An appraisal of the popularity of fundamental and technical analysis as decision making tools for investing in the equity markets by portfolio managers working for large institutional investors in South Africa.

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Executive Summary

The literature reveals that, behavioural finance lends some support to the methodologies of both fundamental and technical analysis. Behavioural Finance supports the concept of investment behaviour being grounded in two dimensions, viz., the dimensions of emotion and rationality. The evidence, presented in the literature suggests that fundamental analysis is grounded in the rational investor, while technical analysis is an attempt to model the behavioural side of investing through trend following, charting and the use of indicators (e.g., momentum, stochastic, etc.).

Typically large investment houses tend to use both technical and fundamental analysis; technical analysis appears to be used primarily for timing, while fundamental analysis is used to establish intrinsic or fair value of the share under focus – thus making it easy to establish whether the share is cheap or expensive.

The null Hypothesis was based on the premise that both technical and fundamental analysis was popular with a significant proportion of portfolio managers, while the alternative hypothesised that there was a significant preference for one or the other.

The response rate of the questionnaire resulted in a sample size of 12. The sample size was sufficient for a statically valid inference. Approximately 50 questionnaires were sent out. Of these 13 responses were received, and 12 selected (from four large institutions) for inclusion – translating into a response rate of 26%.

The low response rate did retain sufficient power and provided evidence to support the null hypothesis - almost all portfolio managers showed a preference for fundamental analysis. However, there was also evidence, at the 95% confidence level, that between 40% and 90% of portfolio managers used technical analysis as well. A possible explanation for this is covered in section 6.

Acknowledgements

Many thanks to my study leader, Greg Dalton for his engaging and useful insights; to the school of business leadership for the administration and general support, with a special mention for the friendly, helpful and efficient SBL library staff.

It would be remiss of me not to acknowledge the portfolio managers and their assistants who took the time to either respond to the questionnaire or arrange responses. Without your co-operation an important part of this report would not have been completed. Thank you.

My love and appreciation to my long suffering family, who've had to put up with me (or is that – put me up).

List of Acronyms

BEP	Basic earnings power
DSO	Days sales outstanding
EBIT	Earnings before interest and taxes
EBITDA	Earnings before interest , taxes, depreciation and amortisation
EMH	Efficient Market Hypothesis
P/E	Price to earnings ratio
ROA	Return on assts
ROE	Return on equity
TIE	Times interest earned
WACC	Weighted average cost of capital

Glossary of Terms

Arbitrage	The practice of making a profit by buying and selling a factor of production in two separate markets where a significant price difference exists which would cover transaction costs.
Bandwagon Effect	The tendency for people to follow the crowd, when making decisions and in the process forgoing a rational approach.
Bearish	Market price that trends downwards
Beta	A popular (mathematically derived) factor usually associated with a company's performance relative to the market.
Bullish	Market price that trends upwards
Business Analysis	The structured and critical method of studying an organisations strategy and environment (internal and external) in which it operates. This includes an in depth understanding of the companies markets, its products and processes and other factors that affect its overall business performance.
Causal study	A study that tries to understand the relationship between an independent and a dependant variable/s.
Chaos Theory	Also referred to as non-linear dynamics, chaos theory is a mathematical theory that tries to explain non-linear behaviour. Chaos theory embodies a set of ideas that attempts to reveal structure in a-periodic, unpredictable dynamic systems such as cloud formation or the fluctuation of biological populations. Although chaotic systems obey certain rules that can be described by mathematical equations, chaos theory underscores the difficulty of predicting their long-range behaviour.
Chart	A time series of price for any security
Co-integration	An econometric technique for testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be co-integrated.
Cross-sectional	A snapshot or study that relates a situation at a given point in

	time.
Descriptive study	A study that tries to answer, who, what, where, when or how much.
Ex ante	Variables represent before the fact expected values, i.e. predicted values
Ex post facto	Variables represent after the fact as well as events subsequent.
Futures	The trading of commodities; to be delivered at some, specified future date.
Go long	Buy security
Go short	Sell security
Longitudinal	A study that tracks changes over a period of time
Open interest	The total number of options or open contracts that have not been delivered on a specific day
Options	The choice (option) to buy or sell a given security at a given price; usually valid for a given period of time. The cost of an option is usually very much less than the security as well. The price usually varies with the closeness of the expiry date of the option and the actual price of the security.
Paereto principle or approach	The *Pareto principle* (also known as the *80-20 rule*, the *law of the vital few* and the *principle of factor sparsity*) states that for many phenomena, 80% of the consequences stem from 20% of the causes.
Random Walk Theory	A theory that expounds that future steps or directions cannot be predicted based on past movements. Implicitly assumes that successive price changes are independent, i.e., the past cannot predict the future.
Resistance	A upper bound price barrier in a chart that has not been broken
Security	Any financial instrument that can be bought or sold on the open market.
Snark	A mythical and extremely rear animal that does not exist reality.
Support	A lower bound price barrier in a chart that has not been broken
Trend lines	Trend lines are patterns that are seen in charts

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Chapter 1 - Introduction

1 Chapter – Introduction

Many of you may have heard the searing debate of Darwinism vs. Creationism. Well there is another hot topic on the block, which has been going on for even longer – technical analysis vs. fundamental analysis. As it appears, behavioural finance appears to be bridging the gap between the technologists and fundamentalists. What this development highlights is that even though we may have a personal preference, to be truly informed, we should at the same time acknowledge that we don't know with absolute certainty.

To understand this debate we need to consider the arguments from the side of technologists and fundamentalists. What exactly is the argument about? Well the short answer is profit. Which approach makes more profit, and how does it achieve this? Of equal importance is the question of understanding what the situation is in South Africa. Do South African portfolio managers share the same view with there global counterparts?

This research paper investigates the popularity of technical and fundamental analysis as decision making tools by South African portfolio managers working for large institutional investors. It does this through an in-depth enquiry into the underlying philosophy and perceived efficacy of these two approaches.

The statistical variability of equity prices from their established fundamental values has long been an impetus for researches to develop more predictive models. The inability of fundamental valuation models to predict this variability, especially in short time frames, naturally would lead us to seek more predictive models. This variability was reportedly observed in the 17th century by Munehisa Homna, a Japanese rice trader; and technical analysis was born with his creation of the price bar or Japanese candlestick (Wikipedia, no date: no page).

It is only much more recently that behavioural finance has explained some of this variability by showing that human investors (as opposed to their computerised counterparts) are grounded in two dimensions, viz. the dimensions of emotion and intellect.

Chapter 2 – Background

2 Chapter - Background

2.1 Study Beneficiaries

This paper is being submitted to an assessor, at *Unisa's Business School*, for the purpose of evaluation as partial fulfilment towards the requirements of the *Masters Degree in Business Leadership*. It will be made available to fellow students interested in the subject of *technical and fundamental analysis*, subject to the rules of the University and the requirements of the research participants. Copies of this paper will also be provided to participating financial institutions, and organisations. It must be emphasised that for the purposes of confidentiality, under no circumstances will any of the research participants be identified.

2.2 Problem Statement

The investment community has long debated the relative merits of fundamental analysis and technical analysis, with the academic finance community generally having a weak view of the latter. While the academic community supports and teaches fundamental investment concepts such as the EMH (Efficient Market Hypothesis) and CAPM (Capital Asset Pricing Model), it has long realised that it needs to explain the significant variability of stock returns that is not explained by fundamentals.

A more comprehensive understanding of how stocks move is being uncovered in such areas as behavioural finance and the psychology of financial markets. These subjects and others, like crowd psychology appear to be the underpinnings of technical analysis. Technical analysis predates CAPM and EMH by decades; and even Charles Dow (founder of Dow Jones) would acknowledge the Japanese rice merchant of the middle Ages who invented the *price bar* (discussed under Charting).

In South Africa technical analysis has found a following amongst both professional and novice traders, who use these tools in just about any market where securities (of whatever kind), are traded. As in other markets, technical analysis as a science has not garnered much faith amongst academia.

- The questions that begs answering is whether teachers are ignoring a ready market that is hungering for exposure to this and associated analytical methods (behavioural finance).
- Should business schools and other institutions add technical analysis to their curricula, in addition to fundamental analysis?
- Is it useful for practitioners to learn or know the tools taught by both technical and fundamental analysis?
- What does the literature say about the current position of technical and fundamental analysis amongst practitioners and academia?

To be able to answer these questions, it would be useful to explore the current thinking of academics/practitioners (through the literature) and identify if the 'serious' investors' put any credence to this methodology for making investment decisions (literature and survey).

The problem statement would therefore read as follows: How popular is fundamental and technical analysis as decision making tools for investing in the equity markets by institutional investors in South Africa? Typically these institutional investors would be represented by portfolio managers employed by these organisations. It is their opinions that will be valued in answering this question.

2.3 Research Objective

Both fundamental and technical analyses are used by many investors, both professional and amateur alike, to make investment purchasing decisions of equities. They are significant tools in the investment community, in that they are not only used for valuing equities, but also for timing buy and sell decisions. Very little information is available about the South African investment community's preference for either of these analysis methods.

The *primary* objective of this research paper is to answer the following question:

- What does the current literature have to say about the pervasiveness and relative merits of technical and fundamental analysis?

- What is the current view of the perceived and proven efficacy of technical and fundamental analysis in the investment community?
- To what degree do large institutional investors in South Africa prefer Technical Analysis as compared to fundamental analysis to make investment decisions in the capital, markets?

To better understand the research objective the following Hypotheses have been developed for a significance test. In the context of significance testing, we can define two basic kinds of situations, reject-support (RS) and accept-support (AS). In RS testing, the null hypothesis is the opposite of what the researcher actually believes, and rejecting it supports the researcher's theory. We will be using the RS approach. The hypotheses developed are:

Ho: *Null Hypothesis* – Both Fundamental and Technical analysis are equally preferred decision making tools as used by the majority of South African portfolio managers for purchasing equity investments.

H1: *Alternative Hypothesis* – There is a statistically significant preference for technical analysis over fundamental analysis or vice versa, as used by the majority of South African portfolio managers for purchasing equity investments.

If a statistically significant proportion of portfolio managers preferred either technical or fundamental analysis, then the null hypothesis would be rejected and the alternative hypothesis supported. A significant number would be any proportion over 0.5 or 50% of portfolio managers. So for example, if can be inferred that 80% of the population of portfolio managers preferred one or the other method when making equity buy or sell decisions, then the alternative hypothesis would be supported. However, if it can be inferred that this proportion is 0.5, than the null hypothesis would be supported.

To be able to answer the above question effectively a broader understanding of the environment was necessary. To facilitate this understanding a few *Secondary* objectives were distilled to be answered during the course of the investigation. These were:

- Who are the large institutional investors in South Africa? In other words broadly define the population?
- Apart from any specific preference are South African portfolio manager familiar with fundamental and technical analysis?
- Does the holding period of the investment have any effect on the preference of one method over the other?
- Is there a correlation between the depth of knowledge an investment manager has of either method and his/her relative preference.
- To what extent is fundamental as compared to technical analysis a driver of investment decision making.
- Is technical analysis viewed as a complement to fundamental analysis, or is the view that they can be applied independently with equal efficacy.

Please note that it was not mandatory to answer these secondary questions, to satisfy the objectives of the primary research hypothesis. Answering these questions simply added a much broader understanding of the primary null and alternative hypothesis. Most of this information was either extracted from the literature survey or inferred from the questionnaires that were answered.

2.4 Benefits of the Study

Having a consolidated and current view of technical and fundamental analysis is of great benefit to anyone with a passing interest in the research objectives of this paper. A consolidated view was achieved primarily through the use of an extensive literature survey.

The benefits of the study will also include a better understanding of the preferred models in local industry (South African). This will be achieved by measuring the preference of technical and fundamental analysis concepts for decision making in the South African investment community. In other words it will answer the question; how significant/important are the use of the different concepts to industry practice.

From an academic point of view this type of information is useful, in that, in can be used to make teaching material in the classroom more relevant to the student (current or future practitioners in the financial industry). Future curricula can be adjusted, to at least, introduce the concepts of these divergent decision making tools. For practitioners, the benefits of this study are informational; i.e., they will be informed of the value placed in technical and fundamental analysis by their fellow practitioners and peers in the industry. Furthermore, it is hoped that this research will provide groundwork for others interested in this subject.

Other areas that may benefit from this study as background are:

- Research into software that makes use of both fundamental and technical analysis.
- Research into the underlying mathematical models that predict price changes based on technical and fundamental analysis.
- Standardising the varying nomenclature that exists within the practise of fundamental and more so within technical analysis.

2.5 Contribution to existing body of knowledge

Compared to literature from international sources, very little has been captured in South Africa with regards to understanding the pervasiveness of technical and fundamental analysis in relative terms. In fact, there is a large global footprint of technical analysts within the financial industry, despite the lack of support for this approach in the academic world (Oberlechner, 2001).

The literature survey thus far has revealed only two attempts to measure the use of technical analysis; one done at Morris University in California and another by the University of Delhi in India. Both of these were conducted within the geographical boundaries of their own home countries.

This paper is intended to answer one basic research question – that of the extent to which portfolio managers rely on technical or fundamental analysis when making share purchasing or selling decisions in South Africa.

2.6 Limitations

The following limitations have been identified:

- The research design limits the population under study to South African industry participants. Inferences beyond this geographical boundary may not be made.
- The study is limited to concepts of fundamental and technical analysis.
- Respondents will be trusted to answer the questionnaire directly, via e-mail or via a facilitator at their organisation (a facilitator makes data gathering more efficient).
- This is a descriptive study in scope and does not make any causal inferences. It purely describes the preferences of a selected group of individuals who are identified by their profession, their affiliation to large institutions and finally by there geographic location (within the boarders of South Africa).
- The survey study had a low response rate. A sample frame of 12 respondents were analysed and a number of pertinent inferences were made.

2.7 Assumptions

The following key assumptions have been made:

- All institutional investors are adequately represented on the internet, as this has been the primary search tool to identify candidates for the population.
- Participants selected for inclusion in the sample offer services that are available throughout South Africa and beyond. For the purposes of this study the data will be assumed only to be applicable in South Africa.
- Respondents in each institution have a sound knowledge of key financial and statistical concepts used in the questionnaire. This assumption was checked directly by the questionnaire.
- Due to strong competition in the financial markets it has been assumed that the population has equal access to the basic tools of both fundamental and technical analysis. This is a reasonable assumption, given the availability of information, the sophistication of the industry in general, and the corroborative responses of the survey. The general literature also supports the view that large financial institutions have access to sophisticated software that make use of complex modelling techniques based on both technical and fundamental analysis.

Chapter 2 – Literature Review

3 Chapter – Literature Review

3.1 General

'One of the greatest gulfs between academic finance and industry practice is the separation that exists between technical analysts and their academic critics' (Lo, Mamaysky & Wang, 2000: 1705). Finance, appears, not driven solely by fundamental and/or statistical analysis. Some approach needs to be found to explain 'the 80% of variability that exists in stock prices, which is not explained' by fundamental analysis (Flanegin and Rudd, 2005: 28). Researchers have sought the answers to these questions in the areas of behavioural finance; which includes the study of crowd psychology, sociology and the psychology of capital markets.

By definition, fundamental analysis measures all the underlying economic factors to arrive at an intrinsic value of a commodity or asset. By comparing this value to the current market price one can immediately determine if the market is overpriced, under-priced or at equilibrium, indicating a sell, buy or hold, respectively. While fundamental analysis focuses on, inter alia, the economics of supply and demand and their effects on price levels, technical analysis is the study of market action, i.e., price and volume. Both approaches, attempt to solve the same problem, i.e., to correctly predict the direction that prices are likely to move, and by how much. According to Murphy (1999), fundamental analysis is the study of the *cause* of price movements while a technical analysis is the study of the *effect*.

The *Random Walk Theory* is predicated on the basic assumption that the future cannot be predicted by looking at the past, or stated differently; past prices are not correlated, or rather, have insignificant correlation to future prices. Insignificant correlation, in this case would be determined by the investor not being able to use the series of past behaviour of prices to increase profits. According to Joy (1987) trying to predict stock market price movements may be as prudent as finding a *Snark* (refer to glossary of terms for meaning).

Many have totally negated the value of the *predictive* power of both fundamental and technical analysis. Famous amongst these are Burton G. Malkiel, who, in his book titled ‘A Practical Guide for Random Walkers’, states, ’Neither fundamental analysis of a stock’s firm foundation of value nor technical analysis of the market’s propensity for building castles in the air can produce reliably superior results. Even the pros hide their heads in shame when they compare their results with those obtained by the dartboard method of picking stocks’ (Malkiel, 1999: 407). However, Malkiel does support the view that both *technical* and *fundamental* analysis are *helpful* tools in identifying a portfolio of shares that will at the very least match the market performance indices (Malkiel, 2003).

As discussed by Fama (1965), most empirical tests done up to 1965, supported the assumption of independent price movements, and therefore, of the *Random Walk Theory*. If this model is an accurate one of the market, than technical analysis would be of no value and fundamental analysis only useful when new information is uncovered that will affect the intrinsic value of a stock. In any case, under this theory, returns would not be greater than the expected profits from a naïve buy-and-hold strategy (Fama 1995: 77).

Since then, however, several academic studies have shown some support for technical analysis, and dearth for fundamental analysis. Amongst these papers which reject the *Random Walk Theory* of stock prices are Lo, Mamaysky and Wang (2000), Feng, Yu and Stone (2004), Greenberg (2003), Vaga T (1990) and Taylor (1994).

One explanation for this controversy is perhaps the kinship between Technical Analysis and Chaos theory; a relatively new area in mathematics, which tries to explain, seemingly random events, i.e., the order within apparently chaotic events. An example of an area where chaos theory has been used with some success is in modelling the turbulent flow of a liquid - linear mathematics can model laminar flow, but fails in the turbulent flow regime. It has been asserted by Clyde and Osler (1997) that *technical analysis* may represent a crude way of explaining non-linear qualities in stock price movement. Chaos theory; shows promise in modelling random behaviour in nature, including such things as crowd behaviour and the behaviour of participants in a market.

The development of predictive models of equity markets can be compared to the continual development in models for weather patterns. Over the years with the development of more powerful computers and the concomitant development of more complex software (which does make use of chaos theory), it has become possible to predict weather patterns days in advance with a useful degree of accuracy.

As concerns market pricing; it appears that our mathematical modelling techniques and theories are not advanced enough to be entirely predictive; whether the objective is to accurately model turbulent flow of a liquid, crowd behaviour or the behaviour of investors in a market, we need to develop these models further to capture the complexity that exists in these systems. For now, they provide a fair guide to creating portfolios that, on a balance of probabilities, will provide average returns. The answers we are looking for may well lie in other disciplines (Harvey, 2006).

3.1.1 Fundamental Analysis

Fundamental analysis of any security can be broken down into a three step approach:

- Macroeconomic and microeconomic analysis, which could include forecasting variables such as, international and local GDP growth rates, inflation rates, interest rates, regulatory frameworks, exchange rates, productivity figures and prices for various factors of production e.g., labour and energy.

- Industry analysis, which, depending on the security, inter alia would include an analysis of such variables as price levels, forecasts of total sales (market size), the threat of competing and substitute products, both local and imported and the costs of entry and exit from the industry.

- The third step would be a detailed analysis of the individual security; again depending on the security in question this could include unit sales, prices, base cost of production, transaction costs, issuance of new debt or equity, and a myriad of other variables that are directly related to the security in question.

In stock valuation, fundamental analysis is a method that uses financial and economic analysis tools to establish an intrinsic value. Information analysed may include both qualitative and quantitative data. This could range from a company's financial reports to non-financial information such as estimates of the growth of demand for competing products and services, industry comparisons, effects of new regulations, demographic changes, and other variables that effect the intrinsic value of the share, notwithstanding from which quarter it may originate.

A financial analysis of a company would include looking at a multitude of factors. Some important company factors to consider may include the historical, current and projected figures of earnings, cash flow, revenue, debt, dividends, and cost of sale amongst others. Based on the results of such an analysis a portfolio manager may make a buy, sell or hold decision.

To further this end, ratio analyses are important indicators in determining intrinsic value. An important caveat here is that ratios by themselves are not objective measures; they must be interpreted. For example a high P/E ratio may indicate an overvalued stock or it may indicate a company with good growth potential. One important way of combating this interpretation problem is to use a few different valuation techniques. Some of the more familiar ones are discounted cash flow, book value and dividend yield analysis.

The philosophy underpinning fundamental analysis is that a potential investor must consider all the variables that affect the intrinsic value of a company rather than focusing on the stock price and volume as expounded by the theory of technical analysis.

It has been argued that fundamental analysis is more suited to long run investment decisions. Furthermore, it is an iterative process, which must be redone periodically to account for changing fundamentals. Such an analysis is designed to find companies that last, at least in the medium to long term (as we all know, or learn, in life, nothing lasts forever). What this means is that in the short run the market is a playground for arbitrageurs, while in the long run prices will tend towards, or fluctuate around their intrinsic value. Fundamental analysis has long provided valued tools to investors in determining this ‘potential’ value of a company.

To summaries; fundamental adherents believe that a companies ‘intrinsic value’ will be eventually reflected in the stock price through market forces, because in the long run, the assumption is that of an efficient market.

A fundamental analysis relies on discounting all known information about a risky asset to come to an intrinsic value at a given point in time, a snapshot, if you will. When contrasted against *Technical Analysis* an important difference becomes apparent; it does not assume a correlation between past prices and present value. The model only predicts what the risky assets value should be at the time of its computation. Under the efficient market hypothesis, it would then be reasonable to expect that over time prices should tend towards the most recently calculated value of the risky asset (provided that all known information has been discounted in the determination of that price).

3.1.1.1 Fundamental Analysis Concepts

Portfolio Theory: According to the theory, it's possible to construct an 'efficient frontier' of optimal portfolios offering the maximum possible expected return for a given level of risk. This theory was pioneered by Harry Markowitz in his paper "Portfolio Selection," published in 1952. The optimal set of portfolios for a given level of risk is given by the straight line in Figure 1 below. The figure represents the relationship between return and risk (as represented by the standard deviation of all attainable portfolios). The attainable set is represented by the area enclosed by the conical curve.

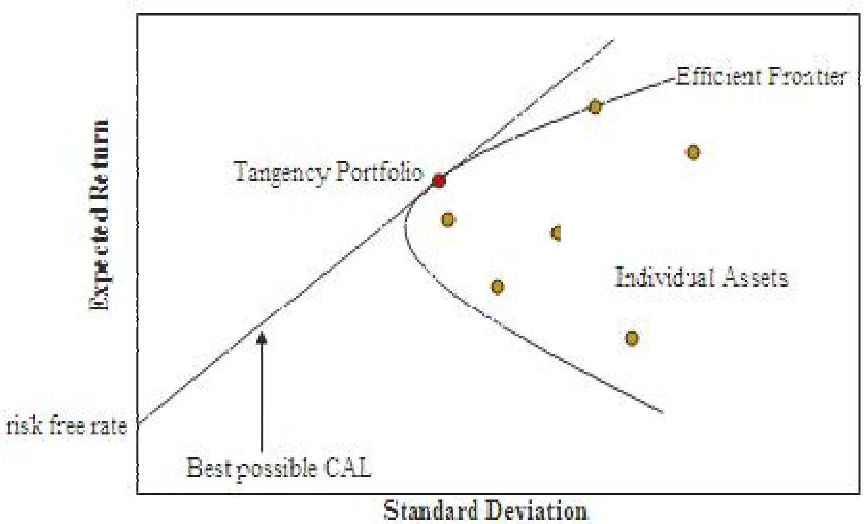

Figure 1: The efficient portfolio frontier or Markowitz Frontier.

There are four basic steps involved in the portfolio construction:

- Security Valuation
- Asset Allocation
- Portfolio Optimisation
- Performance Measurement

Arbitrage Pricing Theory: The theory was initiated by the economist Stephen Ross in 1976. Arbitrage pricing theory (APT) is based on a linear mathematical function that models various macro-economic factors. Each factor's sensitivity to change the underlying price is represented by a beta coefficient (similar to beta in the Capital Asset Pricing Model - CAPM). In fact the CAPM, discussed below, can be interpreted as a special case of the APT.

As with other fundamental analysis models, APT makes certain important assumptions:

- There must be perfect competition in the market, i.e., market efficiency
- The total number of factors that affect the price of a stock may never exceed the total number of stocks (to avoid the problem of matrix singularity).
- Every factor is assumed to be a random variable with a mean of zero.

Arbitrage pricing theory is based on the investor taking advantage of a pricing imbalance between risky assets. He or she does so by selling the asset that is over-priced and buying the one that is under-priced. The process continues until all assets are brought in line with their calculated intrinsic value as predicted by the modelled portfolio theory.

The APT model is described by Equation 1. Please refer to Appendix A for list of equations in this and following sections.

That is, the uncertain return of an asset j is a linear relationship among n factors. Additionally, every factor is also considered to be a random variable with mean zero. Adapted from an article found at http://www.answers.com/topic/arbitrage-pricing-theory

CAPM/Beta: Investors demand a proportional return for bearing risk, i.e. the higher the risk, the higher must be the associated return; and vice versa. In selecting an optimal portfolio, investors face two types of risk, market risk and diversifiable risk. Market risk is usually represented by the standard deviation of the market, while the diversifiable risk is usually represented by the stocks beta coefficient, a concept expanded on in the discussion that follows. The diversifiable risk is achieved by selecting betas that are negatively correlated. In reality this is a near impossible task to consistently find negatively correlated *betas* (most stocks do well when the economy as a whole does well and vice versa). From practise it has been established that a portfolio consisting of 40 or more stocks in a number of different industries will reduce the variability of an average individual stock by almost half.

The *CAPM* (an *ex ante* model) provides an important tool for measuring this important relationship between risk and return, through the concept of the beta coefficient. The main premise of this model is that the only relevant risk is the risk added to a well-diversified portfolio of securities. This relevant risk is measured by the individual securities *beta* coefficient. The beta coefficient for an individual security is given by Equation 3.

Note that high beta stocks are riskier than low beta stocks, i.e. they add greater volatility to the portfolio. Following from this then it can be easily seen that stocks with high correlation coefficients and standard deviations will increase beta, thus adding to the volatility. By definition an average risk stock will have a *beta* of 1. On the other hand if *beta* is greater than 1, then the stock on *average* is more volatile than the market against which its being measured, and vice versa.

The relationship between risk and return is given by the security market line (SML) as in Equation 4.

The CAPM is widely used to estimate the rate of return k_i. Brigham and Ehrhardt (2002), state that a research paper in 2000 reported the results of two surveys, finding that almost 74% and 85% of the respondents in each survey used the CAPM to establish the valuation of stocks.

It must be stressed that, this method, even though widely used, requires a great deal of judgement in determining the exact cost of equity capital. In conclusion, the value of the CAPM can be found in its assertion that: 'The relevant risk of an individual stock is its contribution to the risk of a well-diversified portfolio of shares.' (Brigham and Ehrhardt, 2002: 219).

Internal Rate of Return (IRR): The IRR is defined as the discount rate that equates the present value of a project's expected cash inflows to the present value of the project's costs. This is represented by Equation 5.

The importance of this method lies in the fact that if the IRR exceeds the cost of capital, this results in an increase in shareholder value. This makes it a reasonably undemanding method of determining profitable investments. The IRR finds extensive application in situations where comparisons have to be made between investment opportunities competing for scarce capital resources.

Dividend Discount Model: The dividend discount model stated simply is given by Equation 6. This model is useful for valuing stocks that pay out a large and fairly 'constant' amount of earnings as a cash dividend.

Ratio Analysis: Financial statements are snapshots of the firm's position at a point in time. There value lies in the fact that the historical data accumulated can be analysed in a way that has some predictive power. This analysis has an even greater significance when viewed in conjunction with other indicators within the internal and external environment of the organisation. Usually the analysis of the internal and external environments would fall under the purview of a fully fledged business analysis, with the financial analysis forming an important component.

A financial analysis can be used to predict such important variables as future earnings, dividends and free cash flow. A word of caution here; it is clear that such variables are a function of a much larger equation and should wherever possible be accompanied with a full blown business analysis. Calculating financial ratios are an important component of financial analysis and are designed to help evaluate financial statements.

A good example is evaluating the debt burden of two companies competing in the same market. Company A, might have a higher debt burden then company B, and pay more interest charges, but due to the power of leverage, company A, might be better off despite it's higher debt burden. Ratio analysis helps, to clarify these strategic financial strengths and weaknesses of each company. By calculating ratios, one is in a position to comment on the ratios of an individual firm compared not only to its competitors, but also to industry averages. Through ratio analysis one can make inferences about the financial health of a company, given specific macro-economic and industry conditions; for example, in a high interest environment, a high debt to asset ratio usually adds to the financial risk and is viewed negatively by investors. It is critical when analysing ratios, to look at *trends* over time as well as absolute values. *Trend analysis* involves plotting the ratios in question over time.

Brief descriptions of the more popular ratios are given below:

Current Ratio measures a company's ability to meet short term obligations. It is calculated using Equation 8.

By removing the least liquid of current assets (usually inventories), one gets a better picture of a companies ability to pay off short term obligations.

Inventory turnover ratio is calculated using Equation 10. The intended result is to establish the number of times a company sells out, or turns over its stock holding during the accounting period (usually 1 year, but also calculated for periods of 6 months in interim reports). Because Sales is usually stated at cost + gross profit, while inventory is stated at cost, the intended result is somewhat different. However, if the equation is applied consistently the comparative measure is equally effective.

Another caveat to the above ratio is that sales occur over the entire year, while stock is measured at a given point in time. Due to this it is better to use an average inventory figure. Whichever approach is used, one should be consistent in its application to ensure the effectiveness of the application of this ratio.

Days sales outstanding (DSO), also called the 'Average collection period', measures the average length of time that the firm must wait after making a sale before receiving cash. This is an important ratio, as it measures how much of the companies cash flow is tired up in credit sales. Again an important caveat; the annual sales figure is assumed to be credit sales. If a company has both cash and credit sales the above ratio will not make much sense. For example, a company like Pik 'n Pay, will not have be able to measure this ratio as most of its sales are on a cash basis. The ratio is stated by Equation 11.

Fixed assets turnover ratio given by Equation 12 measures how effectively the firm uses its net fixed assets in generating turnover. Once again, this ratio has more meaning when using it comparatively against other companies operating in the same industry and against industry averages.

The problem of balance sheets reflecting historical asset values has been a problem for the accounting profession for a long time. Essentially, the problem has been one of inflation, where over time assets simply do not reflect a realistic replacement cost (they are acutely understated). What this means is that if one were to compare two similar sized companies in the same industry, with one company being relatively new compare to the other, you would probably find that the older company had the higher fixed assets turnover ratio. This result would be more reflective of the difficulty accountants have with the inflationary effect on the time value of asset on the balance sheet, than with any efficiency problems at the new firm. Financial analysts usually do not have the required information to make the appropriate adjustments; they therefore simple recognise the problem in their analysis.

Total assets turnover ratio, similar to the previous ratio, measures how effectively the firm uses all of its assets in generating turnover. This ratio is stated by Equation 13.

The same limitations apply to this ratio, as with the previous one.

Total Debt to Total Assets, also called the debt ratio, measures the relative amount of funds provided by creditors as compared to equity holders. Total debt includes all of the company's debt, i.e. both current and long-term liabilities. While equity holders want to maximise returns through leverage, creditors prefer low debt to asset ratios, to reduce the risk of loss through liquidation. The ratio is stated by Equation 14.

Times-interest-earned (TIE), given by Equation 15, measures the amount a company earns as a multiple of its interest obligations (due to debt). Because interest is paid with pre-tax income, the figure used in the numerator is EBIT (Earnings before interest and taxes).

This is an important ratio as it is one of the indicators that reflect whether a company is over or under-leveraged *relative* to the industry averages (i.e. to ratios calculated for other companies, *preferably* in the same industry). Note: A better way to calculate the optimal debt-ratio is by plotting the WACC (Weighted average cost of capital) against the debt-to-asset ratio.

This ratio has two shortcomings:

- Interest is not the only fixed financial charge. Firms also must repay debt on time as well as honour lease obligations if these exist

- EBIT does not represent all the cash available for meeting the company's debt obligations, a better measure to EBIT is EBITDA (Earnings before interest, taxes, depreciation and amortisation).

EBITDA coverage ratio is given by Equation 16. The previous ratio listed two major shortcomings. Due to these the EBITDA coverage ratio is a more representative calculation for assessing a company's ability to meet its debt obligations.

Profit margins on sales, given by Equation 17, are useful when used comparatively against other companies and industry averages.

Consideration must be given to a company's use of leverage. Two companies with the same profit margin may show differing returns to stockholders due to the use of leverage.

Basic earning power (BEP) is useful in that it excludes the influence of taxes and leverage on earnings. This is advantageous in that it reflects the efficacy of a company's business strategy in generating earnings without the influence of its financial strategy, which may include the use of leverage and tax avoidance schemes. The BEP is given by Equation 18.

Return on total assets measures net income (available to stockholders) to total assets and is given by Equation 19.

Return on common equity is a 'bottom line' ratio, in that it reflects the return to stockholders. It is given by Equation 20.

Stock holders invest to get a return on their money. Ultimately this ratio (and its future projections) will play an important role in determining the buy or sell decisions of investors.

Price/Earnings ratio as given by Equation 21 is the market cost of a share divided by it's per share earnings.

P/E ratios are an important indicator whose interpretation is company specific. In other words a low P/E ratio can be interpreted very differently depending on specific company and market information.

Price/Cash flow ratio is a relevant ratio, as cash flow or liquidity is an important factor for any going concern. Cash flow problems have led to the demise of many company's, as a result, this ratio is critical to the overall financial analysis of a company. The ratio is calculated using Equation 22.

A quick way to calculate cash flow per share is to add net income plus depreciation and amortisation, then dividing it by common shares outstanding. Note that cash flows due to investing and financing activities are not relevant as an investor is usually only interested in cash flows generated by operating activities. Again, the importance of consistency must be stressed, when calculating, this and other ratios.

Market/Book ratio is given by Equation 23. As discussed previously, because asset values as reported on a balance sheet don't take into account inflation or 'goodwill', M/B ratio, is typically greater than one; meaning that investors generally are willing to pay more for an asset than its stated book value.

3.1.2 Behavioural Finance

The academic world may not have embraced technical analysis; however, huge interest in the area of *behavioural finance* has been evident. The subject was given a tremendous boost with the award of the 2002 Nobel Prize in Economics to Daniel Kahneman. Essentially, what was shown was that human beings, in every walk of life, are defined by, and operate subject to, at least two very powerful dimensions, viz. the Emotional Dimension and the Intellectual Dimension. - There may be others, but certainly these dominate.

Kahneman, together with Tversky (deceased), provided a theoretical foundation (called *prospect theory*) for behavioural finance by integrating *psychology*, *sociology* and *economics*. Their work demonstrated that human behaviour consistently departed from those predicted by the rational decision making assumption of traditional economic theory. Furthermore, they showed that through the use of heuristic shortcuts, people systematically depart from the principles of probability. Their work is seen as revolutionary (a paradigm shift) in the field of financial economics, by proposing the behavioural biases in general and *prospect theory* in particular, are better explanations of how decisions are made in risky situations.

While this appears to be a growing field in academic circles, there is some empirical evidence of it being used practically in the financial world; certainly the subject has produced a practical financial model (*prospect theory* is a mathematically formulated theory that provides an alternative to expected *utility theory*, dealing with decision making under uncertainty) that have gained a popular following in the fast-paced, financial world. A question that must be addressed by financial institutions is how to integrate this model of behavioural finance into their computer based financial modelling software.

Be that as it may, it is the beginnings of an attempt to answer the all important question of why markets continually display extremely volatile behaviour. Behavioural finances merge concepts from *financial economics*, *psychology* and *sociology* in an attempt to construct a more representative model of human behaviour in financial markets.

Most of us, who have studied economic theory, have had to grapple with the *Efficient Market Hypothesis* (EMH), introduced by Markowitz in 1952 and subsequently named by Fama in 1970. *EMH* assume that markets incorporate all public information and assert that share prices reflect all relevant information. Fama proposed three forms of market efficiency:

- Weak-form efficiency. Excess returns cannot be earned by developing rules based on historical price or return information and share prices discount all past information.
- Semi-strong form efficiency. Excess returns cannot be earned from trading rules based on publicly available information and share prices discount all information in the public domain.

- Strong-form efficiency. Excess returns cannot be earned from information whether it is publicly or privately available as it has already been discounted into the price. Share price discount all currently available information.

Adapted from Mills R (2004: 35)

A significant body or research, has over years, revealed support for both the weak-form and semi-strong form of market efficiency.

Under *EMH*, all information is discounted into the price of the equity and therefore future prices are unpredictable and will follow a random walk. This assumption does not agree with the experience of many of us. The evidence that supports the efficiency of markets is that it is very difficult to consistently earn returns, which beat the market. There are very few portfolios that consistently outperform the market, and then too, it is has been argued in the literature that this can be explained on the basis of statistical chance (Brabazon and Menyah, 2004). The Nobel Prize in effect, highlighted the dubious grounding of the *Efficient Market Hypothesis*, which evidently only relies on the intellectual side of investor behaviour. However, the weak form of *EMH* still has merit and applicability in the financial world.

Traditional economic theory is underscored by the assumption of participants with perfect rationality that engages in utility maximising behaviour. This assumption is in every way an over-simplification of the reality which surrounds us. In a fast moving decision environment, it is clearly not possible to assimilate all the relevant information. As a result, to make the process more efficient we adopt *mental heuristics*, that, in the process of simplifying the decision making processes, omits information in exchange for efficiency. These heuristics have the potential to lead to *cognitive illusions* such as:

- *Representative-ness*: This is the tendency to make decisions based on stereotypes, i.e. seeing patterns where none may exist. Under this fallacy, investors would be encouraged by chasing stocks that have performed well in the recent past. Under *EMH* theory, markets are fully rational, and any trends in share prices should not be predictive of the future price.

- *Over-confidence*: This behaviour is experienced by investors who over-emphasise their predictive ability, and therefore engage in 'timing' the market. This can result in over-trading, which can lead to increased trading costs.
- *Anchoring* occurs when an investor fixes a value scale to a share, based on the trading range in the recent pass.
- *Gambler's fallacy* occurs when investors make predictions about a trend reversal, based on historical price trends.

The above list of cognitive illusions is often levelled at technical analysts.

A second group of illusions can be grouped under *prospecting theory* (Kahneman and Tversky, 1979). This theory uses a descriptive approach to try and understand how people make decisions under risk. It suggests that several 'state of minds' exist which can influence these decisions. Three important descriptors for these elements are:

- *Loss aversion* is based on the perceived psychological penalty associated with a given loss being greater than the perceived reward from a gain of the same size. By extension this means that if, investors are loss averse, they may be reluctant to realise losses and may even take increasing risks in the hope of recouping those losses. Loss aversion provides a feasible explanation for 'averaging down' investment tactics, investors increase exposure to a falling stock in an attempt to recoup prior losses.
- *Regret aversion* usually is embodied by a type of paralyses of the decision maker. This stems from a desire to avoid feeling the pain of regret resulting from a poor decision. Regret aversion may result in 'herd behaviour', e.g. investing in hot stocks as these carry an implicit lower risk of regret.
- *Mental accounting* refers to an individual pigeon holing financial decisions. For example he/she may mortgage a home at a relatively high interest rate to purchase a car while at the same time saving at relatively low interest rate for a child's university fund.

Empirical evidence of the relevance of behavioural finance can be found in the dot.com bubble, the Enron debacle, the recently highlighted, highly questionable business practises of some large firms and other similar events. Some of these events like the tulip bulb mania in Holland in the 17^{th} century and the more recent dot.com bubble; have causes which can all be traced back to human emotion. 'Increasingly, behavioural finance is questioning the impact of individual behaviour and crowd psychology on decision-making in financial markets', (Brabazon and Menyah, 2004: 22).

While the above cited examples represent extreme forms of behaviour, more subtle forms can also be identified in shorter trading cycles. A good example of this was the recent (June 2006) rise in local interest rates by the reserve bank which was quickly followed by a noticeable under-correction in share prices. The JSE All Share Index dropped by almost 3,000 points, down to the 18,000 level, representing an approximate 15% drop in prices. Five months later, despite further rate hikes (of similar magnitude), the index, had not only corrected itself closer to its original levels, but had broken new records at the 24,000 level.

The implications of all of this for the financial markets are:

- Biased over and under reaction to price changes – prices fluctuate about intrinsic value.
- Extrapolation of past trends into the future – emotion (bandwagon effect) dictates buying and selling trends.
- Lack of attention to the fundamentals underlying a stock – loosing touch with reality, e.g. dot.com bubble.
- Undue focus on popular stocks – Enron, Worldcom, where the focus was on the stock and not the fundamental principles of good governance.

The above assertion seems to validate the underlying philosophy of technical analysis. Because of the large, but difficult to measure impact of human behaviour, approaches that model behaviour may have merit in providing additional indicators, which when combined with a fundamental approach may give investment institutions the edge to deliver superior (above average) returns.

Richard Dawkins, in his 1976 book, ‘The Selfish Gene’, lends support to a growing field known as memetics, which believes that investors can become contaminated with infectious thoughts. This means that investors tend to follow the herd (which may not be the incorrect thing to do especially if there is a predator on your tail), and tend to under or over-react to events, which explains the boom and bust cycles we see in the markets. Charles Mackay, as early as 1841, recognised this type of behaviour. Summed up in the title of his book, ‘Extraordinary Popular Delusions and the Madness of Crowds’, he documented Tulip mania (1634-35), the South Sea Bubble (1711) and the Mississippi Scheme (1719-1720). However, these were not the only evidence supporting behavioural finance, since then empirical evidence of this type of manic behaviour can be found in investment in canals, cotton, railroads, gold, oil, computers, biotechnology and the 1999 dot.com bubble, to name only a few. In each case investors lost touch with the intrinsic value of the asset or commodity and prices leaped into orbit. Again, in every case, corrections followed and in many cases, these were over-corrections, again losing touch with the intrinsic or fundamental value of the asset of commodity being traded.

The idea that behavioural finance puts forward is that investors make *satificing* decisions. *Satificing* decisions are those that meet the requirements of our own demands, but make sacrifices in logic and analysis under pressure for a result – again, highlighting the limitations of heuristics.

3.1.3 Technical Analysis

Until relatively recently, technical analysis was regarded as something of an obscure if not a ‘voodoo’ art amongst professional investors and academics; often being seen as divergent as ‘the difference between astronomy and astrology’ (Lo, et al, 2000: 1705). The very idea that historical price patterns could be used to predict future price trends was regarded as ludicrous amongst serious investors. This view, however, has changed over the recent past with this particular area attracting an increasing number of notable adherents.

At the very basic level, technical analysis can be defined as “the study of market action, primarily through the use of charts, for the purpose of forecasting future price trends” (Murphy, 1999: 1). Market action refers to three sources of information, available to the technician, i.e., price, volume and open interest (open interest is used only in futures and options). Essentially this action is the result of *crowd behaviour* or rather, the mass behaviour of buyers and sellers. The aforementioned behaviour is reflected in (reportedly) identifiable patterns made by price movements that are plotted on a scaled time series (a *price chart*). For practical reasons, discussed later, *price charts* are usually plotted on a linear scale in the short term e.g., intra-day or weekly data and on a logarithmic scale for longer time periods i.e., 1-year plus.

Human beings tend to make decisions in the same manner, the world over. Whether it’s trading futures on the Stock Exchange in New York or equities in Johannesburg, investors have a finite set of trading and investing objectives. The tools available to make these decisions are also finite. It could be a single tool such as a *DCF* (Discounted Cash Flow) Analysis, with the result culminating in a buy, sell or hold decision. Or it could be a combination of a number of more sophisticated and exotic tools (including business simulation software), again resulting in one of three decisions - this approach towards decision-making by a large number of individual’s could result in *statistically predictable behaviour* that comes to life in identifiable patterns in *price charts*.

According to Murphy (1999) Technical analysis is based on three fundamental premises:

- The going price discounts all the underlying fundamentals – All information is reflected in the price of the security.
- Price moves have identifiable patterns – basically the basis for charting
- History repeats itself – cyclical patterns in charts (also known as 1-2-3 up and down patterns)

A discussion of fundamentals under the topic of technical analysis may appear out of context. However, it is reasonable to conclude that it is the underlying fundamentals that move markets; while charts are not the causative agents, they simply reflect the underlying psychology of the marketplace. To a technician, price action discounts everything, which is reflected by the relationship between supply and demand. Supply/demand analysis represents the very basis and the early beginnings of all economic forecasting theory. This theory teaches that, in an efficient market, if supply exceeds demand, prices should fall and conversely if demand exceeds supply, prices should rise. Incidentally, no market has been shown to be more efficient or liquid then the foreign exchange (forex) market, where the use of technical analysis proliferates (forexproffessionals.net: module1.1).

So if price discounts everything, then it would be reasonable to conclude that all the technician needs to do is study the market price. In other words, the technician accepts that there are reasons why markets go up or down (*bullish* or *bearish*); he or she just doesn't need to know what those reasons are to forecast using price charts. Of course, knowing the reasons, and being able to identify the resultant pattern strengthens the decision of the investor.

Historically, it has been shown that market price tends to lead the known fundamentals, i.e., the known fundamentals have already been discounted in the price. Many of the most spectacular bull and bear markets were well underway before any changes in the underlying economic fundamentals could be perceived (Murphy, 1999).

While the preceding discussion has emphasised price, it is important to note that volume is also important, primarily because it is an independent indicator from price. Volume tends to act as a confirmation for up or down movements in price and generally validates the identified trend. Equity markets generally tend to make available real time information on volume; however, this is not the case in the forex markets where technical analysis proliferates. Given that real time information on price is available, one can only speculate as to the reasons why volume is not also quoted in forex markets.

The second premise, on which technical analysis is based, is as important as the first, i.e., that prices move in identifiable trends or patterns. This approach requires the identification of trends for the purpose of trading in the direction of this trend until the weight of technical evidence predicts a reversal. While this may at first sound contradictory, technical analysis is predicated on being able to identify trend direction and points of reversal by interpreting the preceding historical patterns.

If one does not accept the argument that prices do in fact trend, and that those trends tend to persist, then there would be no reason to use this forecasting tool.

As has been stated above, technical analysis is about the study of price which is caused by the behaviour of *statistically* large numbers of buyers and sellers. In this scenario the behaviour of an individual buyer or seller is not important compared to the overall interaction of all the players in that market (the assumption is that of an efficient market). This essentially translates to a study of crowd behaviour or human mass, psychology, which as history has shown, tends not to change. According to Murphy (1999), another way of stating this last premise – that history repeats itself – is that we can predict the future by studying the past, or that the future is just the past being repeated.

A central concept in science and the scientific method is that all evidence must be empirical, or empirically based, that is, dependent on evidence that is observable by the senses. It would therefore be instructive to review studies which have empirically tested technical analysis.

Harvey (2006), with the foreign currency market as a backdrop, broadly discusses effects of investment behaviour as a function of the socialisation of the investors involved. His argument emphasises the psychological driving forces as playing an important and often neglected role in determining prices in currency markets. While his arguments have merit one cannot extend them to the equity markets without further empirical evidence. Murphy (1986) looked at 11 technical funds (after initially starting out with 16). These were funds that reportedly only used technical analysis to make investment decisions. His results showed that these funds were inferior to the returns obtained on the US stock market and even on the 'risk-less' T-bill. However, he did also find that during this period that some of the technical funds were at least as effective as the passive buy-and-hold strategy. His data set consisted of 60 monthly observations from May 1980 to April 1985.

Fiess and MacDonald (1999), have used a Granger causality model (a discussion of this model is beyond the scope of this research report, but may be found in the literature), to demonstrate a relationship between stochastic time series data for the Dollar/German mark and Dollar/Japanese Yen. Using the daily high, low and close prices it was shown that a *co-integration* relationship existed. Using a derived dynamic modelling strategy it was further shown that in these two separate currency markets it was possible to beat the buy-and-hold strategy. They concluded that this 'technical' approach provided a statistically significant profitability over the naïve buy-and-hold strategy. Again, given the scope of the above cited research, it was not possible to extend these results to the equity markets.

Neftci (1984) found that the predictive power of trend following and moving average methods of technical analysis in the soybean, gold, copper and T-bill markets all showed statistically significant returns. It was not clear, weather these returns beat the buy-and-hold strategy or a strategy which was underpinned by a fundamental analysis.

In her paper Núñez-Letamendia (2002), explores the usefulness of genetic algorithms, an artificial intelligence technique, in the design of technical trading systems. Genetic Algorithms or GA's as she calls them, are based on evolutionary mechanisms and theories of natural selection and genetics, the design and methodology of which lends it-self to many other applications. Four different models were programmed and applied to the IBEX-35 on the Madrid stock exchange; each one based on technical indicators. The results indicated a statistically significant profit, albeit not very much larger than a buy-and-hold strategy would have yielded.

From the above, it can be seen that the literature has provided some evidence that supports the technical approach. However, this is by no means conclusive.

3.1.3.1 Technical Analysis Concepts

Charting: A price chart is a sequence of prices plotted over a specific timeframe. Prices are plotted from left to right, with the most recent plot being the furthest on the chart.

The timeframe used for forming a chart depends on the compression of the data; e.g. daily data has been compressed to show each day as a single data period, with the result that a daily chart will display one or two months worth of data, depending on the physical size of the chart.

Long term charts are usually used to identify the primary trends, while shorter term charts are used to identify the secondary and tertiary trends. In other words long term charts are used to get the broad picture, while short term charts are used to zoom in on for the purpose of trading. Log linear scale is also quite popular (prices being on the log scale), as this scale makes it easier to visually see the doubling of prices.

There are four popular types of charts, viz.

- Bar Charts
- Line Charts
- Japanese Candle Sticks
- Point and Figure

Bar Charts are the most commonly used by technical analysts. The horizontal scale on the bottom of the chart indicates the passage of time. The time scale can be anywhere from minutes to years, with the most popular scale being the daily bar chart, the weekly bar chart and the monthly bar chart. The “bar" is the range of price for the particular time period; the top of the bar represents the highest value, while the bottom of the bar represents the lowest value. Attached to the bar are two tics, one extending to the left and one extending to the right. The left tic represents the opening price and the right tic represents the closing or settlement price. Figure 2 below is an example of a daily bar chart.

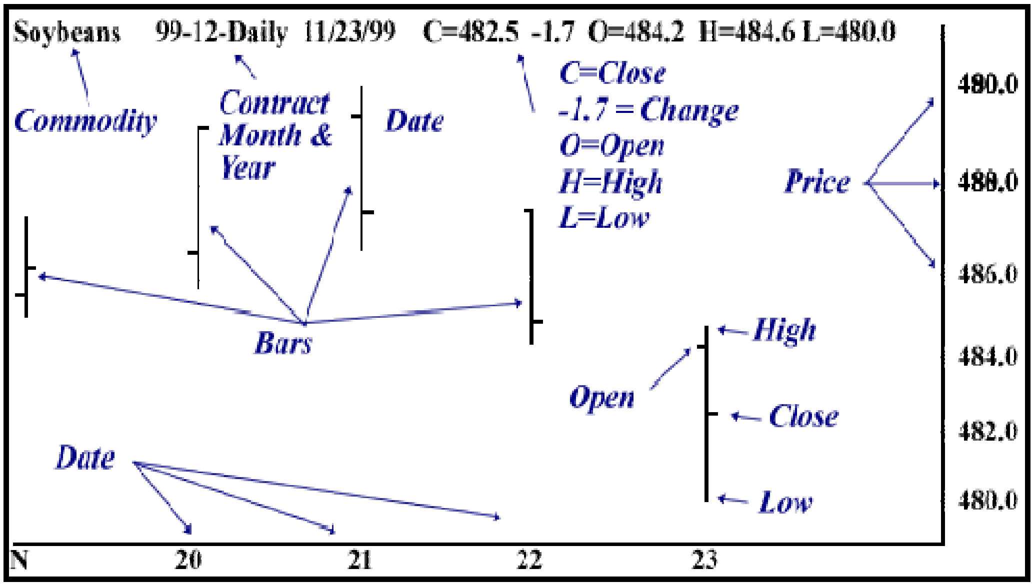

Figure 2: Daily Bar Chart

Line Charts are simply charts with lines joining the closing prices. Time periods may be varied to obtain different resolutions of the trends. *Japanese Candlesticks* are a variation of bar charts, in that they use colour coding to depict when a close is higher than an open and vice versa. *Point and Figure* charts are an interesting variation in that they do not have a time scale. The chartist decides what changes in price he'd like to see, and makes a tick every time the security changes price by that amount. If there is a change in direction of price, a new line is plotted.

Charting is the primary tool for the technical analyst and are purported to displays the following characteristics:

- Prices move in identifiable trends, much of the time
- That trends can be identified as patterns that are seen repeatedly
- There are three types of trends; primary, secondary and tertiary.
- Primary trends lasting months or years are punctuated by secondary trends lasting weeks or months and finally tertiary trends lasting hours or days (long, medium and short term).
- Trends are assumed to be in effect until a number of indicators show that they have changed.

A good metaphor for pattern recognition would be a medical student learning to diagnose a disease. Each disease is defined by a discrete set of signs and symptoms. By running appropriate tests and making proper observations of the patient, the medical student can gather the information needed to recognise that particular disease. Becoming an expert doctor requires seeing many patients and gaining practice in putting the pieces of information together rapidly and accurately.

Technical analysts attempt to group market "signs" and "symptoms" into identifiable patterns that help the trader "diagnose" the market. Some of the patterns may be chart patterns; others may be based upon the identification of cycles and configurations of oscillators, etc. Like the doctor, the technical analyst cultivates expertise by seeing many markets and learning to identify the patterns in real time.

Trend lines: Technical analysis is built on the assumption that prices trend. Trend Lines are an important tool in technical analysis for both trend identification and confirmation. A trend line is a straight line that connects two or more price points and then extends into the future to act as a line of support or resistance. Many of the principles applicable to support and resistance levels can be applied to trend lines as well.

Identifying a trend can often be a paradox. Whenever we talk of trend it has to be related to the context of time (the exception being when a point & figure chart is used). An intra-day price chart may show a significant trend which is contrary to a trend recognizable on a daily price chart which may be contrary to a trend on a weekly chart. Successful investing depends on recognizing the primary or long term trend, the intermediate trend and short term corrections. Usually trading will be done when at least the short term and intermediate term trends are in the same direction. The ideal will be when all three trends are in unison, but this is not a prerequisite, as intermediate trends can be substantial in both time and price. It would be too exclusive a trading strategy to ignore these opportunities and only trade when all three trends are in harmony.

A simple definition of trend is simply the general direction of price movements. An up trend is present when prices make a series of higher highs and higher lows. A down trend is present when prices make a series of lower highs and lower lows. When prices move without such a discernible series prices are said to be trading side ways, in a range or without any discernable trend.

Momentum: As given by Equation 24, a leading indicator; momentum measures a currency's rate-of-change. The ongoing plot forms an oscillator that moves above and below 100. Bullish and bearish interpretations are found by looking for divergences, centreline crossovers and extreme readings.

Figure 3: Typical up and down trend lines on a price chart

The rationale is that the hot get hotter and the cold get colder. Bullish momentum players buy currency pairs or commodities that are popular or that they believe will become popular. As the word spreads and popularity grows, the advance will accelerate. Price acceleration is the same as an increase in momentum

Relative Strength Index (RSI): The Relative Strength Index (RSI) is a bounded momentum oscillator that compares the magnitude of a currency's recent gains with the magnitude of its recent losses. The RSI ranges between 0 and 100 with 70 and 30 commonly used as overbought/oversold levels. It takes a single parameter, the number of time periods that should be used in the calculation; 14 is commonly used. The RSI was created by J. Welles Wilder.

MACD – Histogram: Developed by Gerald Appel, Moving Average Convergence Divergence (MACD) is one of the simplest and most used indicators available.

The Moving Average Convergence/Divergence (MACD) indicator is calculated by subtracting the 12-period exponential moving average of a given currency or commodity from its 26-period exponential moving average. A 9-period exponential moving average of the MACD itself is usually plotted over this line as a signal or trigger line. By using moving averages, MACD has trend following characteristics. In addition, by plotting the difference of the moving averages as an oscillator, MACD also has momentum characteristics. There are three techniques commonly used to interpret the MACD:

Divergence: When MACD moves counter to the direction of the currency itself, it is a warning that the currency's trend may change.

Centreline Crossover: Some analysts choose to buy or sell when the MACD goes above or below zero (the centreline).

Trigger line: When the MACD crosses above the slower trigger line, this is a bullish signal. When the MACD goes below the trigger line, it's a bearish signal.

Figure 4: Example of MACD indicator

Fibonacci Numbers: Leonardo Fibonacci, a mathematician in the 1200's created a numerical sequence of numbers, which, from left to right after the first two numbers, displayed successively increasing values. Each number, in turn (from the third one onwards), is determined by the sum of the previous two numbers.

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377,... to get the next value of Fibonacci series after 377 add 233 to 377 and arrive at 610, and so on. One interesting relationship of this number sequence is that if we take the ratio of two successive numbers in the Fibonacci series (that is, we divide each number by the number after it in the sequence) we will move towards a particular constant value. That value is 0.6180345 which is referred to as "the golden ratio", because of its pervasiveness in nature. If you also calculate the ratios using alternate numbers in the Fibonacci series (that is, do the same calculation but skip over a number) the resulting ratios approach e = 0.38196.

Many technicians use Fibonacci numbers in their Technical Analysis when trying to determine support and resistance, and commonly use 38.2%, 50%, 61.8% retracements. Commonly, a 0.382 retracement from a trend move is interpreted as implying a continuation of the trend. A 0.618 retracement is interpreted as a trend change in the making. Many such rules have been adopted by technicians.

Elliot Wave: R. N. Elliott believed markets had well-defined waves that could be used to predict market direction. In 1939, Elliott detailed the Elliott Wave Theory, which states that stock prices are governed by cycles founded upon the Fibonacci series (1-2-3-5-8-13-21...).

According to the Elliott Wave Theory, stock prices tend to move in a predetermined number of waves consistent with the Fibonacci series. Specifically, Elliott believed the market moved in five distinct waves on the upside and three distinct on the downside. The basic shape of the wave is shown below.

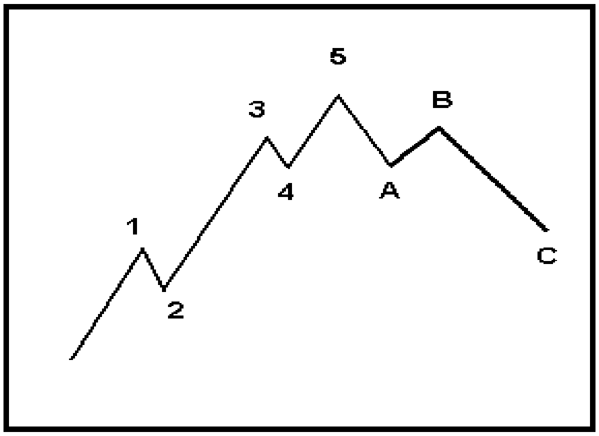

Figure 5: Elliott waves

Waves one, three and five represent the 'impulse', or minor up-waves in a major bull move. Waves two and four represent the corrective or minor down-waves. The waves lettered A and C represents the minor down-waves in a major bear move, while B represents the one up-wave in a minor bear wave.

Elliott proposed that the waves were fractal in nature, i.e. they existed at many levels; or stated simply, there could be waves within waves. To clarify, this means that the Figure 5 above not only represents the primary wave pattern, but it could also represent what occurs just between points 2 and 4. The diagram below shows how primary waves could be broken down into smaller waves.

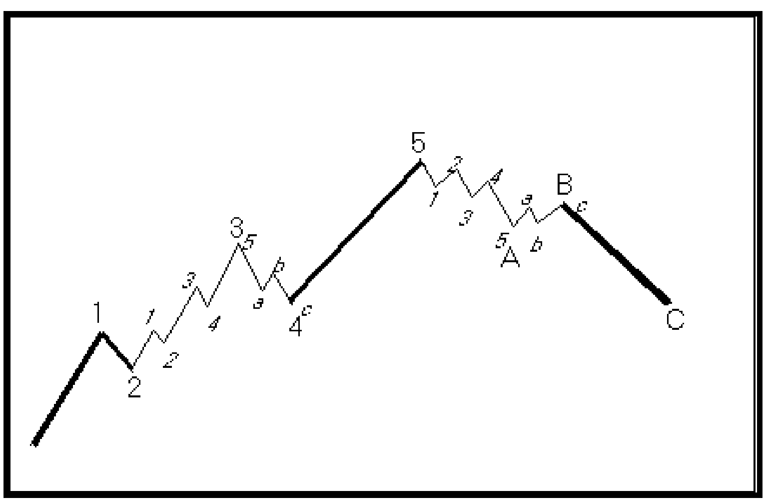

Figure 6: Fractal nature of Elliott waves

Elliott Wave theory ascribes names to the waves in order of descending size:

- Grand Supercycle
- Supercycle
- Cycle
- Primary
- Intermediate
- Minor
- Minute
- Minuette
- Sub-Minuette

An explanation of these terms is beyond the scope of this discussion.

The major waves determine the major trend of the market, and minor waves determine minor trends. This is similar to the way Dow Theory postulates primary and secondary trends. Elliott provided numerous variations on the main wave, and placed particular importance on the golden mean, 0.618, as a significant percentage for retracement.

Trading using Elliott Wave patterns is quite simple. The trader identifies the main wave or Supercycle, enters long, and then sells or shorts, as the reversal is determined. This continues in progressively shorter cycles until the cycle completes and the main wave resurfaces. The caution to this is that much of the wave identification is taken in hindsight and disagreements arise between Elliott Wave technicians as to which cycle the market is in.

Stochastic: Developed by George Lane, the Stochastic Oscillator is a momentum indicator that measures the price of a currency or commodity relative to the high/low range over a set period of time. The indicator oscillates between 0 and 100, with readings below 20 considered oversold and readings above 80 considered overbought. A 14-period Stochastic Oscillator with a reading of 30 would indicate that the current price was 30% above the lowest low of the last 14 days and 70% below the highest high. The Stochastic Oscillator can be used like any other oscillator by looking for overbought/oversold readings, positive/negative divergences and centreline crossovers.

A 14-day %K (14-period Stochastic Oscillator) would use the most recent close, the highest high over the last 14 days and the lowest low over the last 14 days. The number of periods will vary according to the sensitivity and the type of signals desired. As with RSI, 14 is a popular number of periods for calculation. Equation 25 and Equation 26 represent the stochastic equations.

Volume Tracking: Volume refers to the number of contracts of a specific security that is traded in a given time period. It is essentially a measure of supply and demand that is independent of price. It is often looked at for confirming evidence of price trend reversal patterns. Volume data is readily available in the equity markets, but paradoxically not available in the financial trading packages. For the technical analyst though the value of volume as an independent indicator is equally valid no matter which market is being traded.

3.1.4 Summary

The above discussions of technical and fundamental trading models are intended to give some idea of the heuristics used by portfolio managers and security analysts in general.

It is quite clear that many, if not all the technical models discussed, do not lend themselves to deductive or even inductive reasoning. They seem to lack the same type of mathematical rigour found with their fundamental counterparts.

The fact that identifiable patterns continually appear in stock charts tend to indicate that investor behaviour may be predictable. The usefulness of the above indicators are more often than not, used to supplement fundamental analysis of stock markets. Studies to demonstrate their stand-alone superiority above fundamental analysis are generally inconclusive, i.e. none have shown a *consistent* ability to beat the market average return.

In any event the market for training in technical analysis is large and growing. The reason for this may be a need for models that are more representative of the fluctuating trends found in stock price charts. The fact that behavioural finance is also gaining ground in academic circles supports the assertion that there is a large gap between the explained and unexplained portions of stock market movements and a more all-encompassing model is needed.

Chapter 3 – Research Design

4 Chapter – Research Design

4.1 Background

The research design followed the steps laid out below:

- Clarify the purposes
- Define the Research question
- Define the study population
- Investigating the general population size and roughly estimate the sample size
- Decide what information to collect
- Researching the extant literature on the research question
- Deciding how to measure the information and designing the measurement instrument
- Collect the data
- Record, analyse, and interpret the data

The steps above in many respects were iterative and not mutually exclusive. The research question has to a large extent determined the *quantitative* and *statistical* nature of this study. Given that we are trying to infer a behavioural characteristic (the preference) of a population, from a sample.

The study is *descriptive* as opposed to *causal* in that it will be describing how much preference is being given to two different choices. An essential component of the research design was an examination of literature on the subjects of technical and fundamental analysis (*secondary data source*).

The *time dimension* of this study is to be *cross-sectional*. This means that the data that will be obtained will be valid for a specific time, a snap shot of the situation that is being studied. A *longitudinal study*, which has the advantage of tracking changes over time, is not a practical option, considering that time is not a variable that effects the choice of one model over another. Indeed some fundamental and technical models have stood the test of time.

4.1.1 Data Collection

There are generally four possible sources of data:

- Published by government and private institutions
- Data obtained by designing an experiment
- Through completing a survey – interrogation/communication study
- Through an observational study

The relative merits of each method were assessed based on the requirements of the research being done. *Primary data* to answer the research question was obtained by a survey, which used a questionnaire. The responses yielded both categorical and discrete numerical data.

Respondents were approached either directly or through a representative of their organisation (a facilitator). Communication was either telephonic or via e-mail. It was estimated that each questionnaire could be quickly completed within 15 to 20 minutes; however, respondents were given 2 to 3 weeks, before they were contacted again.

Secondary data was obtained from the literature review. To date, none have been found that are relevant in the South African context.

4.1.2 Measurement Instrument

An *ex post facto* (after the fact) questionnaire design has been used to illicit information to answer the specific question of the 'popularity' of technical and fundamental analysis. This type of design does not give the observer any control over the variable being studied. In contrast to this, is the experimental design which does give control over variables being measured; this approach was not practical in this case.

The questionnaire will be the primary source of information to identify to what extent institutional investors in South Africa prefer technical and fundamental analysis. From a scientific viewpoint it is imperative that we define what the words 'popular' and 'use' means within the context of the research question. In my opinion, the most reasonable conclusion would be to reduce these words to ‘frequency of use’, i.e. if a specific portfolio manager, frequently uses technical analysis (for making buy or sell decisions on stock), than this will be interpreted as the ‘preferred’ choice of that manager.

Note that the literal interpretation of frequency of use is ‘the number of times and event occurs per time period’. It would be literally impossible in a study of this nature to expect respondents to remember the exact number of times they have used a certain method. It is, however, reasonable to assume that a respondent will be able to answer on which method he/she preferred over a period of time. This criterion for a well designed questionnaire would therefore be to measure the ‘preference’ of use or in the context of the discussion, the relative ‘preference’ of technical analysis as compared to fundamental analysis.

Furthermore, the measurement instrument is designed to identify if each analytical method is limited to certain markets or timelines. While the questionnaire has been designed by the author, some pre-designed questions recorded in the literature were adapted and included. Note that the questionnaire has been designed to elicit a great deal more information than what the Hypothesis testing will require. This has been done so that a more comprehensive picture of technical and fundamental analysis (as viewed by portfolio managers working for large South African institutions) can be obtained. In any event having more data about a subject of interest is usually better than having less.

A pre-test of the questionnaire and field procedures is the only way of finding out if everything ``works'' especially if a survey employs a new procedure or a new set of questions. Since it is rarely possible to foresee all the possible misunderstandings or biasing effects of different questions and procedures, it is vital for a well-designed survey plan to include provision for a pre-test. This is usually a small-scale pilot study to test the feasibility of the intended techniques or to perfect the questionnaire concepts and wording. This pre-test was completed during July/August of 2006.

Obtaining and securing *informed consent* from respondents was a key element prior to the distribution of the measurement instrument. In this instance due to the nature of the research consent was obtained either telephonically or via e-mail.

4.1.3 Validity

It would be appropriate at this point to briefly discuss data validity. Generally the risks associated with two types of data validity must be considered, viz. *internal validity* and *external validity* as discussed by Cooper and Schindler (2003).

Under internal validity, the following seven are considered:

- History
- Maturation
- Testing
- Instrumentation
- Selection
- Statistical regression
- Experimental mortality

Maturation refers to changes that occur to the variables being measured that are subject to the passage of time. For example, the respondent of a questionnaire may be susceptible to becoming bored, tired or hungry if the instrument is too long. These circumstances can affect response results. These may also be factors in tests that are as short as an hour or two. For our 20 minute questionnaire this was not a major issue to be considered.

Testing refers to a process where experiencing the same or similar test, can affect the response of the second test. The learning effect may have either a positive or negative outcome depending on the specific research being undertaken. This normally occurs after pre-test results in changes to the questionnaire. There were no changes to the questionnaire.

Instrumentation refers to issues arising due to changes in questions, or even the wording of questions between measurements. This is an obvious source of potential trouble. Under this heading one must also consider the observers perspective. Observers experience, boredom, fatigue and anticipation can potentially distort responses.

Selection is an important criterion for validity. This refers specifically to the selection of the sample from the defined population. The only way to mitigate this threat is to use statistical random sampling methods.

Statistical regression refers to errors that are introduced due to the method of measurement. For example not considering the effects of time on variables being measured may lead to extraneous results if the measurement is done only on a small time frame. Over longer time frames one will find that the variables being measured will settle to their long term means.

Experimental mortality occurs when the test subjects selected for a sample group changes due to natural events. If the population is large and uniform, replacement can easily be done, however, in lab experiments this problem could endanger the research validity.

Due to the nature of this questionnaire the only concern was *instrumentation*. The effect of this was reduced by carefully wording the questionnaire to elicit the required information.

Under External Validity, the following are discussed

- The reactivity of testing on X
- Interaction of selection and X
- Other reactive factors

The reactivity of testing on X refers to the process of pre-testing subjects. For example in the process of validating a measurement instrument by pre-testing it, one can sensitise respondents to the subject of the questionnaire and subsequently when the final questionnaire is answered they may, having been sensitised to the subject, made an effort to find out more about it in their organisation or from other sources.

Interaction of selection and X refers to the error introduced when one selects samples from a population which may not be the same as the population to which one wishes to generalise results. Care was taken in selecting the correct sample population to avoid this error.

Other reactive factors such as the tendency to role play are very real risks to validity. Respondents who have been selected for the sample can role play in a way that distorts the variable being measured.

Generally the rule of thumb is to first seek internal validity and then to look for as much external validity as the internal validity requirements. The mitigation of validity risk was an important part of the questionnaire's design.

4.2 Target Population

The target population are individual portfolio managers working for large institutional investors within the borders of South Africa. The managers who will form the sample of respondents must have decision making authority for buying and selling equity securities. It must be noted that the population being targeted is limited geographically, i.e. within the borders of South Africa; it does not limit the equity markets in which the manager participate. So a South African investment manager who participates in equity markets overseas is also a valid member of the population being measured.

Using an internet business search engine found at http://www.brabys.com over 60 stock and share broking companies were found that operated in the borders of South Africa. If a conservative average of 10 portfolio managers are employed at each firm this would give a potential population of 600 portfolio managers working for institutional investment companies.

According to the Financial Services Board (FSB) there are around 14000 registered individuals and institutions that are legally allowed to provide equity portfolio investment services. The actual number of institutional investors (companies) could not be identified from their database. It would be reasonable to expect therefore, that the actual size of the population can be estimated in the lower tens of thousands, say around 5 000 as a first estimate. This number could be much lower given that we are focussing on only the 'large' institutional investors. The actual size of the population is not important as the statistical test used did not depend on (independent of) this variable. More specific data could not be obtained from the FSB as their database was reportedly not yet ready at the time of writing.

Some of the more well known brands (large institutional investment companies) identified below as potential candidates for the survey are listed below:

- Investec Ltd
- First Rand Ltd
- Rand Merchant Bank
- Nedbank Ltd
- ABSA
- Standard bank Ltd
- AngloRand
- BoE

We therefore, do not have an unbiased estimator of the population size. To invalidate this issue, we will use a sampling technique that does not require a known list of the population. This is discussed in the following section.

4.3 Sample Size

According to Cooper & Schindler (2003), the question of sample size must consider the following:

- Sample size is proportional to the variance and dispersion in the population under consideration, i.e. the larger the variance and dispersion, the bigger the sample must be.
- The greater the required precision the bigger the sample.
- The higher the confidence levels of the estimate the larger the sample.
- The greater the number of subgroups the larger the sample.

- The time available to complete a given survey can and does impact a sample size. Larger samples take longer to survey and this must be considered in the projected timeline.
- If a calculated sample size is greater than 5% of the population than sample size can be reduced without sacrificing precision.
- Sample size is proportional to the overall cost of completing the research. Cost refers to the cost of data collection usually through reduced travelling expenses and interviewer time and also through costs associated with processing the data gathered. It is imperative that all the above factors are considered when deciding on a specific sample size.

Simple random sampling is often impractical for the following reasons:
It requires a population list (sampling frame) that is known or can be established within a reasonable time and at a reasonable cost. Better sampling methods exist that don't require knowledge about the exact size of the population. These methods can be more statistically efficient in the sense that they afford a given precision (standard error of the mean or proportion) with a smaller sampling size which translates to lower cost. Some of these methods which meet the criteria discussed above are: systematic sampling, stratified sampling, cluster sampling and double sampling.

Since this research paper is concerned with a specific geographic area, viz. South Africa, we will use ***area sampling***, which is a type of cluster sampling technique. This approach concerns itself with identifying a population by some geographic area. In this study we will consider our cluster to include all portfolio managers working for institutional investment firms within the boarders of South Africa.

The primary consideration of the sample size is to obtain a representative cross-section of the population of institutional investors. The sample size will be based on two considerations, viz. statistical rules and conventions for sample selection to prevent bias and finally the time available in which to obtain data from the respondents.

For proportional sampling *without replacement*, which meets the conditions for normality, Equation 27 is given by Levine, Berenson and Stephan (1999):

The acceptable sampling error is defined as the difference between the sample proportion and the actual population proportion, i.e. $p_s - p$. Assuming a normal distribution, to illustrate, Table 1, Table 2 and Table 3 (Appendix B) have been drawn up using Equation 28. In section 4.4, the assumption of a normal distribution will be substituted for Student's t distribution given the small sample size.

Let's say that our budget, the cooperativeness of the subjects, the time available and our patience lets us do a study with only 12 subjects in any one sample. How much information can we obtain? Is such a study worth doing?

To better understand the subsequent arguments refer to Table 2 and Table 3 on page 77 which have been calculated with Equation 28.

With a small study, we know we are going to have to make do with a moderate amount of power (confidence interval). Consider a power of only 50%. That means that even if the true effect is what we hypothesize, there is only a 50% chance of getting a "statistically significant" result. Furthermore the error will be +/- 0.097 (Standard Deviations, hereafter referred to as the error) in the case of $p = 0.9$ and 0.058 in the case of $p = 0.5$. In the first instance we are saying that there is a 50% chance that $0.997 > p > 0.803$, while in the second instance we are saying that there is a 50% chance that $0.442 > p > 0.558$. If there is only a 50% chance, of inferring a population proportion within these ranges, what's the point of doing the experiment? We want more power than that, but know we can't have a huge amount of power without a large sample size. So the trade-off is between an acceptable power and a tolerable error range that still meets with the criteria set by our hypothesis.

So let's pick 95% power, which is extraordinarily conventional. The highlighted row and column in Table 2 and Table 3 on page 38 is for a power of 95%. This means that if there really is a difference of the tabulated size, there is a 95% chance that we'll obtain a "statistically significant" result when we run the study, leaving a 5% chance of missing a real difference (chance of making a Type I error – not to be confused with error as discussed here; which refers to standard deviation). Again lets consider the situation for p = 0.9 (error 0.17 – two standard deviations) and p = 0.5 (error 0.283 – two standard deviations). For p = 0. 9 we are saying that there is a 95% chance that 1 > p > 0.730 and for a proportion of p = 0.5, we are saying that there is a 95% chance that 0.783 > p > 0.217.

Now considering the descriptive nature of this study, if our sample proportion turns out to be 0.5, we will be in a position to say that there is 95% chance that between 21.7% and 78.3% of portfolio managers has a specific preference. The difference between 21.7% and 78.3% is quite large and is of limited value insofar as making inferences about anything accept the broadest of hypothesis (which may include ours). At a proportion of 0.9 for a given sample this range of inference gets much better; now we will be able to say that between 73% and 100% of portfolio managers has a specific preference. Therefore, at higher levels of a sample proportion p, a smaller sample is needed for the same power (standard deviation).

Given the descriptive nature of this study we can tolerate a fair margin of error (+/- 17% seems reasonable) when making inferences for proportions p > 0.8. If for example, the sample proportion is measured as 0.5 and the population proportion can be inferred at a 95% confidence with the range 0.5 +/- 0.283, giving an inferred proportion for the population of 0.283 > p > 0.783, from Table 3. This means that for a proportion of 0.5 we can be 95% certain that p is in the range defined by 0.783 > p > 0.283. As the proportion we test gets higher, so does our accuracy of the inference. From Table 2, at a proportion of 0.9 we only need to tolerate an error of 0.170 (+/- 17%). This means that our p will lie in the range defined by 0.9 +/- 0.170, or 1 > p > 0.730. This error is low enough for us to comfortably make inferences for proportions of around 0.9.

So with this argument in mind we will use the available sample size of 12 to test for proportions of 0.9 with an acceptable error level of 0.17 (+/- 17%).

Clearly then, if the sample mean is close to 0.9 then it is reasonable, based on the preceding argument to make inferences about the population variable under study.

This sample size analysis has helped us figure out what we can hope to learn given the sample size available. Now we can decide whether the experiment is even worth doing. Different people would decide this differently. Some would conclude that much smaller differences might be important, in this case it clearly isn't. Always keep in mind that larger sample size in this case will not add more to the inference. If between 73% and 100% of portfolio managers prefer a certain method of stock selection than it would be reasonable to conclude that this is a preference of the majority.

For our purpose, given that we can detect a change of $^{+}/{-}17\%$ with a 95% power (confidence level), it makes doing the statistical on the sample of 12 responses, worthwhile.

4.4 Data Analysis Methods

The method of choice when dealing with *categorical variables* in the primary data set is provided by the theory of sampling distributions of the proportion. When dealing with proportions we are still interested in calculating the traditional statistical variables that describe the sample under scrutiny. The following discussion has been adapted from Levine et al (1999).

The sample proportion and standard error of the proportion are given by Equation 29. An example will clarify: If in a telephone survey of 50 households, a question was asked, 'Do you or any member of your household own a cellular telephone?' Of the 50 respondents, if 15 said yes and 35 no than the there will be two sample proportions that can be studied:

- The sample proportion of those with cell phones which is 15/50 = 0.3
- The sample proportion of those without cell phones which is 35/50 = 0.7

Note that the sum of the proportions equals one.

From theory, it can be established that when sampling from a finite population, the sampling distribution of the proportion follows the binomial distribution. However, the normal distribution can be used to approximate the binomial distribution when nxp and nx(1-p) are each at least 5. This means that if inferences are made of the variables in question the sample size must be large enough to meet this criterion, we therefore use Student's t distribution (Equation 31), which is an approximation for small sample sizes. Therefore we can estimate the mean for the population as in Equation 32

Since we are dealing with sample proportions (not sample means), we have:

p_s = sample proportion

p = population proportion

Substituting into student's distribution, we get Equation 33.

The sampling methodology discussed in the theory above assumes sampling with replacement. In our survey research sampling will be conducted without replacement from a population that is of a finite size N. In this case a small warning is necessary; i.e. when the sample size n is not small in comparison with the population size N, so that n/N>0.5, a finite population correction factor (fpc) must be used to define both the standard error of the mean and the standard error of the proportion. The correction factor is expressed by Equation 34.

Substituting in the equations for the standard error of the Mean and Proportion for Finite Populations we then obtain Equation 35.

The sample size is 12 and given the estimated population size the correction factor is not applicable. We therefore do not need to use this factor when calculating the standard error of the mean and proportion.

For a proportion of 0.9 and 0.8, Students t distribution gives us Table 4 and Table 5 in Appendix B.

4.4.1 Hypothesis testing

A central concept in science and the scientific method is that all evidence must be empirical, or empirically based, that is, dependent on evidence that is observable by the senses. It is usually differentiated from the philosophic usage of empiricism by the use of the adjective "empirical" or the adverb "empirically." "Empirical" as an adjective or adverb is used in conjunction with both the natural and social sciences, and refers to the use of working hypotheses that are testable using observation or experiment. In this sense of the word, scientific statements are subject to and derived from our experiences or observations.

Hypothesis-testing methodology provides clear definitions for evaluation and enables us to quantify the decision-making process so that the probability of obtaining a given sample result can be found. This is achieved by first determining the sample distribution for the statistic of interest (e.g. the sample mean) and then computing the particular *test statistic* based on the given sample result. Because the sampling distribution for the test statistic will be approximated by *Student's t distribution*, we can use this distribution to determine the likelihood of a null hypothesis being true.

In this instance for the *null hypothesis* to be true, we are looking for a proportion of 50%, i.e. both technical and fundamental analysis are preferred equally by investment managers. Any significant deviation from this will lead us to rejecting the null hypothesis and accepting the alternative hypothesis.

The critical value approach to Hypothesis-testing requires the selection of a *critical value (*α) to make a decision concerning the *null Hypothesis*. Generally, it has been established in the literature that a level of significance must be selected based on the risk (cost) of making an error. The size of the rejection region is directly related to this risk involved in making decisions about the population parameter of interest based on sample evidence.

We have selected p to be 0.9 (which minimises n and is also in agreement with our null hypothesis, i.e. both technical and fundamental analysis are equally preferred).

Furthermore we will select a confidence level of 95% and an error of +/- 0.17 (17%). For a two-tailed test and a 95% confidence Z (our critical value) is 1.960 (read from normalised probability tables), and our sample size is 12. To achieve the selected confidence and error levels this must be the minimum sample size.

If we look at the null hypothesis as finding a mean of 0.9 or 90% for an equal preference between technical and fundamental analysis, it seems more realistic to select a higher confidence level of between 90% or even 95%. So if the sample mean falls outside this selected area it would mean that portfolio managers have a preference of one method over the other, depending on which side of Z the sample mean falls on. In both scenarios we would want a small sample standard deviation which will increase the validity of the result. For the purposes of this research document we will use >50% as the critical value, i.e. if 50% or more of portfolio managers prefer technical or fundamental analysis, then this is a significant number from a market point of view.

At this point we will quickly review the type of risks associated with hypothesis testing.

A Type I error occurs if the null Hypothesis H_0 is rejected when in fact it is true and should not be rejected. The probability of a type I error occurring is α, which has been selected as 5%.

A Type II error occurs if the null Hypothesis H_0 is not rejected when in fact it is false and should be rejected. The probability of a type II error occurring is β.

β is dependent on the difference between the sample statistic and the actual population parameter. It is usually easier to estimate β, when it is large than when it is small.

The *confidence coefficient*, denoted by 1- α, is the probability that the null hypothesis H_0 is not rejected when in fact it is true and should not be rejected.

Hypothesis testing as described above is the method chosen for accepting the null or alternative hypothesis.

4.5 Measurement Instrument

The primary means of measurement will be a questionnaire. Questions will be either open or close-ended and structured to obtain specific information to satisfy the stated research objectives. More data about a subject is better than less, with this in mind the questionnaire has been structured to obtain both general and specific data about the use of technical and fundamental analysis concepts by portfolio managers.

The questionnaire is designed to illicit specific information to answer the research question. It is intended to measure the practical application of Fundamental and Technical Analysis by investment and portfolio managers of large institutional investors in South Africa. The instrument is divided into three sections; Section B and C of the measurement instrument makes use of a five point Likert Scale, while section A uses a simple yes or no response. Section A broadly identifies the level of knowledge and experience of the respondent with respect to the concepts of both Technical and Fundamental Analysis.

Section C of the questionnaire will be the primary source of information to identify to what extent institutional investors are using specific technical and fundamental analysis concepts as discussed in Chapter 3. The questionnaire further tries to identify if each analytical method is limited to certain investment timelines or periods (to try to distinguish for example, day trading from longer trading periods).

The proposed questionnaire follows in Appendix A. The basis of both technical and fundamental analysis has been discussed in Chapter 3. Specific models under each theory that are specifically mentioned in the questionnaire were selected using a *Paereto* analytical approach. They are listed and clarified below.

The questionnaire refers to the following concepts under fundamental analysis:

- Arbitrage Pricing Theory
- CAPM/Beta

- Portfolio Theory
- Required Rate of Return
- Internal Rate of Return (IRR)
- Ratio Analysis
- Discounted Cash Flow
- Dividend Discount Model
- Arbitrage Pricing Theory

Under technical analysis the following concepts are referred to:

- Volume Tracking
- Charting
- Trend lines
- Over Bought/Over Sold
- Relative Strength Index (RSI)
- MACD – Histogram
- Fibonacci Numbers
- Elliot Wave
- Japanese Candlesticks
- Support and Resistance Levels
- Trading Ranges
- Stochastics

The above listed concepts were adapted from Flanegin et al (2005: 36).

Chapter 4 – Research Results

5 Chapter – Research Results

The arguments presented in section 4.3 are critical to the interpretation of the results discussed below. The results inferred for the population are at the 95% confidence level. The raw data and basic stats from the questionnaire are tabulated in Appendix 0 and 0.

5.1 Findings

5.1.1 Survey of South African Portfolio Managers

Between 63% and 100% of portfolio managers have a post graduate degree (Variable V13 – V15), with working experience in access of 5 years (V16-V19). It can reasonably be inferred that all portfolio managers have a general understanding of fundamental analysis while there is 95% confidence that between 75% and 100%, have a similar understanding of technical analysis (V1 and V2 of the questionnaire). Variables V3 to V6 confirmed that this was the case by asking questions which explored if the understanding claimed, was in fact so.

It can be reasonably inferred that all portfolio managers use Fundamental analysis (V7), while there is only a 95% confidence that between 42% and 91% of managers actually make use of technical analysis (V8). The exact same result was obtained when managers were asked if their respective organisation encouraged the use of fundamental and technical analysis. 100% (V9) of organisations support fundamental analysis and between 42% and 91% (V10) encourage technical analysis.

The critical question of *preference* for technical or fundamental analysis was captured in variables V11 and V12 and confirmed again by variable V20-V22. Between *77% and 100%* of portfolio managers show a *preference* for Fundamental analysis if faced with a choice between the two.

There appears to be weak statistical support which shows an inclination to use technical analysis for the short term – 0 to 12 months (V23 and V24) and fundamental analysis for longer periods – 1 to 3 years (V30).

77% to 100% of managers agreed that a sound fundamental analysis was much more important than doing a technical analysis of shares.

Finally, there was great variability around the specific technical models used for both technical and fundamental analysis. No conclusive evidence of a preference for any specific technical model was evident (V36 to V54).

5.1.2 Analysis of results

The hypotheses formulated in section 2.3 are reproduced below:

Ho: *Null Hypothesis* – Both Fundamental and Technical analysis are equally preferred decision making tools as used by the majority of South African portfolio managers for purchasing equity investments.

H1: *Alternative Hypothesis* – There is a statistically significant preference for technical analysis over fundamental analysis or vice versa, as used by the majority of South African portfolio managers for purchasing equity investments.

Clearly there is significant evidence presented in both the literature and questionnaire to support the *alternative* hypothesis. Even though the preference is clearly for fundamental analysis, it has been shown at the 95% confidence level that between 42% and 91% of portfolio mangers make use of technical analysis.

It appears that technical analysis has gained ground amongst professional portfolio managers. What is interesting about this development is the fact that, within the halls of academia, technical analysis is not generally regarded as a financial science with good, if any, bona fides.

So why would perfectly rational, highly educated professionals ‘invest’ in such ‘science’. The answer may well lie in the fact that despite the usefulness of fundamental analysis to produce very good estimates of intrinsic value it does not in any way address the variability that is found in the movement of share prices – and where there is variability, there is opportunity for profit.

Day trading, and short and medium term trading (especially with leverage), is an area for investors and speculators alike. For the long term portfolio manager, timing a purchase or a sale can translate into a significant change in profits. This makes timing and the associated understanding of variability crucial to the investment cycle. The unfortunate fact is that, academically, not a lot of consideration was given to this area until relatively recently, when; the theory (notably *prospect theory*) underpinning behavioural finance won its primary creator a noble prize.

Chapter 6 – Conclusion & Recommendations

6 Chapter – Conclusion & Recommendations

6.1 Conclusion

This research paper is firmly grounded on the existing literature describing the inter-related fields of behavioural finance, fundamental and technical analysis. Over 50 individual papers, books and journal articles were referred to in an effort to obtain a meaningful, and to some extent, a multidimensional view on the subject. It is unfortunate that much of the reference material was based on studies done overseas, however, given, the close correlation of the level of sophistication of local financial markets and their overseas counterparts; it is possible to reasonably argue the applicability of these findings.

The literature provided a wealth of information that allowed the writer to gauge the popularity and the pervasiveness of both these approaches amongst practitioners and teachers (academia). However, it became very evident early on that like the theory of Darwin and the opposing view of creationism, the literature tended to characterize the theories of technical and fundamental analysis as mutually exclusive. The discussion on behavioural finance made it very clear that this was not the case. The reality is that even experienced investment managers, (and certainly laymen in the trade) are subject to two very dominant human traits, the dimensions of emotion and intellect. Both of these traits interact in complex ways which result in the variability of equity prices. The fact remains that technical analysis lacks the grounding in sound theory found in fundamental analysis.

A number of papers investigated the real returns obtained by using heuristics based on technical and fundamental analysis. The results largely showed that notwithstanding which approach was used that it was difficult to obtain consistent, market beating, results in the long term. Profitable stock portfolios, while supporting both a fundamental and technical approach, did not provide consistent evidence of beating the market average over the long run. Of note is the repeated warning of transactions costs which in all cases significantly reduced profitability as compared to the buy and hold approach.

Much of the literature focused either on technical or fundamental concepts with relatively few doing a comparative study of their efficacy or of there pervasiveness amongst practitioners. Experimental evidence emphasised the utility of both methods in isolation. The survey conducted amongst South African portfolio managers provided statistical proof of their preference for fundamental analyses. It can be concluded the majority of portfolio managers depended on fundamental analysis, but also made use of technical analysis. There was some evidence to support the view that technical analysis was relied on as a timing tool rather than the primary tool for making a buy or sell decision.

6.2 Recommendations

The evidence presented in this paper supports the notion that financial institutions in general and business schools in particular would be well-served by looking at broadening their knowledge base to include areas that model variability. Amongst these, of course, are behavioural finance and technical analysis (both subjects try to address the fundamental question of how to model variability).

A careful internet search reveals a plethora of foreign formal and informal teaching aids for both fundamental and technical analysis. Given the identified preference of portfolio managers it would be reasonable to assume that this is an opportunity for local teaching institutions. It is recommended that South African Investment and teaching institutions should in the short to medium term supplement there internal skills and knowledge base with short courses in:

- Behavioural Finance
- Technical Analysis

Furthermore, it is recommended that a research program to explore models that describe the variability of prices in shares and other financial instruments be encouraged.

It is also recommended that financial institutions, as defined by this research report should supplement their skills base by introducing programs in the above two areas.

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Appendix A – List of Equations

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + ... + b_{jn}RP_n$$ **Equation 1: APT**

$$r_j = E(r_j) + b_{j1}F_1 + b_{j2}F_2 + ... + b_{jn}F_n + \epsilon_j$$ **Equation 2: APT**

Where, *E(rj)* is the risky asset's expected return,

RPk is the risk premium of the factor,

rf is the risk free rate,

Fk is the macroeconomic factor,

bjk is the sensitivity of the asset to factor k, also called factor loading,

and *εj* is the risky asset's characteristic random shock with mean zero.

$$b_i = \left(\frac{\sigma_i}{\sigma_M}\right) * r_{iM}$$ ……………………. **Equation 3: Beta coefficient**

here σ_i is the standard deviation of stock *i*

And σ_M is the standard deviation of the market *M*

And r_{iM} is the correlation of the individual stock *i* with the market *M*.

$$k_i = k_{RF} + (k_M - k_{RF}) * b_i$$ ……………. **Equation 4: Security Market Line**

Where k_i is the expected rate of return on the *i* th stock

k_{RF} risk-free rate of return, usually the return on long term treasury bonds

k_M is the average market return, also on an average (*beta* = 1) stock.

b_i *i* th stock's beta coefficient.

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t} = 0$$ ………………. **Equation 5: Internal Rate of Return**

Where NPV is the Net present value of the security in question

CF_t is the cash flow at time *t*

IRR is the rate that equates the costs to the Net Present Value

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+k_s)^t}$$ .... **Equation 6: Dividend Discount Model**

Where P_0 is the current price of the stock

And D_t is the dividend expected to be paid at the end of year *t*

And k_s is the required rate of return

If the dividends are expected to grow at a constant rate g then the above equation reduces to:

$$P_0 = \frac{D_1}{k_s - g}$$ .... **Equation 7: Constant growth, Discount Model**

$$CurrentRatio = \frac{CurrentAssets}{CurrentLiabilities}$$ .... **Equation 8: Current ratio**

Where: *Current Assets* include cash, marketable securities, accounts receivable and inventories. *Current Liabilities* consist of accounts payable, short-term notes payable, current maturities of long-term debt and accrued expenses.

Quick or Acid test ratio is calculated as follows:

$$QuickRatio = \frac{CrrentAssets - Inventories}{CurrentLiabilities}$$ **Equation 9: Quick ratio**

$$InventoryTurnover = \frac{Sales}{Inventories}$$ **Equation 10: Inventory turnover ratio**

$$DSO = \frac{\mathrm{Re}ceivables}{AverageSalesperday} = \frac{\mathrm{Re}ceivables}{AnnualSales/360}$$ **Equation 11: Days sale outstanding**

$$FixedAssetsTurnoverRatio = \frac{Sales}{NetFixedAssets}$$

Equation 12: Fixed Asset turnover

$$TotalAssetsTurnoverRatio = \frac{Sales}{TotalAssets}$$

Equation 13: Total asset turnover ratio

$$DebtRatio = \frac{TotalDebt}{TotalAssets}$$

Equation 14: Debt ratio

$$TimesInterestEarned(TIE)ration = \frac{EBIT}{InterestCh\arg es}$$

Equation 15: TIE ratio

$$EBITDAratio = \frac{EBITDA + LeasePayments}{Interest + \Pr incipalPayments + LeasePayments}$$

Equation 16: EBITDA

$$\Pr ofitM\arg inOnSales = \frac{NetIncome}{Sales}$$

Equation 17: Profit margin on sales

$$BasicEarningPower(BEP) = \frac{EBIT}{TotalAssets}$$

Equation 18: Basic earnings power

$$\operatorname{Re} turnOnTotalAssets(ROA) = \frac{NetIncome}{TotalAssets}$$

Equation 19: Return on total assets

$$\operatorname{Re} turmOnCommonEquity(ROE) = \frac{NetIncome}{CommonEquity}$$

Equation 20: ROE

$$\Pr ice / Earnings(P / E)Ratio = \frac{\Pr icePerShare}{EarningsPerShare}$$

Equation 21: Price to earnings ratio

$$\Pr ice / CashFlow = \frac{\Pr icePerShare}{CashFlowPerShare}$$

Equation 22: Price to Cash flow ratio

$$Market / BookRatio = \frac{Market\,Price\,PerShare}{BookValuePerShare}$$ **Equation 23: Market to book ratio**

$$Momentum = \frac{Price}{Price(nPeriodsAgo)} * 100$$ **Equation 24: Momentum**

$$\%K = 100 * \frac{RecentClose - LowestLow(n)}{HighestHigh(n) - LowestLow(n)}$$ **Equation 25: Stochastic %K**

$$\%D = 3 - PeriodMovingAverageof\,\%K$$ **Equation 26: Stochastic %D**

Where n is the number of periods used in the calculation

$$n = \frac{Z^2 p(1-p)}{e^2}$$ ………………… **Equation 27: Sample size for a proportion**

Where e is the acceptable sampling error

Z is the normalised probability at the required confidence level

And p is the proportion of interest

$$e = \sqrt{\frac{Z^2 p(1-p)}{n}}$$ ………………….. **Equation 28: Re-arrangement of equation 1.**

$$p_s = \frac{X}{n}$$ …. **Equation 29: Sample proportion**

$$\sigma_{p_s} = \sqrt{\frac{p(1-p)}{n}}$$ …. **Equation 30: Standard error**

Where p_s is the sample proportion under scrutiny,

X is number of successful outcomes of a particular variable

And n is the sample size, respectively.

$$t = \frac{\overline{X} - \mu}{\sigma} = \frac{\overline{X} - \mu}{\frac{S}{\sqrt{n}}}, \text{ where } \sigma \cong \frac{S}{\sqrt{n}}$$

Equation 31: Student's t distribution

$$\mu = \overline{X} +/- t\frac{S}{\sqrt{n}}, \ S = \sqrt{p_s(1-p_s)}$$

Equation 32: Estimate for population mean µ

Where: $\overline{X}$ is the sample mean.

μ is the population mean to be inferred,

σ is the unknown population standard deviation.

S is the sample standard deviation.

n is the sample size.

$$t \cong \frac{p_S - p}{\sqrt{\frac{p(1-p)}{n}}} \cdots\cdots\cdots$$

Equation 33: Difference between sample and population proportion in t units.

$$fpc = \sqrt{\frac{N-n}{N-1}} \ \ldots\ldots\ldots\ldots\ldots\ldots$$

Equation 34: Finite population correction factor.

$$\sigma_{\bar{x}} \cong \frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}, \text{ and } \sigma_{p_s} = \sqrt{\frac{p(1-p)}{n}}\sqrt{\frac{N-n}{N-1}} \ \cdots$$

Equation 35: Standard error and mean for finite populations.

Appendix B – List of Tables

p =	0.8	Power (Z)					
Sample Size n	99% 2.575	98% 2.325	95% 1.960	93% 1.810	90% 1.645	80% 1.285	50% 0.675
3	0.595	0.537	0.453	0.418	0.380	0.297	0.156
4	0.515	0.465	0.392	0.362	0.329	0.257	0.135
5	0.461	0.416	0.351	0.324	0.294	0.230	0.121
6	0.420	0.380	0.320	0.296	0.269	0.210	0.110
7	0.389	0.352	0.296	0.274	0.249	0.194	0.102
8	0.364	0.329	0.277	0.256	0.233	0.182	0.095
9	0.343	0.310	0.261	0.241	0.219	0.171	0.090
10	0.326	0.294	0.248	0.229	0.208	0.163	0.085
12	0.297	0.268	0.226	0.209	0.190	0.148	0.078
14	0.275	0.249	0.210	0.193	0.176	0.137	0.072
16	0.258	0.233	0.196	0.181	0.165	0.129	0.068
18	0.243	0.219	0.185	0.171	0.155	0.121	0.064
20	0.230	0.208	0.175	0.162	0.147	0.115	0.060
25	0.206	0.186	0.157	0.145	0.132	0.103	0.054
30	0.188	0.170	0.143	0.132	0.120	0.094	0.049
35	0.174	0.157	0.133	0.122	0.111	0.087	0.046
40	0.163	0.147	0.124	0.114	0.104	0.081	0.043
50	0.146	0.132	0.111	0.102	0.093	0.073	0.038
60	0.133	0.120	0.101	0.093	0.085	0.066	0.035
70	0.123	0.111	0.094	0.087	0.079	0.061	0.032
80	0.115	0.104	0.088	0.081	0.074	0.057	0.030
90	0.109	0.098	0.083	0.076	0.069	0.054	0.028
100	0.103	0.093	0.078	0.072	0.066	0.051	0.027
150	0.084	0.076	0.064	0.059	0.054	0.042	0.022
200	0.073	0.066	0.055	0.051	0.047	0.036	0.019
300	0.059	0.054	0.045	0.042	0.038	0.030	0.016
400	0.052	0.047	0.039	0.036	0.033	0.026	0.014
500	0.046	0.042	0.035	0.032	0.029	0.023	0.012
1000	0.033	0.029	0.025	0.023	0.021	0.016	0.009

Table 1: Error, for a given Power (Z), sample size and proportion of 0.8

p =	0.9	Power (Z)					
Sample Size n	99% 2.575	98% 2.325	95% 1.960	93% 1.810	90% 1.645	80% 1.285	50% 0.675
3	0.446	0.403	0.339	0.314	0.285	0.223	0.117
4	0.386	0.349	0.294	0.272	0.247	0.193	0.101
5	0.345	0.312	0.263	0.243	0.221	0.172	0.091
6	0.315	0.285	0.240	0.222	0.201	0.157	0.083
7	0.292	0.264	0.222	0.205	0.187	0.146	0.077
8	0.273	0.247	0.208	0.192	0.174	0.136	0.072
9	0.258	0.233	0.196	0.181	0.165	0.129	0.068
10	0.244	0.221	0.186	0.172	0.156	0.122	0.064
12	0.223	0.201	0.170	0.157	0.142	0.111	0.058
14	0.206	0.186	0.157	0.145	0.132	0.103	0.054
16	0.193	0.174	0.147	0.136	0.123	0.096	0.051
18	0.182	0.164	0.139	0.128	0.116	0.091	0.048
20	0.173	0.156	0.131	0.121	0.110	0.086	0.045
25	0.155	0.140	0.118	0.109	0.099	0.077	0.041
30	0.141	0.127	0.107	0.099	0.090	0.070	0.037
35	0.131	0.118	0.099	0.092	0.083	0.065	0.034
40	0.122	0.110	0.093	0.086	0.078	0.061	0.032
50	0.109	0.099	0.083	0.077	0.070	0.055	0.029
60	0.100	0.090	0.076	0.070	0.064	0.050	0.026
70	0.092	0.083	0.070	0.065	0.059	0.046	0.024
80	0.086	0.078	0.066	0.061	0.055	0.043	0.023
90	0.081	0.074	0.062	0.057	0.052	0.041	0.021
100	0.077	0.070	0.059	0.054	0.049	0.039	0.020
150	0.063	0.057	0.048	0.044	0.040	0.031	0.017
200	0.055	0.049	0.042	0.038	0.035	0.027	0.014
300	0.045	0.040	0.034	0.031	0.028	0.022	0.012
400	0.039	0.035	0.029	0.027	0.025	0.019	0.010
500	0.035	0.031	0.026	0.024	0.022	0.017	0.009
1000	0.024	0.022	0.019	0.017	0.016	0.012	0.006

Table 2: Error, for a given Power (Z), sample size and proportion of 0.8

p =	0.5	Power (Z)					
Sample Size n	99% 2.575	98% 2.325	95% 1.960	93% 1.810	90% 1.645	80% 1.285	50% 0.675
3	0.743	0.671	0.566	0.523	0.475	0.371	0.195
4	0.644	0.581	0.490	0.453	0.411	0.321	0.169
5	0.576	0.520	0.438	0.405	0.368	0.287	0.151
6	0.526	0.475	0.400	0.369	0.336	0.262	0.138
7	0.487	0.439	0.370	0.342	0.311	0.243	0.128
8	0.455	0.411	0.346	0.320	0.291	0.227	0.119
9	0.429	0.388	0.327	0.302	0.274	0.214	0.113
10	0.407	0.368	0.310	0.286	0.260	0.203	0.107
12	0.372	0.336	0.283	0.261	0.237	0.185	0.097
14	0.344	0.311	0.262	0.242	0.220	0.172	0.090
16	0.322	0.291	0.245	0.226	0.206	0.161	0.084
18	0.303	0.274	0.231	0.213	0.194	0.151	0.080
20	0.288	0.260	0.219	0.202	0.184	0.144	0.075
25	0.258	0.233	0.196	0.181	0.165	0.129	0.068
30	0.235	0.212	0.179	0.165	0.150	0.117	0.062
35	0.218	0.196	0.166	0.153	0.139	0.109	0.057
40	0.204	0.184	0.155	0.143	0.130	0.102	0.053
50	0.182	0.164	0.139	0.128	0.116	0.091	0.048
60	0.166	0.150	0.127	0.117	0.106	0.083	0.044
70	0.154	0.139	0.117	0.108	0.098	0.077	0.040
80	0.144	0.130	0.110	0.101	0.092	0.072	0.038
90	0.136	0.123	0.103	0.095	0.087	0.068	0.036
100	0.129	0.116	0.098	0.091	0.082	0.064	0.034
150	0.105	0.095	0.080	0.074	0.067	0.052	0.028
200	0.091	0.082	0.069	0.064	0.058	0.045	0.024
300	0.074	0.067	0.057	0.052	0.047	0.037	0.019
400	0.064	0.058	0.049	0.045	0.041	0.032	0.017
500	0.058	0.052	0.044	0.040	0.037	0.029	0.015
1000	0.041	0.037	0.031	0.029	0.026	0.020	0.011

Table 3: Error, for a given Power (Z), sample size and proportion of 0.5

p_s = 0.9	Students t Distribution - Power (t)											
S = 0.3	99.5%		99.0%		97.5%		95.0%		90.0%		75.0%	
t =	3.1058		2.7181		2.2010		1.7959		1.3634		0.6974	
Sample Size n	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower
3	1.4379	0.3621	1.3708	0.4292	1.2812	0.5188	1.2111	0.5889	1.1361	0.6639	1.0208	0.7792
4	1.3659	0.4341	1.3077	0.4923	1.2302	0.5699	1.1694	0.6306	1.1045	0.6955	1.0046	0.7954
5	1.3167	0.4833	1.2647	0.5353	1.1953	0.6047	1.1409	0.6591	1.0829	0.7171	0.9936	0.8064
6	1.2804	0.5196	1.2329	0.5671	1.1696	0.6304	1.1200	0.6800	1.0670	0.7330	0.9854	0.8146
7	1.2522	0.5478	1.2082	0.5918	1.1496	0.6504	1.1036	0.6964	1.0546	0.7454	0.9791	0.8209
8	1.2294	0.5706	1.1883	0.6117	1.1335	0.6665	1.0905	0.7095	1.0446	0.7554	0.9740	0.8260
9	1.2106	0.5894	1.1718	0.6282	1.1201	0.6799	1.0796	0.7204	1.0363	0.7637	0.9697	0.8303
10	1.1946	0.6054	1.1579	0.6421	1.1088	0.6912	1.0704	0.7296	1.0293	0.7707	0.9662	0.8338
12	1.1690	0.6310	1.1354	0.6646	1.0906	0.7094	1.0555	0.7445	1.0181	0.7819	0.9604	0.8396
14	1.1490	0.6510	1.1179	0.6821	1.0765	0.7235	1.0440	0.7560	1.0093	0.7907	0.9559	0.8441
16	1.1329	0.6671	1.1039	0.6961	1.0651	0.7349	1.0347	0.7653	1.0023	0.7977	0.9523	0.8477
18	1.1196	0.6804	1.0922	0.7078	1.0556	0.7444	1.0270	0.7730	0.9964	0.8036	0.9493	0.8507
20	1.1083	0.6917	1.0823	0.7177	1.0476	0.7524	1.0205	0.7795	0.9915	0.8085	0.9468	0.8532
25	1.0863	0.7137	1.0631	0.7369	1.0321	0.7679	1.0078	0.7922	0.9818	0.8182	0.9418	0.8582
30	1.0701	0.7299	1.0489	0.7511	1.0206	0.7794	0.9984	0.8016	0.9747	0.8253	0.9382	0.8618
35	1.0575	0.7425	1.0378	0.7622	1.0116	0.7884	0.9911	0.8089	0.9691	0.8309	0.9354	0.8646
40	1.0473	0.7527	1.0289	0.7711	1.0044	0.7956	0.9852	0.8148	0.9647	0.8353	0.9331	0.8669
50	1.0318	0.7682	1.0153	0.7847	0.9934	0.8066	0.9762	0.8238	0.9578	0.8422	0.9296	0.8704
60	1.0203	0.7797	1.0053	0.7947	0.9852	0.8148	0.9696	0.8304	0.9528	0.8472	0.9270	0.8730
70	1.0114	0.7886	0.9975	0.8025	0.9789	0.8211	0.9644	0.8356	0.9489	0.8511	0.9250	0.8750
80	1.0042	0.7958	0.9912	0.8088	0.9738	0.8262	0.9602	0.8398	0.9457	0.8543	0.9234	0.8766
90	0.9982	0.8018	0.9860	0.8140	0.9696	0.8304	0.9568	0.8432	0.9431	0.8569	0.9221	0.8779
100	0.9932	0.8068	0.9815	0.8185	0.9660	0.8340	0.9539	0.8461	0.9409	0.8591	0.9209	0.8791
150	0.9761	0.8239	0.9666	0.8334	0.9539	0.8461	0.9440	0.8560	0.9334	0.8666	0.9171	0.8829
200	0.9659	0.8341	0.9577	0.8423	0.9467	0.8533	0.9381	0.8619	0.9289	0.8711	0.9148	0.8852
300	0.9538	0.8462	0.9471	0.8529	0.9381	0.8619	0.9311	0.8689	0.9236	0.8764	0.9121	0.8879
400	0.9466	0.8534	0.9408	0.8592	0.9330	0.8670	0.9269	0.8731	0.9205	0.8795	0.9105	0.8895
1000	0.9295	0.8705	0.9258	0.8742	0.9209	0.8791	0.9170	0.8830	0.9129	0.8871	0.9066	0.8934

Table 4: Students t distribution for a proportion of 0.9

p = 0.8 S = 0.4	Power (t)											
t =	99.5% 3.1058		99.0% 2.7181		97.5% 2.2010		95.0% 1.7959		90.0% 1.3634		75.0% 0.6974	
Sample Size n	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower	µ Upper	µ Lower
3	1.5173	0.0827	1.4277	0.1723	1.3083	0.2917	1.2147	0.3853	1.1149	0.4851	0.9611	0.6389
4	1.4212	0.1788	1.3436	0.2564	1.2402	0.3598	1.1592	0.4408	1.0727	0.5273	0.9395	0.6605
5	1.3556	0.2444	1.2862	0.3138	1.1937	0.4063	1.1213	0.4787	1.0439	0.5561	0.9248	0.6752
6	1.3072	0.2928	1.2439	0.3561	1.1594	0.4406	1.0933	0.5067	1.0226	0.5774	0.9139	0.6861
7	1.2696	0.3304	1.2109	0.3891	1.1328	0.4672	1.0715	0.5285	1.0061	0.5939	0.9054	0.6946
8	1.2392	0.3608	1.1844	0.4156	1.1113	0.4887	1.0540	0.5460	0.9928	0.6072	0.8986	0.7014
9	1.2141	0.3859	1.1624	0.4376	1.0935	0.5065	1.0395	0.5605	0.9818	0.6182	0.8930	0.7070
10	1.1929	0.4071	1.1438	0.4562	1.0784	0.5216	1.0272	0.5728	0.9725	0.6275	0.8882	0.7118
12	1.1586	0.4414	1.1139	0.4861	1.0541	0.5459	1.0074	0.5926	0.9574	0.6426	0.8805	0.7195
14	1.1320	0.4680	1.0906	0.5094	1.0353	0.5647	0.9920	0.6080	0.9458	0.6542	0.8746	0.7254
16	1.1106	0.4894	1.0718	0.5282	1.0201	0.5799	0.9796	0.6204	0.9363	0.6637	0.8697	0.7303
18	1.0928	0.5072	1.0563	0.5437	1.0075	0.5925	0.9693	0.6307	0.9285	0.6715	0.8658	0.7342
20	1.0778	0.5222	1.0431	0.5569	0.9969	0.6031	0.9606	0.6394	0.9219	0.6781	0.8624	0.7376
25	1.0485	0.5515	1.0174	0.5826	0.9761	0.6239	0.9437	0.6563	0.9091	0.6909	0.8558	0.7442
30	1.0268	0.5732	0.9985	0.6015	0.9607	0.6393	0.9312	0.6688	0.8996	0.7004	0.8509	0.7491
35	1.0100	0.5900	0.9838	0.6162	0.9488	0.6512	0.9214	0.6786	0.8922	0.7078	0.8472	0.7528
40	0.9964	0.6036	0.9719	0.6281	0.9392	0.6608	0.9136	0.6864	0.8862	0.7138	0.8441	0.7559
50	0.9757	0.6243	0.9538	0.6462	0.9245	0.6755	0.9016	0.6984	0.8771	0.7229	0.8395	0.7605
60	0.9604	0.6396	0.9404	0.6596	0.9137	0.6863	0.8927	0.7073	0.8704	0.7296	0.8360	0.7640
70	0.9485	0.6515	0.9300	0.6700	0.9052	0.6948	0.8859	0.7141	0.8652	0.7348	0.8333	0.7667
80	0.9389	0.6611	0.9216	0.6784	0.8984	0.7016	0.8803	0.7197	0.8610	0.7390	0.8312	0.7688
90	0.9310	0.6690	0.9146	0.6854	0.8928	0.7072	0.8757	0.7243	0.8575	0.7425	0.8294	0.7706
100	0.9242	0.6758	0.9087	0.6913	0.8880	0.7120	0.8718	0.7282	0.8545	0.7455	0.8279	0.7721
150	0.9014	0.6986	0.8888	0.7112	0.8719	0.7281	0.8587	0.7413	0.8445	0.7555	0.8228	0.7772
200	0.8878	0.7122	0.8769	0.7231	0.8623	0.7377	0.8508	0.7492	0.8386	0.7614	0.8197	0.7803
300	0.8717	0.7283	0.8628	0.7372	0.8508	0.7492	0.8415	0.7585	0.8315	0.7685	0.8161	0.7839
400	0.8621	0.7379	0.8544	0.7456	0.8440	0.7560	0.8359	0.7641	0.8273	0.7727	0.8139	0.7861
1000	0.8393	0.7607	0.8344	0.7656	0.8278	0.7722	0.8227	0.7773	0.8172	0.7828	0.8088	0.7912

Table 5: Students t distribution for a proportion of 0.8

Appendix C – Questionnaire

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2006-09-07

TO WHOM IT MAY CONCERN

This letter serves to confirm that Mr YMM Essop, student number 8476616 is a registered final year student at the Graduate School of Business Leadership for 2006. He is doing the MBLREP-P as part of the requirements of obtaining the MBL postgraduate degree.

The Business School will observe any confidentiality requirements as requested by your institution regarding any information made available to the student in assisting with this report. The student must give his agreement as well to the confidentiality requirement.

On behalf of the Business School and Mr Essop, we thank you for your cooperation.

Yours sincerely

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Background

The questionnaire is designed to illicit specific information to answer the research question. It is intended to measure the practical application of Fundamental and Technical Analysis by investment and portfolio managers of large institutional investors in South Africa. The instrument is divided into three sections; Section B and C of the measurement instrument use a five point Likert Scale, while section A uses a simple yes or no response. Section A is designed to broadly identify and confirm the level of knowledge and experience of the respondent with respect to the concepts of both Technical and Fundamental Analysis in addition to exploring the primary hypothesis.

Section A and B of the questionnaire will be the primary source of information to identify to what extent institutional investors are using technical and fundamental analysis generally. Section C elicits specific information with respect to the 'popularity' of selected technical and fundamental analysis concepts as discussed in Chapter 3.1.3. The questionnaire further tries to identify if each analytical method is limited to certain investment timelines or periods (to try to distinguish day trading from longer trading periods).

The proposed questionnaire follows on the next page.

Part of this questionnaire was adapted from Flanigan and Rudd (2005).

Introduction

Hello, my name is **Yusuf Essop**, a student participating in the MBL programme at the **University of South Africa's School for Business Leadership (UNISA SBL)**. I'm conducting a **survey** of investment institutions based in South Africa to appraise the popularity of Technical and Fundamental analysis as decision making tools for equity investments amongst their portfolio managers. The results of this survey will be available to the UNISA SBL as well as all participating organisations. The survey takes about **15 minutes** to complete.

Your participation is anonymous and **voluntary**, and all your answers will be kept completely **confidential**. If there are any questions that you don't feel you can answer or want clarification on, please let me know.

You can contact me on my **cell** at **084-740-8509** or at **home** on **(011) 852-7566**.

This survey is being conducted under the mentorship of Greg Dalton, from the School of Business leadership. Please do not contact him directly.

Section A

Please review the questions below and select the answer you believe to be most appropriate.

I have a general understanding of the following concepts:		
Fundamental Analysis	Yes	No
Technical Analysis	Yes	No

Fundamental Analysis includes the following areas of study:		
The internal and external business environments	Yes	No
The current and historical financial statements of the company	Yes	No

Technical Analysis involves predicting future price movements;		
Based on historical price trends	Yes	No
Based on companies financial statements	Yes	No

In making purchasing decisions for publicly traded shares I have made use of		
Fundamental Analysis	Yes	No
Technical Analysis	Yes	No

The organisation that I work for encourages the use of both		
Fundamental Analysis	Yes	No
Technical Analysis	Yes	No

In making purchasing decisions for publicly traded shares I prefer	
Fundamental Analysis	□
Technical Analysis	□

My level of formal education is (please select one)	
Matriculated	□
Graduate	□
Post-Graduate	□

I have spent the following number of years in the securities industry (please select one)	
0 to 5 years	□
5 to 10 years	□
10 to 15 years	□
15 years plus	□

Section B

Please review the questions below and select the answer you believe to be most appropriate. Please tick the correct answer.

I prefer the following approach for making purchasing decisions of equities:	
I prefer Fundamental Analysis	□
I prefer Technical Analysis	□
I do not have a specific preference.	□

When considering the period for which I intend holding equity securities, I prefer *technical* analysis for the following time periods.		
Very Short term	(0 to 6 months, including day trading)	□
Short term	(6 months to one year)	□
Medium term	(1 to 3 years)	□
Long term	(3 to 5 years)	□
Very Long term	(5 years and more)	□

When considering the period for which I intend holding equity securities, I prefer *fundamental* analysis for the following time periods.		
Very Short term	(0 to 6 months, including day trading)	□
Short term	(6 months to one year)	□
Medium term	(1 to 3 years)	□
Long term	(3 to 5 years)	□
Very Long term	(5 years and more)	□

Having *insider* information is more important than:		
Fundamental Analysis	Yes	No
Technical Analysis	Yes	No

Doing a proper *Business Analysis* is more important than:		
Technical Analysis	Yes	No

Section C

When doing an analysis for making purchasing decision for publicly traded shares, how often you would use each of the models listed below? You may choose only one ranking for each item.

Ranking

1	Do not use
2	Used a little
3	Used a moderate amount
4	Used a lot
5	Used all the time

Fundamental Analysis					
CAPM/Beta	1	2	3	4	5
Portfolio Theory	1	2	3	4	5
Required Rate of Return	1	2	3	4	5
Internal Rate of Return (IRR)	1	2	3	4	5
Ratio Analysis	1	2	3	4	5
Discounted Cash Flow	1	2	3	4	5
Dividend Discount Model	1	2	3	4	5
Arbitrage Pricing Theory	1	2	3	4	5
Technical Analysis					
Volume Tracking	1	2	3	4	5
Charting	1	2	3	4	5
Trend lines	1	2	3	4	5
Relative Strength Index (RSI)	1	2	3	4	5
MACD - Histogram	1	2	3	4	5
Fibonacci Numbers	1	2	3	4	5
Elliot Wave	1	2	3	4	5
Japanese Candlesticks	1	2	3	4	5
Support and Resistance Levels	1	2	3	4	5
Trading Ranges	1	2	3	4	5
Stochastic	1	2	3	4	5

Section D

Please review and tick the appropriate answer/s.

When considering the period of investment, i.e. the time period for which you intend to hold the shares you purchase, do you prefer any of the specific models below for making the purchasing decisions? Note that these selections are not mutually exclusive. It is possible to have more than one selection for each item.

Ranking

1	Very Short term	(0 to 6 months, including day trading)
2	Short term	(6 months to one year)
3	Medium term	(1 to 3 years)
4	Long term	(3 to 5 years)
5	Very Long term	(5 years and more)

Fundamental Analysis					
CAPM/Beta	1	2	3	4	5
Portfolio Theory	1	2	3	4	5
Required Rate of Return	1	2	3	4	5
Internal Rate of Return (IRR)	1	2	3	4	5
Ratio Analysis	1	2	3	4	5
Discounted Cash Flow	1	2	3	4	5
Dividend Discount Model	1	2	3	4	5
Arbitrage Pricing Theory	1	2	3	4	5
Technical Analysis					
Volume Tracking	1	2	3	4	5
Charting	1	2	3	4	5
Trend lines	1	2	3	4	5
Relative Strength Index (RSI)	1	2	3	4	5
MACD - Histogram	1	2	3	4	5
Fibonacci Numbers	1	2	3	4	5
Elliot Wave	1	2	3	4	5
Japanese Candlesticks	1	2	3	4	5
Support and Resistance Levels	1	2	3	4	5
Trading Ranges	1	2	3	4	5
Stochastic	1	2	3	4	5

Appendix D – Raw Data

		Yes	No	Tot
Q1	**I have a general understanding of the following concepts:**			
V1	Fundamental Analysis	12	0	12
V2	Technical Analysis	11	1	12
Q2	**Fundamental Analysis includes the following areas of study:**	**Yes**	**No**	**Tot**
V3	The internal and external business environments	11	1	12
V4	The current and historical financial statements of the company	12	0	12
Q3	**Technical Analysis involves predicting future price movements;**	**Yes**	**No**	**Tot**
V5	Based on historical price trends	12	0	12
V6	Based on companies financial statements	2	10	12
Q4	**In making purchasing decisions for publicly traded shares I have made use of**	**Yes**	**No**	**Tot**
V7	Fundamental Analysis	12	0	12
V8	Technical Analysis	8	4	12
Q5	**The organisation that I work for encourages the use of both**	**Yes**	**No**	**Tot**
V9	Fundamental Analysis	12	0	12
V10	Technical Analysis	8	4	12

		Tick	Tot
Q6	**In making purchasing decisions for publicly traded shares I prefer**		
V11	Fundamental Analysis	12	
V12	Technical Analysis	1	13
Q7	**My level of formal education is (please select one)**	**Tick**	**Tot**
V13	Matriculated 0	1	
V14	Graduate 1	1	
V15	Post-Graduate 2	10	12
Q8	**I have spent the following number of years in the securities industry (please select one)**	**Tick**	**Tot**
V16	0 to 5 years	0	
V17	5 to 10 years	4	
V18	10 to 15 years	4	
V19	15 years plus	4	12
Q9	**I prefer the following approach for making purchasing decisions for equities:**	**Tick**	**Tot**
V20	I prefer Fundamental Analysis	11	
V21	I prefer Technical Analysis	0	
V22	I do not have a specific preference.	1	12

			Tick	Tot
Q10	**When considering the period for which I intend holding equity securities, I prefer *technical* analysis for the following time periods.**			
V23	Very Short term	(0 to 6 months, including day trading)	6	
V24	Short term	(6 months to one year)	6	
V25	Medium term	(1 to 3 years)	2	
V26	Long term	(3 to 5 years)	0	
V27	Very Long term	(5 years and more)	1	15

			Tick	Tot
Q11	**When considering the period for which I intend holding equity securities, I prefer *fundamental* analysis for the following time periods.**			
V28	Very Short term	(0 to 6 months, including day trading)	2	
V29	Short term	(6 months to one year)	1	
V30	Medium term	(1 to 3 years)	10	
V31	Long term	(3 to 5 years)	3	
V32	Very Long term	(5 years and more)	2	18

		Yes	No	Tot
Q12	**Having *insider* information is more important than:**			
V33	Fundamental Analysis	3	6	9
V34	Technical Analysis	6	3	9

		Yes	No	Tot
Q13	**Doing a proper *Business Analysis* is more important than:**			
V35	Technical Analysis	11	1	12

Q14 **When doing an analysis for making purchasing decisions for publicly traded shares how often would you use each of the following?**

	No of responses for each rank	1	2	3	4	5	Tot
	Fundamental Analysis						
V36	CAPM/Beta	4	4	1	2	1	12
V37	Portfolio Theory	1	4	3	3	1	12
V38	Required Rate of Return	1	1	6	1	3	12
V39	Internal Rate of Return (IRR)	1	2	4	4	1	12
V40	Ratio Analysis	1	1	3	4	3	12
V41	Discounted Cash Flow	0	0	4	4	4	12
V42	Dividend Discount Model	0	1	5	3	3	12
V43	Arbitrage Pricing Theory	4	1	6	0	1	12
	Technical Analysis						
V44	Volume Tracking	3	5	1	3	0	12
V45	Charting	3	1	3	3	2	12
V46	Trend lines	1	1	2	6	2	12
V47	Relative Strength Index (RSI)	2	3	3	2	2	12
V48	MACD - Histogram	4	2	4	1	1	12
V49	Fibonacci Numbers	7	3	1	1	0	12
V50	Elliot Wave	8	2	0	2	0	12
V51	Japanese Candlesticks	10	0	1	1	0	12
V52	Support and Resistance Levels	5	0	3	3	1	12
V53	Trading Ranges	3	2	2	5	0	12
V54	Stochastic	3	3	3	2	1	12

Q15 When considering the period of investment, i.e. the time period for which you intend to hold the shares you purchase, do you prefer any of the specific models below for making the purchasing decisions?

	No of responses for each rank	1	2	3	4	5	Tot
	Fundamental Analysis						
V55	CAPM/Beta	4	1	3	3	1	12
V56	Portfolio Theory	1	1	5	4	1	12
V57	Required Rate of Return	1	0	5	5	1	12
V58	Internal Rate of Return (IRR)	2	0	5	4	1	12
V59	Ratio Analysis	0	2	4	5	1	12
V60	Discounted Cash Flow	1	1	8	1	1	12
V61	Dividend Discount Model	0	0	5	5	2	12
V62	Arbitrage Pricing Theory	7	0	3	2	0	12
	Technical Analysis						
V63	Volume Tracking	8	4	0	0	0	12
V64	Charting	4	6	1	0	1	12
V65	Trend lines	3	5	3	0	1	12
V66	Relative Strength Index (RSI)	5	4	2	0	1	12
V67	MACD - Histogram	7	3	1	1	0	12
V68	Fibonacci Numbers	6	4	1	0	1	12
V69	Elliot Wave	7	2	1	0	2	12
V70	Japanese Candlesticks	8	4	0	0	0	12
V71	Support and Resistance Levels	7	4	1	0	0	12
V72	Trading Ranges	4	7	1	0	0	12
V73	Stochastic	3	3	2	4	0	12

Appendix E – Data Analysis

	n	p1	p2	Sum of p	Confidence Interval	p1 Upper	p1 Lower	p2 Upper	p2 Lower
V1	12	1.000	0.000	1	0.000	1.000	1.000	0.000	0.000
V2	12	0.917	0.083	1	0.156	1.073	0.760	0.240	-0.073
V3	12	0.917	0.083	1	0.156	1.073	0.760	0.240	-0.073
V4	12	1.000	0.000	1	0.000	1.000	1.000	0.000	0.000
V5	12	1.000	0.000	1	0.000	1.000	1.000	0.000	0.000
V6	12	0.167	0.833	1	0.211	0.378	-0.044	1.044	0.622
V7	12	1.000	0.000	1	0.000	1.000	1.000	0.000	0.000
V8	12	0.667	0.333	1	0.267	0.933	0.400	0.600	0.067
V9	12	1.000	0.000	1	0.000	1.000	1.000	0.000	0.000
V10	12	0.667	0.333	1	0.267	0.933	0.400	0.600	0.067
V33	9	0.333	0.667	1	0.308	0.641	0.025	0.975	0.359
V34	9	0.667	0.333	1	0.308	0.975	0.359	0.641	0.025
V35	12	0.917	0.083	1	0.156	1.073	0.760	0.240	-0.073

	n	p1	Sum of p	Confidence Interval	p1 Upper	p1 Lower
V11	13	0.923		0.145	1.068	0.778
V12	13	0.077	1	0.145	0.222	-0.068
V13	12	0.083		0.156	0.240	-0.073
V14	12	0.083		0.156	0.240	-0.073
V15	12	0.833	1	0.211	1.044	0.622
V16	12	0.000		0.000	0.000	0.000
V17	12	0.333		0.267	0.600	0.067
V18	12	0.333		0.267	0.600	0.067
V19	12	0.333	1	0.267	0.600	0.067
V20	12	0.917		0.156	1.073	0.760
V21	12	0.000		0.000	0.000	0.000
V22	12	0.083	1	0.156	0.240	-0.073
V23	15	0.400		0.248	0.648	0.152
V24	15	0.400		0.248	0.648	0.152
V25	15	0.133		0.172	0.305	-0.039
V26	15	0.000		0.000	0.000	0.000
V27	15	0.067	1	0.126	0.193	-0.060
V28	18	0.111		0.145	0.256	-0.034
V29	18	0.056		0.106	0.161	-0.050
V30	18	0.556		0.230	0.785	0.326
V31	18	0.167		0.172	0.339	-0.006
V32	18	0.111	1	0.145	0.256	-0.034

	n	p1 Upper	p1 Lower	p2 Upper	p2 Lower	p3 Upper	p3 Lower	p4 Upper	p4 Lower	p5 Upper	p5 Lower	Sum of p
V36	12	0.3333		0.3333		0.0833		0.1667		0.0833		1
		60%	7%	60%	20%	24%	0%	38%	6%	24%	-8%	
V37	12	0.0833		0.3333		0.2500		0.2500		0.0833		1
		24%	-7%	60%	20%	50%	13%	50%	13%	24%	-8%	
V38	12	0.0833		0.0833		0.5000		0.0833		0.2500		1
		24%	-7%	24%	0%	78%	36%	24%	0%	50%	0%	
V39	12	0.0833		0.1667		0.3333		0.3333		0.0833		1
		24%	-7%	38%	6%	60%	20%	60%	20%	24%	-8%	
V40	12	0.0833		0.0833		0.2500		0.3333		0.2500		1
		24%	-7%	24%	0%	50%	13%	60%	20%	50%	0%	
V41	12	0.0000		0.0000		0.3333		0.3333		0.3333		1
		0%	0%	0%	0%	60%	20%	60%	20%	60%	6%	
V42	12	0.0000		0.0833		0.4167		0.2500		0.2500		1
		0%	0%	24%	0%	70%	27%	50%	13%	50%	0%	
V43	12	0.3333		0.0833		0.5000		0.0000		0.0833		1
		60%	7%	24%	0%	78%	36%	0%	0%	24%	-8%	
V44	12	0.2500		0.4167		0.0833		0.2500		0.0000		1
		50%	1%	70%	27%	24%	0%	50%	13%	0%	0%	
V45	12	0.2500		0.0833		0.2500		0.2500		0.1667		1
		50%	1%	24%	0%	50%	13%	50%	13%	38%	-5%	
V46	12	0.0833		0.0833		0.1667		0.5000		0.1667		1
		24%	-7%	24%	0%	38%	6%	78%	36%	38%	-5%	
V47	12	0.1667		0.2500		0.2500		0.1667		0.1667		1
		38%	-4%	50%	13%	50%	13%	38%	6%	38%	-5%	
V48	12	0.3333		0.1667		0.3333		0.0833		0.0833		1
		60%	7%	38%	6%	60%	20%	24%	0%	24%	-8%	
V49	12	0.5833		0.2500		0.0833		0.0833		0.0000		1
		86%	30%	50%	13%	24%	0%	24%	0%	0%	0%	
V50	12	0.6667		0.1667		0.0000		0.1667		0.0000		1
		93%	40%	38%	6%	0%	0%	38%	6%	0%	0%	
V51	12	0.8333		0.0000		0.0833		0.0833		0.0000		1
		104%	62%	0%	0%	24%	0%	24%	0%	0%	0%	
V52	12	0.4167		0.0000		0.2500		0.2500		0.0833		1
		70%	14%	0%	0%	50%	13%	50%	13%	24%	-8%	
V53	12	0.2500		0.1667		0.1667		0.4167		0.0000		1
		50%	1%	38%	6%	38%	6%	70%	27%	0%	0%	
V54	12	0.2500		0.2500		0.2500		0.1667		0.0833		1
		50%	1%	50%	13%	50%	13%	38%	6%	24%	-8%	
V55	12	0.3333		0.0833		0.2500		0.2500		0.0833		1
		60%	7%	24%	0%	50%	13%	50%	13%	24%	-8%	
V56	12	0.0833		0.0833		0.4167		0.3333		0.0833		1
		24%	-7%	24%	0%	70%	27%	60%	20%	24%	-8%	
V57	12	0.0833		0.0000		0.4167		0.4167		0.0833		1
		24%	-7%	0%	0%	70%	27%	70%	27%	24%	-8%	
V58	12	0.1667		0.0000		0.4167		0.3333		0.0833		1
		38%	-4%	0%	0%	70%	27%	60%	20%	24%	-8%	
V59	12	0.0000		0.1667		0.3333		0.4167		0.0833		1
		0%	0%	38%	6%	60%	20%	70%	27%	24%	-8%	
V60	12	0.0833		0.0833		0.6667		0.0833		0.0833		1
		24%	-7%	24%	0%	93%	53%	24%	0%	24%	-8%	

V61	12	0.0000		0.0000		0.4167		0.4167		0.1667		1
		0%	0%	0%	0%	70%	27%	70%	27%	38%	-5%	
V62	12	0.5833		0.0000		0.2500		0.1667		0.0000		1
		86%	30%	0%	0%	50%	13%	38%	6%	0%	0%	
V63	12	0.6667		0.3333		0.0000		0.0000		0.0000		1
		93%	40%	60%	20%	0%	0%	0%	0%	0%	0%	
V64	12	0.3333		0.5000		0.0833		0.0000		0.0833		1
		60%	7%	78%	36%	24%	0%	0%	0%	24%	-8%	
V65	12	0.2500		0.4167		0.2500		0.0000		0.0833		1
		50%	1%	70%	27%	50%	13%	0%	0%	24%	-8%	
V66	12	0.4167		0.3333		0.1667		0.0000		0.0833		1
		70%	14%	60%	20%	38%	6%	0%	0%	24%	-8%	
V67	12	0.5833		0.2500		0.0833		0.0833		0.0000		1
		86%	30%	50%	13%	24%	0%	24%	0%	0%	0%	
V68	12	0.5000		0.3333		0.0833		0.0000		0.0833		1
		78%	22%	60%	20%	24%	0%	0%	0%	24%	-8%	
V69	12	0.5833		0.1667		0.0833		0.0000		0.1667		1
		86%	30%	38%	6%	24%	0%	0%	0%	38%	-5%	
V70	12	0.6667		0.3333		0.0000		0.0000		0.0000		1
		93%	40%	60%	20%	0%	0%	0%	0%	0%	0%	
V71	12	0.5833		0.3333		0.0833		0.0000		0.0000		1
		86%	30%	60%	20%	24%	0%	0%	0%	0%	0%	
V72	12	0.3333		0.5833		0.0833		0.0000		0.0000		1
		60%	7%	86%	44%	24%	0%	0%	0%	0%	0%	
V73	12	0.2500		0.2500		0.1667		0.3333		0.0000		1
		50%	1%	50%	13%	38%	6%	60%	20%	0%	0%	