is reduced if the valuer is debiased and supported in his decisions*
- (3) The anchoring effect is most prevalent for expert valuers operating in geographically unfamiliar markets*

## **1.6 Research objectives**

The research objectives are to:

1. Determine valuation variations with and without decision support systems
2. Determine whether the anchoring effect is reduced with debiased approach
3. Determine the processing time with decision support systems
4. Establish whether a valuer exhibits heuristic behaviour in an unfamiliar area

## **1.7 Research method**

The above objectives will be achieved by adopting the following research method:

1. A literature review of material pertinent to this study
2. A mock valuation of a property in Cape Town, with experts and novices will be conducted
3. Analysis and interpretation of data
4. Conclusions and recommendations based on findings

## **1.8 Limitations**

This study is subject to the following limitations:

1. Only professional valuers registered with the South African Council for the Property Valuers Profession and current Property Studies honours students from a recognised institution will be invited for the experiment.

2. A potential difficulty in conducting the mock valuation is that experts or novices may have come across the software before.
3. The research will be focus on a property within the Western Cape property market
4. An existing design decision support tools for the real estate market will be used.

### 1.9 Structure of the report

This report consists of five chapters:

The research topic is introduced in **Chapter One**. The chapter begins with an overview of the topic and then provides a background to the study that identifies the research question. The problem statement and hypothesis to be tested are then discussed. The objectives of the research are identified, followed by the research methodology. A statement listing the limitations to the study is then given.

**Chapter Two** provides the theoretical framework on which the empirical study is carried out. This chapter presents a comprehensive literature review, defining valuation, identifying the types of valuation bias and analysing the impact of valuation in the property and financial market. The use of decision support system in the real estate market is also examined.

The research method to be adopted in this study is discussed in **Chapter Three**. This involves a critical review of methods previously adopted by researchers in this field and a description of the research method to be used in this study, as well as a justification thereof.

**Chapter Four** reports on the administration of the mock valuation and, presents the analysis and interpretation of the data collected through the survey instrument.

In **Chapter Five**, the hypothesis is affirmed or denied based on the research findings. Conclusions are then drawn, and recommendations for the implementation of decision support systems are made. Recommendations for further research are also offered.

## REFERENCES

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- Amidu, A.R. (2011). Research in Valuation Decision Making Processes: Educational Insights and Perspectives. *Journal of Real Estate Practice and Education*. 14(1), 19-33.
- Bhandari, G. and Hassanein, K. (2004). A Cognitive DSS For Investment Decision Making: Challenges & Opportunities. *MeRC Working Paper No 13*.
- Babawale, G.K. and Omirin, M. (2012). An Assessment of the relative impact of factors influencing inaccuracy in valuation. *International Journal of Housing Markets and Analysis*. 5(2), 145-160.
- Bretten, J. and Wyatt, P. (2001). Variance in commercial property valuations for lending purposes: an empirical study. *Journal of Property Investment & Finance*, 19(3), 267-282.
- Crosby, N. (2000). Valuation accuracy, variation and bias in the context of standards and expectations. *Journal of Property Investment & Finance*, 18(2), 130-161.
- Crosby, N., Lavers, A. and Murdoch, J. (1998). Property valuation and the 'margin of error' in the UK. *Journal of Property Research*, 15(4), 305-330.
- Diaz, J. III and Hansz, A. (2007). Understanding the behavioural paradigm in property research. *Pacific Rim Property Research Journal*, 13(1), 16-34.
- Dust, A., Evans, K., Lausberg, C. and Viruly, F. (2014). Reducing the property appraisal bias with decision support systems: A two-country, two-method experiment. *Power point presentation presented at the 14<sup>th</sup> AfRES Conference, Cape Town, September 2-5*.
- Geltner, D. (1998) Appraisal smoothing: The other side of the story – A comment. *Working Paper, Department of Finance, University of Cincinnati*, available at <http://www.ssrn.com>, (accessed September 2014)

- George, J.F., Duffy, K. and Ahuja, M. (2000). Countering the anchoring and adjustment bias with decision support systems. *Decision Support Systems*, 29, 195-206.
- Gilbertson, B. and Preston, D. (2005). A vision for valuation. *Journal of Property Investment & Finance*, 23(2), 123-140.
- Hansz, J.A. and Diaz, J.III. (2001). Valuation Bias in Commercial Appraisal: A Transaction Price Feedback Experiment. *Real Estate Economics*, 29, 553-565.
- Kishore, R. (2006). Theory of Behavioral Finance and its Application of Property Market: A Change in Paradigm. *Paper presented at the 12<sup>th</sup> Pacific Rim Real Estate Society Conference, Auckland, New Zealand, January 22-25.*
- Pagourtzi, E., Assimakopoulos, V., Hatzichristos, T. and French, N. (2003). Real estate appraisal: a review of valuation methods. *Journal Property Investment & Finance*, 21(4), 383–401.
- Payne, J.W., Bettman, J.R. and Schkade, D.A (1999). Measuring constructed preferences: Towards a building code. *Journal of Risk and Uncertainty*, 19, 243-270.
- Scott, P.J. and Lizieri, C. (2011). Consumer house price judgements: new evidence of anchoring and arbitrary coherence. *Journal of Property Research*, 29(1), 49-68.
- Shim, J.P., Warkentin, M., Courtney, J.F., Power, D.J., Sharda, R., and Calsson, C. (2002). Past, present, and future of decision support technology. *Decision Support Systems*, 33, 111-126.
- Tidwell, A. and Gallimore, P. (2013). The influence of a decision support tool on real estate valuation. *Journal of Property Research*, 31(1), 45-63.
- Tversky, A. and Kahneman, D. (1974). Judgement under uncertainty: heuristic and biases. *Science*, 185, 1124-1131.
- Yiu, C.Y., Tang, B.S., Chiang, Y.H. and Choy, L.H.T. (2006) Alternative Theories of Appraisal Bias. *Journal of Real Estate Literature*, 14(3), 321-344.

## **ADDENDUM NO 2**

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In a covering email, the participants will be made aware of the purpose of the experiment and they will be informed of the possibility to win an iPad or iPod. The gift, which will be issued on a random draw, serves to motivate participants to complete the experiment.

**ADDENDUM NO 3**

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Not applicable

ADDENDUM NO 4

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Not applicable