Investigating the probability of a specific mark-up on white maize on SAFEX

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Abstract

Due to the volatility of grain trading of white maize on the SAFEX trading platform, a white maize farmer can clearly sell his maize at a loss. The aim of this study was to investigate if white maize can be produced and sold at a specific mark-up.

To determine if this was possible a quantitative method of research was used. Data was obtained from SAFEX, Grain SA and SAGIS. This data included average daily selling prices of white maize on SAFEX for the past 12 years, as well as input cost as obtained from Grain SA per year for the past 12 years for the Hoopstad region. The transport differential for Tierfontein was also obtained for the past 12 years to ensure that accurate calculations could be done.

The study concluded that the farmer could in fact sell at a specific mark-up, however, the farmer needs to have a thorough knowledge of his input costs as well as needs to adhere to a consistent observation of SAFEX prices. This will ensure that a farmer can attain a specific predetermined mark-up.

It is recommended that further studies be done on the other grains to determine if the same is attainable.

Keyword: white maize, SAFEX, Grain SA, SAGIS, mark-up, probability, input costs

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Abbreviations

Abbreviation	Meaning
CBOT	Chicago Board of Trade
Grain SA	Grain South Africa
ICEC	Interagency Commodity Estimates Committee
JSE	Johannesburg Stock Exchange
NAMC	National Agricultural Marketing Council
OSI	Oscillation
SAFEX	South African Futures Exchange
SAGIS	South African Grain Information Service
SASDE	South African Supply and Demand Estimates
SOI	Southern Oscillation Index
USD/ZAR	United States Dollar / South African Rand exchange rate pair
USDA	United States Department of Agriculture
WAOB	World Agricultural Outlook Board
WASDE	World Agricultural Supply and Demand
WM / WMAZ	White maize
ZAR	South African Rand

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Chapter 1: Nature and scope of the study

1.1 Introduction

Before the dawn of democracy in South Africa in 1994, agricultural commodities were governed by a variety of agricultural boards (Vigne, 2010). These boards were the first to be deregulated, leaving the agricultural commodity market to urgently establish a free market system (Vigne, 2010). The emerging sector suffered from a lack of organisation, bargaining power and knowledge (Department of Agriculture, 2020). The South African Futures Exchange (SAFEX) is the futures exchange subsidiary of the Johannesburg Stock Exchange (JSE) Limited, the Johannesburg-based futures exchange. SAFEX was formed in 1990 which, as an independent exchange, experienced steady growth over the following decade. In 1995 a separate agricultural market division was formed for the trading of agricultural derivatives to make provision for the gap in marketing maize (SAFEX, 2020).

As SAFEX is a trading platform, it was open for speculative trading on the market, which resulted in fluctuations and mispricing of the market (Burger, 2015). Given the volatility of the market, there was also a possibility that farmers could sell their grain at a loss (Geyser & Cutts, 2010).

1.2 Problem statement

Farmers have fixed input costs for maize cultivation (Grain SA, 2020). Since the abolishment of the Maize Board individual farmers were personally responsible for the marketing of their own maize (Roux, 2018:3). As this is a free market system, the price of maize is extremely volatile, and thus a farmer can sell at a loss. Farmers who are not up to date with their administration might be looking at turnover figures and not realise that they are not making a profit. Given the volatility of the market price, the problem to be investigated in this study is whether there is a way for the farmer to stabilise his income at a level above input costs.

1.3 Objectives of the study

1.3.1 Primary objective

This is an essential study to determine at which point maize cultivation becomes profitable and sustainable at a specific profit margin. This study aims to provide the South African maize farmer with a potential strategy to utilise a mark-up option in successfully managing an agricultural marketing system.

To deliver this strategy, it must be determined if it is possible to sell at a specific mark-up. For this we need to compare historical SAFEX selling prices to the SAGIS input costs every year to determine if it would have been possible to sell at a specific mark-up.

1.3.2 Secondary objectives

The secondary objectives of the study can be differentiated into those in the literature and those in the empirical part of the study.

1.3.2.1. Literature

- Discuss the background of the cultivation of maize.
- Identify and discuss the previous marketing system of maize in South Africa.
- Identifying the factors influencing the supply and demand of maize.
- Contextualise the trading of maize.

1.3.2.2. Empirical

- Identify the research theory.
- Identify the research method and design.
- Identify the data collection method.
- Discuss how the data will be analysed.
- Discuss the results and make recommendations.

1.4 Scope of the study

Where the text refers to “agricultural commodities” it only includes maize. Financial derivatives like futures and options are not considered, including puts and calls. This study considers each year individually, from cultivation to marketing. This study is only done in the South African context where SAFEX influences maize marketing. All SAGIS and SAFEX historical data are included and any historical data from private history are excluded.

The following assumption will be part of the study:
This study assumes that *ceteris paribus* is in place. This means that the study assumes that the maize cultivation industry will stay the same in that maize will still be cultivated, and maize will still be sold through SAFEX.

1.5 Research methodology

The study will consist of a literature review and an empirical study.

1.5.1 Literature review

The literature review will be performed by using a variety of search engines such as Google Scholar, EBSCOhost, plus websites such as SAFEX, Grain SA, SAGIS, Omnia and services such as the NWU library for PhD and MBA publications.

1.5.2 Empirical study

The process of quantitative research involves a series of specific steps to get to the expected result. Quantitative research takes a broadly deductive approach, which is why the study started with a theory. The theory forms the basis for the definition of questions and hypotheses. Experimental and survey research is most likely to form the specification of the hypotheses. This is not always true in practice and theory is used to contextualise the concerns related to the concepts to be studied.

The next step would be the selection of the research design. This has implications for a variety of issues and therefore it needs to be addressed carefully. The next step

involves arriving at measures of the concepts of the researcher's interest. This process is often called "operationalism" (Bryman *et al*., 2014:32).

This study makes use of the quantitative approach, as it entails the collection of numerical data, then regards the relationship between theory and research as deductive. Although this study makes use of a natural science approach, the results that the farmer can benefit from after doing the suggested calculations, is so much more that only numbers and figures. It has a distinctive epistemological and anti-logical position, which suggests that there is a good deal more to it than the mere presence of a number. The emphasis is on quantification in the collection and the analysis of data, consisting of a linear series of steps, moving from theory to conclusions, including numbers and measurements, rigid, reliable SAFEX data. Researchers are detached from the subject.

Quantitative research entails a specific set of steps. It starts off with theory, which forms the basis for the definition of research questions. The second step theory is used to contextualise the research concerns to be studied and the collection of data. The third step is the selection of the research design as this could influence the findings considerably.

With step four, the measures arrive at the concept which is of interest. Steps five and six entail the selection of a research site and subjects. The administration of the research instruments is done during step seven and during step eight the information collected must be prepared to be quantified and transformed into data. Step nine involves using quantitative data analysis techniques to summarise the data collected to test for relationships between variables and to develop ways of presenting the results. The results of the data analysis will be identified as findings in step ten. Step eleven entails the writing down of the research in the form of a report (Bryman *et al*., 2014:33).

The study will be a cross-sectional research design. It will involve the collection of quantitative data on the SAFEX-trade to detect patterns of association in the variables at a specific time, by testing theories.

The above-mentioned data will be integrated into an Excel spreadsheet to be able to calculate the daily loss or profit, if the farmer sold at the daily closing price. This information or data will enable the study to mathematically add specific mark-ups to the input costs and determine the possibility of attaining a consistent mark-up. Input costs consist of the direct cultivation costs, including fertiliser, seed, herbicides, pesticides and diesel. SAFEX selling price consists of the daily closing price but does not consider the transport differential, as this varies from town to town (Grain SA, 2020).

The SAFEX units of analysis that will be included in this study are the daily closing prices of each month of each year for the past 12 years. On the input side, the Grain SA units of analysis will include the costing as described above per month, per year for the past 12 years. The information can be acquired publicly via the internet on the websites of Grain SA, SAGIS and SAFEX, sorted per geographical area (Grain SA, 2020). If needed, input costs could also be obtained from Grain SA at their head office in Bothaville (SAFEX, 2021).

There are three sets of historical data that will be used in this study. The first two sets of historical data will comprise of input costs for the last 12 years and will be obtained from Grain SA and/or SAGIS. The second set of historical data will comprise of selling prices obtained from SAFEX.

This data will be obtained from both institutions' websites, where it is available in electronic format. The information can be very easily obtained, as it is publicly accessible. No permissions are required, whether electronically or physically, as it is in the public domain.

This data will be integrated into an Excel spreadsheet per day, per month, and per year for the past 12 years. The quantitative data gathered from the internet need to be analysed, to meet the criteria of authenticity, credibility, representativeness and meaning. In the first instance, historical data from SAFEX are based on historical daily values and cannot be changed due to laws and regulations of governing futures and exchange platforms. In the second instance, the information that this study dealt with is originated from Grain SA/SAGIS, which is an organisation "by the farmer for the

farmer". Grain SA does not buy nor supply any of the inputs, but merely gathers cost prices from the manufacturers and users and publishes this on their website to the benefit of their members. In the same way SAGIS holds the historical data of all trades on SAFEX.

The SAFEX website came into operation when trading started in the late 1990s and already exists for more than 12 years, while the Grain SA website exists for even longer. Grain SA and its website adhere to the regulations of corporate governance as set by its board and members, thus binding them to a strict set of moral codes. Both these institutions are 100% representative of the maize cultivation topic and there is no space for misinterpreting their historical data.

This data is directly downloadable from each organisation's website. Alternatively, it is available on hard copy at either of these two organisations' head office. The historical data collected will be utilised to determine the difference between these two sets of data, to obtain an answer or variable, by making use of Excel spreadsheets. This answer will then be the variable against which achievability for a specific set of predictions is tested. The data analysis technique of frequency tables will be used to determine the frequency of results (Bryman *et al*., 2014:318).

The data from the input costs will be captured in Column B of the spreadsheet, while the data from the selling price will be captured in Column C. Column C minus Column B will give the needed variable in Column D. For this study, a specific mark-up on the cost will be tested against Column E, e.g., cost + 30% will be tested whether it is equal to or larger than the answer in Column D by making use of the IF function in Excel. If equal to or greater than, Column F will be flagged.

According to Bryman *et al*. (2014:318) this will be a univariate analysis using a frequency table, which provides the count and percentage belonging to each of the categories for any type of variable. The frequency of the flagged column needs to be calculated to determine the percentage. The same method could be used in the next columns to test against cost + 35%, cost + 45% or cost + 55%. These percentages were identified as possible profit margins but due to the risk of dry land cultivation it is not economically feasible to go below 35%. After cost +55% the probability declined drastically and thus indicated it was not statistically attainable.

The results of the above calculations will then be used to create line charts to indicate which possibility is the most achievable. A histogram can be used to show the relationship between selling cost + mark-up and direct delivery sales. Many farmers do not use data analysis to market their maize, but rather deliver directly from the field, regardless of price. The identified findings would be the next step, as this is the result of the data analysis. According to Bryman *et al*. (2014:33) the researcher will at this point consider the relationship between the findings and the question raised at the beginning of the research.

The final step is to write down the research as a report. This report needs to convince readers that the conclusions are important and that the findings are convincing and valid.

1.6 The quality and rigour of the proposed research design

The quality of the data in this study is without reproach. SAFEX is legally bound to provide accurate figures on a daily ongoing basis about each transaction, including the market price for the day. SAFEX must abide by the rules of the Financial Markets Control Act of 1989 (SAFEX, 2020). This is published electronically, and a summary is published in a hard copy format. These figures are relevant, authentic and meaningful (Bryman *et al*., 2014:276).

Grain SA is basically in the same situation. Their data are published electronically as well as in their quarterly magazine and can thus not be changed. Their data are also relevant, authentic and meaningful (Grain SA, 2020). The quantitative approach entails a linear series of steps moving from theory to conclusion. Researchers are detached from the subject.

1.7 Limitations of the study

No limitations can be foreseen at this stage.

1.8 Conclusion

Having highlighted the nature and the scope of the study, the study started in the next chapter with a literature review, followed by the empirical study.

1.9 Layout of the study

Chapter 1: Nature and scope of the study

Chapter 2: Literature review

Chapter 3: Empirical study

Chapter 4: Conclusions and recommendations

Chapter 2: Literature review

2.1 Introduction

The following chapter discusses the origin, usage and cultivation of maize. It also has a look at maize trading and how it has evolved in South Africa. The study also provides some background on the economic theory of trading, including the factors influencing demand and supply.

2.2 Maize

Maize has been in use for ages and is believed to have originated in Mexico some 5 000 years ago (Heymans, 2008:11). Maize was introduced to South Africa in the mid-1600s. Maize was firstly introduced to Western Africa by Portuguese traders in the early 1500s and only reached Southern Africa in the mid-1600s, with the arrival and establishment of a fresh provision way station in Cape Town by the Dutch East India Company (McCann, 2001).

Maize was subsequently established as a crop, and agricultural data show that the total South African production reached a tonnage of 328 000 tons in 1904. In 1935 this total reached 1,68 million tons and with more maize farmers entering the production, together with better cultivation methods, this increased further and in 2015 the total production reached 12,2 million tons. The cultivated area, however, decreased by 35,7% from 1935, showing an 8,6-fold increase in average maize yields. It is also clear that the preference of yellow maize vs white maize is shifting, as yellow maize is a faster grower, delivering higher yields (Greyling & Pardey, 2019:21).

In South Africa users prefer white maize for human consumption, as it is perceived to be of a higher social status when compared to yellow maize, as yellow maize is associated with food-aid programmes and poverty. The animal feeding industry mainly consumes yellow maize (Ranum *et al*., 2014:107).

In general, maize contains about 72% starch, 9,4% protein and 4,3% fat, supplying an energy density of 361 kcal/100 g. Many of the B vitamins, essential minerals and fibre are inherent in maize (Ranum *et al*., 2014:106).

Maize is mainly used for mealie-meal and flour, but as it is a very versatile product, it can also be used for processing into a variety of food and industrial products. This includes starch, sweeteners, maize oil, beverages, glue, industrial alcohol and fuel ethanol, to name a few alternate products (Ranum *et al*., 2014:108).

Maize could also be used as the source of many other products, for example, in Wellington in the Western Cape, maize is solely used to distil Three Ships Whiskey, a whiskey that has received various international recognitions (Three Ships Whiskey, 2021). At the same distillery, gas is extracted from the fermentation batches and used for heating purposes; the leftovers are used as fodder (Toraman, s.a.).

Maize-germ could be used for medicinal and/or pharmaceutical purposes, where they extract the phytochemicals for medicinal purposes. Germ oil could also be extracted and used as cooking oil, but has a short shelf life. Sunflower oil is usually added to enhance the shelf life. Maize, especially yellow maize, is used as a source of fodder for most animals (Sheng *et al*., 2018).

Through a distillation process, ethanol could be produced from maize by the same token, even pure medicinal alcohol could be produced. The oil could also be extracted from the germ and transformed into biodiesel. Maize could even be fractionated, and the fibre used for baking chips or cereals, or it could be sold directly to the fibre market (Dijkstra, 2016).

2.3 Cultivation

To cultivate maize successfully, the following is needed: fertile soil, adapted cultivars for specific areas, plant population, soil tillage, fertilisation, control for weed, diseases and insects, harvesting, marketing and financial resources (Du Plessis, 2003). It is, however, quite expensive to cultivate maize. Apart from the financing costs for the land, the farmer must also provide for a permanent labour force, as well as for mechanical tillage and the fuel necessary, seed, fertiliser, herbicides, pesticides and later harvesting (Du Plessis, 2003).

The cost of agricultural equipment has risen dramatically over the last number of years, partly due to the weaker Rand and the lower Rand/Dollar exchange rate as well as South Africa not manufacturing spare parts (Trading Economics, 2021).

Where fertilisers were once seen as a by-product of the fuel-production industry (like Sasol) and sold at low prices, this has changed dramatically with prices going up every year irrespective of the local demand. The low Rand/Dollar exchange rate has made it quite profitable to export and this has led to extreme price increases. The problem with South African grain cultivation is that input costs keep on rising each year, while selling prices do not necessarily follow this trend.

This has led to situations where farmers are losing money in the process and grain farmers are therefore compelled to look at alternative ways of farming profitability. It is quite possible for maize to be sold at a loss, especially where a farmer is not knowledgeable about expenses and input costs and sell at whatever rate is applicable from SAFEX at the day of delivering the maize. Farmers learned from experience that the system is not farmer-friendly like the agricultural boards used to be and that they had to start doing their own homework to survive (Department of Agriculture, Forestry and Fishery, 2019).

During the growing season, the maize plant completes a series of growth stages. After planting, when the seeds are in the soil, the seed will start to absorb water and swell. When sufficient water has been taken in and soil temperatures are favourable, the germination process will start. The first to emerge will be the root, called radicle, after which the mesocotyl will begin to elongate and the coleoptile, which is a protective sheath over the mesocotyl, will be seen as it emerges. This process is overly sensitive to soil temperatures. Extreme temperatures that are too hot or too cold will influence the growing process (Du Plessis, 2003).

For the plant to reach maturity, it will have to undergo several growth stages. These stages are separated into two groups, namely vegetative and reproductive. At the appearance of the silks, the point of separation of these two groups are reached (Du Plessis, 2003). Maize is a summer crop and is planted in the early summer, usually after the first summer rains. In South Africa, this means between September and November, depending on which part of the country is cultivated and the standard rainfall pattern for that area. In the north-western parts of the Free State, the planting season normally runs from the first week of November. The standard varieties of maize

take from 120 to 150 days to ripen, but there are cultivars that are known as “short-growers” and ripen within 90 to 120 days, depending on climatic conditions.

2.4 Maize Board

The formal South African national agricultural system basically started operating in the early 1930s and has gone through a number of applicable laws. Of these, the 1937 Marketing Act was the most influential, an enabling act mainly aimed at stabilising producer prices in the wake of overproduction and low international prices. This act allowed for the establishment of agricultural control boards, which produced, handled, processed and traded agricultural commodities (Dreyer, 2019:27).

A few years after the establishment of this marketing act, South Africa experienced severe droughts between 1941 and 1942, reducing the production of maize considerably. Additionally, shortages of inputs, increased demand, and the inability to import were all consequences of the war, leading to the establishment of the Maize Board to maintain control over supply and shortages and to ensure that prices did not escalate. Prices for both the producer and the processor were determined by the Board. These prices were calculated in such a way that a profit margin could be expected by the farmer (Dreyer, 2019:36).

The Maize Board was established to administer the Summer Grain Scheme. This was a single-channel, fixed-price marketing system. The Board was the only buyer, seller, and exporter of maize in the country. The main purpose of the Maize Board was to bring price stability to the market (Dreyer, 2019:37). The National Party came into power in 1948 and used the control board system to increase producer prices. Over the next three decades, government control through these control boards grew drastically. Warnings and criticism from other economists were disregarded, and it seemed that government clearly had no intent to stop or even gradually ease the extent of intervention (Dreyer, 2019:37).

The Maize Board exercised control over the maize by appointing agricultural co-operatives as agents for the receipt, storage and payment of deliveries. These payments would be reimbursed by the Board and the co-operative would deliver to

end-users as per the Board's instructions. The Maize Board initiated a silo-building programme through levies on maize deliveries, linking to the existing railway infrastructure and even extending the railway infrastructure to accommodate the transport of maize and other agricultural commodities. These silos benefitted the co-ops directly and became a leading force in the marketing system, ultimately handling 93% of the South African maize production (Dreyer, 2019:37).

On the other hand, the control boards driven by government consisted of producers and government employees drafted from the Department of Agriculture, but eventually consisted of mainly producers. This led to a skewed representation and was not sustainable. With the liberalisation of the financial system in the 1970s, macro-economic pressure led to the transformation of the agricultural control boards (Dreyer, 2019:38). The controlled marketing promoted stability within the agricultural sector. To maintain stability, however, the 1937 Marketing Act was regularly amended and eventually consolidated into the new Marketing Act of 1968 (Dreyer, 2019:38).

The main objectives of the 1968 Act were to ensure continued, smooth farming operations, with sufficient supply for the demand at specified margins. This, however, revealed negative implications for the maize sector. Some of these implications included the fact that government control steadily increased the costs of marketing. When this occurred, more controls were put in place, demanding even higher costs (Dreyer, 2019:38).

These increased marketing costs were included in the management and administration costs of the Board, which annually calculated the domestic price of maize offered to the farmers. This price also included the financing costs of land (or rental if not owned), as well as a profit margin to the farmer. This in turn effected increased agricultural output, increased production, increased subsidies by government and an increase in the ratio of hectares cultivated to hectares grazing, thus maize to meat prices. It also led to soil deprivation, influencing sustainable animal farming. During white maize shortages, government forced millers to mix white and yellow maize, regardless of preferences. Local prices eventually exceeded the international prices, and another set of controls was introduced to stabilise this effect.

In the 1980s it became more difficult to maintain subsidies due to budget constraints (Dreyer, 2019:39).

In 1996, the Marketing of Agricultural Products Act No 47 of 1996 was aimed at preventing intervention and provided for the closure of all control boards, promulgating a new marketing act establishing a free-market pricing system. The Maize Board was thus closed down in April 1997. Since then, prices were determined by domestic supply and demand, import/export parity prices and tariffs (Dreyer, 2019:41).

SAFEX was formed in 1990, but a separate division was only established in 1995 for the purpose of trading agricultural derivatives. The eventual demise of the Maize Board was in 1997 (Brown *et al*., 2010) and the only alternative market left was SAFEX (SAFEX, 2020).

2.5 Economic theory

In the next section the discussions are on the economic theory of supply and demand as well as the effect of price support and production quotas.

The buyers and sellers of products create demand and supply. They come together in a “market”, which can take up any form – from the grocery store on the corner, to the fresh produce market, to JSE and SAFEX. Transactions in this market have a direct correlation to the demand and supply of the specific product (Janse van Rensburg *et al*., 2015:54).

2.5.1 Demand

The demand of a product represents the quantity of the product that consumers are willing to purchase at specific prices over a specific period (Pindyck & Rubinfeld, 2013:24). Demand thus reflects the quantities of the product available at various possible prices, all other things being equal (*ceteris paribus*). Demand can easily be explained in Figure 2.1. The law of demand is a fundamental principle which states that when prices fall, the quantity demanded rise and as prices rise, the quantity demanded decreases. There is thus a negative or inverse relationship between price and quantity demanded, if all else being equal (Janse van Rensburg *et al*., 2015: 54).

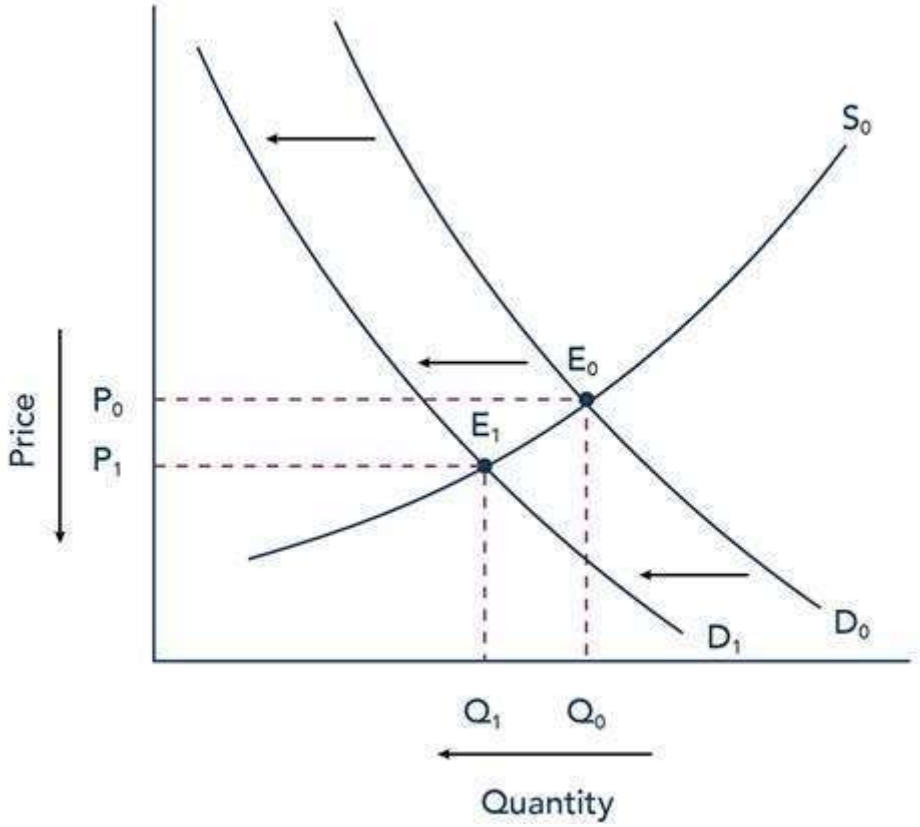

Figure 2.1 Demand Curve

Source: Kenton (2021a)

Factors that influence demand for not being “all things being equal”, include:

- Common sense price is an obstacle to consumers buying – the higher the price, the higher the obstacle. It is common sense that lower prices will sell more.
- Diminishing marginal utility – the buyer of a product will derive less benefit or satisfaction from each successive purchase, which means that they will consume less (Janse van Rensburg *et al*., 2015: 54).
- Income effect has a direct correlation with the income of a buyer – with more money one can afford to buy better quality products.
- Substitution effect – the buyer will substitute demand with a similar product at a lower price (Pindyck & Rubinfeld, 2013:35).

Factors that affect purchases are called determinants of demand. A change in one or more of these determinants will change demand (Janse van Rensburg *et al*., 2015:56). These basic determinants include:

- Consumer preferences – a favourable change in consumer preferences for a specific product (making the product more desirable) means more will be demanded, and vice versa.
- Number of buyers – an increase in the number of buyers for a specific product will increase the demand for that product.
- Consumer incomes – a change in income will increase the demand for superior products. The demand for inferior products will decrease.
- Prices of related goods – a change in the price of related goods may increase or decrease demand, depending on whether it is substitution or complementary goods: Substitute goods can be used to replace, while complementary goods are used to supplement with other goods (Janse van Rensburg *et al*., 2015:55).
- Prices of substitutes – the increase in price of a substitute product will increase the demand for the other. Conversely will the decrease in price cause a decrease in demand for the other.
- Prices of complementary goods – when an increase in price occurs, a decrease in the demand for the other product will occur, and vice versa.
- Consumer expectation – an anticipated increase in future price causes an increase in current demand.
- Population growth – an increase in population will bring an increase in demand.

Demand elasticity of grain reflects a consumer's ability/preference to change consumption when prices rise or fall. On rising prices, this could mean a preference to substitute other commodities, depending on number and availability of substitutes, as well as the consumer's budget and preferences (Geyser & Cutts, 2010).

On agricultural commodities, the demand side is further determined by politics, stock level, availability of substitutes, global weather patterns, global markets, technology, human preferences, population growth and carry-over stock of maize (Heymans, 2008:20).

Stock levels influence the demand of maize as well. This includes levels of stock in South Africa, as well as across the globe. Due to the different growing seasons between the Northern and Southern Hemispheres, it is not always possible to use real stock levels, but stock estimates are used for this purpose (Dreyer, 2019:75).

The demand for commodities will vary as new methods are found to utilise these products. A good example will be the use of maize sweeteners as a healthy substitute for sugar, which led to an increase in maize consumption in the 1980s (Heymans, 2008:20).

Demand is influenced further by factors like the use of maize to produce ethanol, syrup, animal feeds, additive, cereals, baked chips, thickening agent, edible oils, plastics, chemicals, and others (Jabran *et al*., 2007).

To produce bio ethanol, maize is sent through a dry mill process where the bran is removed, and the rest is then milled. The maize meal is then sent through a fermentation process where the starch is converted into alcohol and the silage is removed and dried. These by-products are known as Distiller's Dried Grains with Solubles (DDGS), a high nutrient quality product for animal feeds and poultry.

The European Union (EU) also favours the use of renewable energy, thus encouraging the production of biofuels. This has resulted in large contents of DDGS entering the raw feed material market. To produce bioethanol, about 40% of the US maize crop is used. The bran removed during the milling process is used to produce a quality bran cereal of high nutrient value (Swiatkiewicz & Koreleski, 2019).

Demand is also influenced by the availability of substitutes, depending on availability and pricing. You can also see this in the relationship between white and yellow maize in South Africa, as both can substitute each other. Animal feed producers will use white maize if there is a shortage in yellow maize and it becomes too expensive, while the millers will use yellow maize when white maize is in shortage (Heymans, 2008:33).

2.5.2 Supply

The various quantities of a product that producers are willing to sell at each of a series of possible prices during a specific period are called the supply (Pindyck & Rubinfeld, 2013:22). The law of supply is that when prices rise, the quantity supplied rise and when prices fall, the quantity supplied falls. While price is an obstacle from the consumers' point of view, this represents revenue for the supplier and thus an incentive to produce and sell.

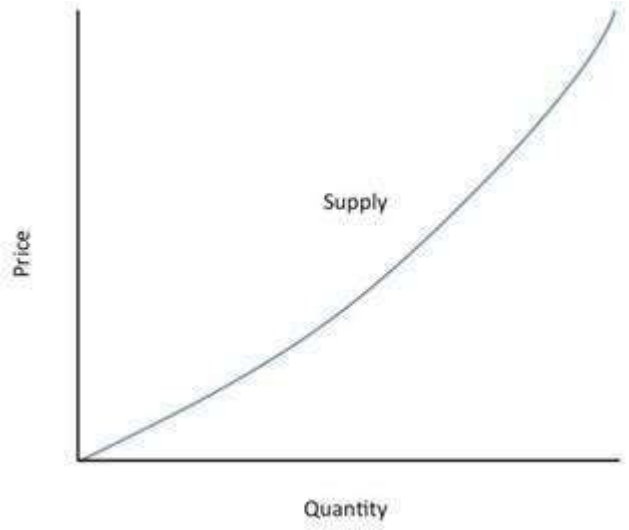

Figure 2.2 Supply Curve

Source: Kenton (2021b)

Market supply is derived from individual supply in the same way that market demand is derived from individual demand. Determinants of supply include resource prices, technology, taxes and subsidies of other goods, producer expectations and the number of sellers in the market. Changes in these determinants affect supply (Janse van Rensburg *et al*., 2015:58).

Determinants affecting market supply:

- Resource prices – higher resource prices raise production costs and reduce profits, thus reducing the incentive to supply and vice versa.
- Technology – improvements in technology enable increased profits.
- Taxes and subsidies – increase in taxes reduces profits.
- Prices of other goods – when the price of alternative or other goods increases, the producer will change production incentives.
- Producer expectations – anticipated future prices may affect the willingness to supply at present prices.
- Number of sellers – the quantity of suppliers in the market competing for the same buyer.

The price of maize is influenced by the supply. The price includes the opportunity costs of resources needed, the costs of producing alternative products, the technology available and legislation. An increase in the price will thus influence the supply. Should maize prices increase, producers will increase production. This again could have a detrimental effect on alternate maize users such as cattle feedlots and chicken broilers that might find it more cost effective to produce their own maize, which would increase the total supply of maize (Heymans, 2008:18).

Other factors that may influence the supply could include the cost of cultivation machinery or equipment and new cultivation methods. Cultivation machinery and equipment include technology like tractors, harvesters and planters. Prices of such machinery and equipment are mainly influenced by the research and development costs, inflation costs and the Rand/Dollar exchange rate (Heymans, 2008:18-19).

Production technology also plays an important role on the supply side, for example the use of agricultural implements like sprayers for herbicides and/or pesticides and the use of liquid fertilisers. The use of such technology could cause farmers to produce at lower costs, which also affects the supply side factor of carry-in, especially in favourable climatic conditions (Heymans, 2008:18-19).

Supply is also influenced by data like the production area (hectares), expected yield per hectare, potential imports and carry-over stock from the previous season. On the demand side, these figures include usage of white maize for humans, animals and alternative users, as well as potential imports. Local and international macro-economic conditions, political and legislative influences and the weather can severely affect these figures (Dreyer, 2019:70).

2.5.3 Equilibrium

The decisions of buyers interact with the decisions of sellers to determine the equilibrium price of quantity. Equilibrium price is the price where the intention of buyers and sellers match. Equilibrium quantity is when the quantity demanded equals the quantity supplied at the equilibrium price (Pindyck & Rubinfeld, 2013:25).

With reference to the above, trading of maize will also be influenced by the abovementioned factors and laws of supply and demand. Supply and demand could be at international or domestic level, depending on supply, demand and stock levels, as well as exchange rates – more specifically the Rand/Dollar exchange rate, which has a direct effect on the import/export parity price (Agriculture, Forestry and Fisheries, 2019:14).

Domestic supply and demand are influenced by actual and anticipated changes in conditions. Supply and demand of grain are relatively resilient and large effects of weather volatility drastically influence agricultural production and prices. The supply elasticity reflects the speed of new supplies in response to prices in a particular season. Stocks are available from domestic or international sources (Geyser & Cutts, 2010).

Quantifiable factors that have an influence on the price of maize in South Africa include the following: The international stock levels of maize as reflected in the Chicago Board of Trade (CBOT) price, domestic supply and demand as well as stock levels, and the Rand/Dollar exchange rate (as it directly affects the import/export parity price). As the United States of America (USA) is the largest grain producer, changes in supply and/or demand in the USA would affect the CBOT price as well as prices of other countries.

The equilibrium price in South Africa's market equals the equilibrium price in the American market, plus the exchange rate and transaction costs. When trade does occur between these markets, the difference in price is equal to the transaction costs (Dreyer, 2019:74). The price of maize is thus determined by the supply and demand factors, substitute and complementary products, as well as the supply and demand of maize.

The World Agricultural Supply and Demand Estimates (WASDE) report is a global agricultural supply and demand estimate that is newly released every year on 15 July. It is also updated monthly on the 15th, giving a clearer indication of stock levels, the CBOT price-index, the exchange rate and import/export parity prices. This report is globally used as a basis for calculating stock levels (Dreyer, 2019:75).

The WASDE report is prepared and released by the World Agricultural Outlook Board (WAOB). The report is released monthly and provides annual forecasts for supply and use of US and world corn or maize. The Interagency Commodity Estimates Committees (ICECs) integrate and interpret information from domestic and international sources to produce an analytical report (US Department of Agriculture, 2021).

In the WASDE a comparative analysis is done between the current and expected supply against current and expected demand. The result indicates if current stock levels would be sufficient for the current season. These figures, however, are not always confirmed figures, as it is gathered from various sources of input like yield estimates, overlapping planting and marketing seasons which prompt different scenarios. As the season progresses, actual figures recalculate the theoretical forecast of supply and demand and the total stock estimates (Dreyer, 2019:70).

2.6 Other factors that influence supply and demand

Weather patterns drive planting conditions and have an impact globally, affecting local production as well as imports and surpluses (Heymans, 2008:20). South Africa is known for its climatic weather extremes and a huge variability of rainfall. This often

leads to huge reductions in maize yields, forcing the maize forecast to be mainly based on rainfall forecasts. Rainfall as such is not the only determining factor of determined yields, but other important factors like temperature, humidity, wind and radiation also play an especially important role in the yield potential (Dreyer, 2019:185).

An increased supply lowers commodity prices, usually associated with a good rainfall. A lower rainfall will cause a decreased supply and higher prices (Heymans, 2008:19). These climatic variables and the associated yield forecasts were identified and over time a collective weather phenomenon was identified, known as the Southern Oscillation Index (SOI). The relation between rainfall forecasts and South Africa's historical maize yield has been successfully linked to the SOI (Dreyer, 2019:186).

SOI is a widespread inter-annual oscillation in sea level pressure between two regions, covering from Northern Australia to the central Pacific Ocean. When air pressure is shifted very strongly between these two areas, this whether pattern is known as El Niño and related phenomenon is known a Southern Oscillation (ENZO). This occurs when the upper sea surface temperature in the tropical eastern Pacific Ocean reaches higher temperatures for a period of five months or longer. Alternatively, when temperatures fall below the five-month average, the cold phase is referred to as La Niña. The distinction between cold and warm phases identifies an even stronger correlation between maize yield and sea surface temperatures (The Long Paddock, 2021).

The Southern Oscillation Index (SOI) is computed daily and converted into monthly and seasonal values to indicate the related phenomena, known as El Niño and La Niña, or Southern Oscillation (ENSO) and anti-ENSO (Australian Bureau Meteorology, 2021).

ENSO describes a variety of changes associated with El Niño. This includes changes in rainfall and atmospheric pressure. The warm phase is a widespread warming of the upper ocean of the tropical eastern Pacific over a period of five months or more. This phase of ENSO is usually associated with drier conditions (Australian Bureau Meteorology, 2021). During this period the central and eastern parts of the tropical Pacific Ocean warms up and the strength of the Pacific trade winds decrease. This

usually brings a decreased rainfall in the Southern Hemisphere (The Long Paddock, 2021).

La Niña, on the other hand, refers to the cold phase of ENSO and the extensive cooling of the central and eastern Pacific of the ocean. During this phase increased cloudiness is generated over the central and eastern Pacific Ocean and usually leads to stronger winds and increased probability of rain (Heymans, 2008:21).

The onset of rain in South Africa tends to be earlier and the rainy season shorter with a lower rainfall during El Niño, while the onset of rain in a La Niña year tends to be later with a longer rainy season and higher rainfall (Dreyer, 2019:78).

El Niño and La Niña are important for the cultivation of grain across the world. Dry conditions will prevail in an El Niño year in South Africa and Australia, while mid-west America will have a good rainfall (NOAA, 2021). A La Niña year, on the other hand, will bring wet conditions in the Southern Hemisphere.

2.7 SAFEX

The equity derivatives market was established on the Johannesburg Stock Exchange (JSE) in 1988 formally known as SAFEX. This platform enabled professional traders and private investors to trade futures and derivatives. SAFEX (South African Futures Exchange) is a subsidiary of the JSE (Johannesburg Stock Exchange), a trading platform for derivatives. Formed in 1990 as an independent exchange for financial futures, it experienced steady growth and formed a separate agricultural division in 1995. A significant reduction of fees occurred in 1997 due to sufficient own reserves (Dreyer, 2019:44).

The JSE securities exchange acquired SAFEX in 2001, agreeing to keep the SAFEX branding. It is a self-regulatory authority functioning in terms of the Financial Markets Control Act of 1989 (Heymans, 2008:28).

According to De Beer (2015:1), taking risks is an essential element to generating wealth. To exploit potentially profitable situations, investors need to take risks.

Obviously, the more profitable risks need to be taken and non-profitable risks avoided, as far as possible. Risk management means the shedding and the economical retention of risk, and this is done by means of derivatives.

“Financial derivatives are tools for managing (i.e., adjusting) equity and bond portfolio and are used for the temporary reallocation of funds – that is, tactical fund allocation as compared to strategic fund allocation.” According to Johan de Beer in *Introduction to Financial Derivatives* (De Beer, 2015:1).

Derivatives are used to hedge price risk by producers and other users, also to diversify a portfolio. Derivates are also used to speculate on price movements. The Maize Board made use of financial derivative instruments on maize provided by CBOT to hedge the value of maize to try and ensure that the domestic maize price does not exceed the international price. In 1987 Rand Accept Bank started their own informal market structure which enabled the trade of future contracts for the JSE all share and industrial indices and certain commodities. This led to the JSE and 21 banks collaborating to define a formal futures exchange resulting in the formation of SAFEX (Dreyer, 2019:45).

Speculators are attracted to the fact that commodity prices in general are known to have a high volatility and SAFEX is not immune to this. Volatility increases the risk of paying higher prices and thus the use of derivative instruments to hedge against price-risk becomes more expensive (Geyser & Cutts, 2010).

Research in the US agricultural futures market has found that maize is the most volatile received and transmitted commodity in the derivatives market (Sayed, 2019). On SAFEX, maize is the largest and most liquid commodity futures contract traded.

In agriculture, price volatility is extremely important, due to its role in overall profitability. The farmers of South Africa already struggle with low profit margins, therefore price volatility affects these producers to a considerable degree. From December through to early May, volatility tends to increase, which makes the timing of marketing decisions important. The July white maize contract is subjective to the

release of new information on local and international growing conditions, found to increase the level of volatility in the price (Monk *et al*., 2010).

Chapter 3: Empirical study

3.1 Introduction

This chapter explains the route followed to do the empirical research. The secondary data obtained were used to determine if the primary and secondary objectives were achieved.

3.2 Description of overall research design

The first step was the selection of the research design. This had implications for a variety of issues, therefore it needed to carefully address the next steps involved, before arriving at measures of the concepts of the researcher's interest.

The process of this research design involves a series of specific steps to get to the expected result. This research takes a broadly deductive approach as it started with a literature review in Chapter 2, including SAFEX and Grain SA. Theory forms the basis for the definition of research questions. Experimental research will most likely form the specification of the research question (Bryman *et al*., 2014:32).

This study made use of the quantitative approach, as it entailed the collection of numerical data obtained from SAFEX and Grain SA. The study regards the relationship between theory of the SAFEX selling prices and research of Grain SA's total cost-plus mark-up as deductive. Although this study makes use of a natural science approach, the results that the farmer can benefit from after doing the suggested calculations, is so much more that only numbers and figures. It had a distinctive epistemological and antilogical position, which suggests that there was a good deal more to it than the mere presence of numbers, as this could have a major influence on the financial sustainability of the maize farmer. The emphasis was on quantification in the collection and analysis of data, consisting of a linear series of

steps, moving from theory to conclusions, including numbers and measurements and hard, reliable SAFEX data.

This was a cross-sectional research design as it involved the collection of quantitative data on SAFEX trade to detect patterns of association in the variables at a specific time, by testing theories.

3.3 Data collection

The selection of research sites and subjects were followed by the administration of the research instruments. There were three sets of historical data used in this study. The first two sets of historical data comprised of input costs for the last 12 years and were obtained from Grain SA and SAGIS. The second set of historical data comprised of selling prices obtained from SAFEX.

This data were obtained from all three institutions' internet websites, where it is available in electronic format. This data were integrated into an Excel spreadsheet, per day per month per year for the past 12 years, according to SAGIS.

The above-mentioned collected data were integrated into an Excel spreadsheet to calculate the daily loss/profit, where the farmer sold at the daily closing price. This information or data enabled the researcher to mathematically add specific mark-ups to the input costs and determine the possibility of attaining a consistent mark-up. Input costs consisted of the direct cultivation costs, including fertiliser, seed, herbicides, pesticides and diesel. SAFEX selling prices consisted of the daily closing price and only took the transport differential from Tierfontein Senwes silos into consideration (Grain SA, 2020).

With the deregulation of the Maize Board, the existing infrastructure was left unchanged. SAFEX determined the price of maize, but the regional prices for maize producers were linked to their location relative to Randfontein. This town was chosen as a preferential point since there is a concentration of milling capacity and rail links

to the existing South African rail infrastructure (Dreyer, 2019). The transport differential system determined the cost of transport from specific districts to Randfontein. Maize producers further away from Randfontein would thus receive a larger differential deduction.

The quantitative data gathered from the internet to be analysed, met the criteria of authenticity, credibility, representativeness and meaning. In the first instance, historical data from SAFEX are based on historical daily values and cannot be changed, due to laws and regulations governing futures and exchange platforms. In the second instance, Grain SA is an organisation by the farmer for the farmer. Grain SA does not buy nor supply any of the inputs, but merely gathers cost prices from the manufacturers and publishes this on their website to the benefit of their members.

The SAFEX website has come into operation when they started trading in the late 1990s and already exists for more than 12 years, while the Grain SA website exists for even longer than that. Grain SA and its website adheres to a corporate governance set by its board and members, thus binding them to a strict set of moral codes. Both these institutions are 100% representative of the maize cultivation system and there is no space for misinterpreting their historical data.

3.4 Data analysis

The information collected needed to be prepared for quantification and transformed into data. To summarise the data the researcher used quantitative data analysis techniques and in the next step, testing for relationships between variables were done and ways developed to present these results.

The identified findings were the next step, as this was the result of the data analysis. The researcher considered the relationship between the findings and the question raised in the beginning of the research.

The historical data collected were utilised to determine the difference between these two sets of data to obtain an answer or variable, by making use of Excel spreadsheets as shown in Table 3.1 and Table 3.2.

Utilising the attributes of the Excel spreadsheet, a statistical model was built to enable the manipulation of the data to determine if it is possible for a maize farmer to sell at a specific mark-up. As shown in Table 3.3 this process is repeated for each year from 2008 to 2020 and listed as Appendix A to M.

3.4.1 Calculation

This statistical model made use of the obtained data. It compared the cost price plus the mark-up to the selling price to determine if a specific mark-up percentage can be achieved. The cost price consisted of various factors, including:

- Diesel
- Seed
- Fertiliser
- Herbicides
- Pesticides
- Repairs and maintenance
- Labour

Not included in the above are bank interest rates and the transport differential. For the purposes of this calculation, an interest rate of prime plus 2% was used. As the transport differential varies from town to town, a differential from the Tierfontein silo is used to standardise these calculations.

The cost of transporting maize from any area to Randfontein Premier Mills is called the transport differential. This is calculated according to the distance from the farm or

silo to Randfontein. For this reason, transport differentials vary considerably between regions.

If a farmer is not in a sound financial position, the farmer needs to borrow money from the bank. Depending on the financial status of the farmer at the bank, different interest rates may apply.

This total costs then became the variable against which achievability for a specific set of predictions were tested. The univariate data analysis technique of frequency tables was used to determine a frequency of results.

Due to various factors influencing the maize yield on a farm, the yields per region vary drastically. For this reason, average yields are calculated per region, multiplied by a number of years to determine the running long-term average (LTA). This model made use of the Hoopstad region LTA for all calculations. A specific geographical area needed to be identified to do calculations. The author decided on Hoopstad. The area is known to him because he was born and bred in this district and is still living and working in the area. Hoopstad is also situated in the maize triangle and this area is specifically known for its well-established and financially strong maize farming.

The input costs were taken from the data obtained from Grain SA, plus the transport differential and the interest rate paid. Average cost per ton was calculated by dividing the total input costs per hectare by the LTA.

The historical data obtained from SAFEX for the year 2020 is broken down and illustrated in Table 3.1 and Table 3.2. This is in the exact format obtained from SAFEX as illustrated in an Excel spreadsheet. Table 3.3 shows the result of the calculations for 2020. A detailed explanation of the calculations is done after Table 3.3.

Column 1 represents January, which indicates the actual date of the transaction on SAFEX. This is repeated per month, for the whole year. Column 2 indicates the average daily price, as traded on the day of the month. The statistical model contains 12 years of integrated historical data. The detail is reflected in Appendix A to M.

Table 3.1 Domestic futures prices of white maize from January to June 2020

Datum/	Average daily prices (R/t)					
Date	2020/01	2020/02	2020/03	2020/04	2020/05	2020/06
2020/01/01	Jan-00	0	0	3195,00	0	2410,00
2020/01/02	2570,00	0	2664,00	3239,00	0,00	2384,00
2020/01/03	2619,00	3044,00	2901,00	3393,00	2535,00	2360,00
2020/01/06	2634,00	3040,00	2893,00	3320,00	2557,00	2374,00
2020/01/07	2651,00	3055,00	2944,00	3289,00	2612,00	2381,00
2020/01/08	2766,00	3094,00	2919,00	3466,00	2637,00	2387,00
2020/01/09	2830,00	3100,00	2925,00	3596,00	2651,00	2421,00
2020/01/10	2829,00	3061,00	2930,00	3690,00	2632,00	2407,00
2020/01/13	2838,00	2967,00	2948,00	3868,00	2636,00	2395,00
2020/01/14	2853,00	2870,00	2930,00	3900,00	2612,00	2427,00
2020/01/15	2874,00	2897,00	2953,00	3836,00	2644,00	2465,00
2020/01/16	2900,00	2813,00	3032,00	3345,00	2667,00	2509,00
2020/01/17	2952,00	2730,00	3126,00	3329,00	2713,00	2562,00
2020/01/20	2974,00	2795,00	3144,00	3660,00	2732,00	2578,00
2020/01/21	3022,00	2743,00	3195,00	0,00	2750,00	2631,00
2020/01/22	3248,00	2699,00	3206,00	0,00	2682,00	2692,00
2020/01/23	3167,00	2743,00	3981,00	0,00	2823,00	0,00
2020/01/24	3163,00	0,00	3200,00	0,00	0,00	0,00
2020/01/27						

Source: Author’s own compilation

Table 3.2 Domestic futures prices of white maize from July to December 2020

Datum/	Average daily prices (R/t)					
Date	2020/07	2020/08	2020/09	2020/10	2020/11	2020/12
2020/07/01	2588,00		3094,00	3327,00		3567,00
2020/07/02	2608,00		3093,00	3407,00	3490,00	3516,00
2020/07/03	2603,00	2784,00	3193,00	3379,00	3465,00	3560,00
2020/07/06	2639,00	2774,00	3113,00	3401,00	3433,00	3546,00
2020/07/07	2621,00	2763,00	3142,00	3488,00	3358,00	3523,00
2020/07/08	2609,00	2797,00	3195,00	3498,00	3361,00	3550,00
2020/07/09	2627,00	2827,00	3197,00	3480,00	3308,00	3481,00
2020/07/10	2646,00	2854,00	3255,00	3511,00	3389,00	3482,00
2020/07/13	2565,00	2804,00	3261,00	3498,00	3521,00	3380,00
2020/07/14	2569,00	2880,00	3256,00	3532,00	3490,00	3298,00
2020/07/15	2521,00	2890,00	3274,00	3622,00	3515,00	3220,00
2020/07/16	2521,00	2970,00	3230,00	3730,00	3510,00	3152,00
2020/07/17	2561,00	2948,00	3269,00	3762,00	3499,00	3305,00
2020/07/20	2552,00	2905,00	3311,00	3811,00	3418,00	3403,00
2020/07/21	2541,00	2974,00	3436,00	3730,00	3433,00	3336,00
2020/07/22	2545,00	3029,00	3412,00	3723,00	3415,00	3260,00
2020/07/23	2586,00	3021,00		3766,00	3445,00	
2020/07/24	2641,00					
2020/07/27						

Source: Author's own compilation

Table 1.3 Results of 2020 calculations

2020 Total Input Costs	LTA	Avg/ton	Transport diff.	Total cost/ton	25%	35%	45%	55%
R10 317,00	5,5	R1 875,82	R303,00	R2 178,82	R2 723,52	R2 941,40	R3 159,29	R3 377,17
				A	60	37	21	9
				B	80	70	60	41
				Total	**140**	**107**	**81**	**50**
				Probability	*56*	*42,8*	*32,4*	*20*

Source: Author's own compilation

The calculations and explanation done n Table 3.3 are as follows:

- Input costs plus interest = R10 317,00
- This is then divided by the long-term average (LTA) = 5,5
- This gives you an average price per ton excluding transport differential = R1 875,82
- The average price per ton is then added to the transport differential, adding up to total cost per ton = R2 178,82
- The mark-up is then multiplied and added to determine the selling price. R2 178,82 * 25% = R2 723,52.
- This is repeated for 35%, 45% and 55%.
- The figures in the row titled “A” show the total number of times that a specific mark-up percentage was achievable according to information in Table 3.1. The figures in the row titled “B” show the total number of times that a specific mark-up percentage was achievable according to information in Table 3.2.

- In the row titled “Total” A and B are added together. This is done for each specific mark-up.

- In the row titled “Probability” the information calculated in the row “Total” is divided by the amount of trading days per month and the answer is then expressed as a percentage, indicating the number of times that the farmer can achieve that specific mark-up (25%, 35%, 45% or 55%).

At the top of Table 3.3 it can be seen that the input costs were divided by the long-term average, giving an average cost per ton. The transport differential is then added to the average cost per ton, which resulted in the total cost per ton. Each mark-up is then added separately to calculate which selling price is needed to attain the specific mark-up. A mark-up is a percentage expressed as an amount that is added above the total cost.

This amount is then used with a “COUNTIF” function in Excel to determine the total number of times that is “equal to” or “greater than” the mark-up amount. The total “COUNTIF” times are added together and then divided by the total number of working days to determine the probability to achieve a specific mark-up percentage. These probabilities are then flagged and added together to show the number of times it was possible to sell at a specific mark-up percentage.

The total number of 25% mark-up amounts are listed. The probability of this is expressed as a percentage of annual possibility. This is repeated for a 35%, 45% and 55% mark-up. The number of probabilities listed in Table 3.3 shows the number of times that the farmer would have been able to sell at that specific mark-up percentage for that season.

These calculations are then repeated from 2008 to 2020 (as illustrated in Appendices A-M), including a summary of probabilities of each year. These summaries are then added and divided to achieve an average of the above-mentioned term. Table 3.4 indicates the percentage of probability that a farmer could have achieved at a specific mark-up percentage over the term of 12 consecutive years.

Table 3.4 Probabilities

Percentage mark-up	Probability
25%	44,65
35%	37,54
45%	28,40
55%	19,82

Source: Author’s own compilation

Table 3.4 indicates the percentage of probability that a farmer could have achieved at a specific mark-up percentage over the term of 12 consecutive years.

After the calculations were done and results were calculated, the final step was to produce the last chapter where the findings are discussed and recommendations are made.

3.5 Research ethics

This study was based on obtaining data from three organisations, namely SAFEX, SAGIS and Grain SA. This data, however, are in the public domain and does not need any consent or approval or any contact with any person at these institutions at all. The data are freely available on the internet, but could also be acquired directly at these organisations, if needed. These figures are relevant, authentic and meaningful.

The quality of the data in this study was without reproach. SAFEX is legally bound to provide accurate figures on a daily ongoing basis about each transaction, including the market price for the day. SAFEX must abide to the Financial Markets Control Act of 1989 and its rules (SAFEX, 2020).

There were thus no ethical values or norms that could be jeopardised. The use, storage and publication of digital data do not involve confidentiality or other ethical issues. This information does not categorise under the copyright law as it is in public domain.

Chapter 4: Conclusion and recommendations

4.1 Introduction

This is the final chapter which marks the end of the research and include conclusions, an evaluation and recommendations. Conclusions are drawn from the findings in the empirical study. This is utilised to make recommendations regarding the sustainability of maize cultivation. The objectives as set out in Chapter 1 are herewith evaluated to determine if it was achieved.

4.1.1 Primary objective

The knowledge gathered from interpreting data form the various sources, shows that it is indeed possible to trade maize on SAFEX at a specific profit margin. This depends on the mark-up that the farmer wants to achieve, as the higher the mark-up the lower the probability is to achieve that specific mark-up. The probability to achieve this mark-up is indicated as a percentage.

Mark-ups attained in the 12 years from 2008 to 2020 show that there was a 44,65% chance to attain a 25% mark-up, as indicated in Table 3.4. This proves that maize farmers can still be profitable but need to give close attention to the market opportunities.

Given that SAFEX is an agricultural trading platform for speculative trading on the market, which can result in fluctuations and mispricing of the market, it is possible for farmers to sell their maize at a loss. The primary objective of the empirical study has however shown that it is indeed possible for farmers to attain a specific mark-up or profit margin.

4.1.2 Secondary objectives

While the primary objective aimed to prove that a specific mark-up was achievable, it was also beneficial to determine the following secondary objectives. The following were identified in the empirical study:

- The research theory, method and design.
- Data collection method.
- Analysis of the data and recommendations.

Data obtained from SAFEX was integrated into an Excel spreadsheet. To simplify calculations, this was done on a daily basis, separating months and years. The first column indicates the date, the second column indicates the closing price of white maize for that day. The third column indicates the selling prices for the following month, and this is repeated to include the first six months of the year. A separate table is done for the following six months of that specific year. This was done for twelve consecutive years.

Data obtained from Grain SA and SAGIS was integrated into an Excel spreadsheet. This was done on a annual basis, covering the twelve years specified in the study. These amounts show the input cost per year, not including financing interest, which was calculated at prime plus two percent and then added.

The long-term average is the average maize yield in a specific region over a long-term period. The twelve-year long term average yield was then integrated into an Excel spread sheet.

The total input cost was then divided by the long-term average, resulting in average price per ton. This average price per ton is then added to the specific transport differential. These two amounts were added together to give a total cost per ton. A specific mark-up is then added to this cost per ton to calculate the amount needed to sell on SAFEX.

This amount was then used with a “COUNTIF” function in Excel to determine the total number of times that it was “equal to” or “greater than” the mark-up amount. The total “COUNTIF” times were added together and then divided by the total number of

working days to determine the probability to achieve a specific mark-up percentage. Those probabilities were then flagged and added together to show the number of times it was possible to sell at a specific mark-up percentage.

All of the secondary objectives as set out to perform the empirical study were adequately met in Chapter 3.

4.2 Conclusions

The study has proven that a maize farmer can indeed sell at a specific mark-up, proving possible sustainability of maize farming. With reference to Table 3.4 it is clear that achieving a 25 and 35 percent mark-up is quite feasible, while the 45 percent mark-up is possible as well, although at a lower rate. To achieve this, the farmer will have to manage his input costs carefully, otherwise it will be difficult to show a profit. Farmers also need to study the market on a daily basis to achieve the best results. When you deal with trading on any market, timing is very important and thus, knowledge is power. The more information you have, the better your chances on success.

4.3 Suggestion

Further studies will indicate if additional methods can be used to maximise profits. It is suggested that the ENZO long term weather predictions be more broadly studied in South Africa, as many farmers are perhaps not yet up to date with the influence and long-term effects of this weather phenomenon. ENZO could probably affect farming strategies to enhance cultivation time frames. This could also enhance the farmer's marketing strategy, making a sustainable higher profit.

4.4 Recommendations

It is recommended that a similar exercise be done on other crops as well to determine if this method can be applied to, for example, sunflower and wheat.

Furthermore, it is recommended that agricultural companies offer educational information days to farmers to further educate them about the possibility of selling at a profit.

Lastly it is recommended that the transport differential be investigated more in-depth, not only using Randfontein as the preferential point, but rather use multiple points in the various regions.

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Appendix A: Domestic future prices of white maize 2008

Domestic futures prices of white maize:

Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)					
Date	2008/01	2008/02	2008/03	2008/04	2008/05	2008/06
2008/01/01		1831,00		1873,00		
2008/01/02	1886,00	1826,00		1885,00		1793,00
2008/01/03	1867,00	1824,00	1811,00	1888,00		1802,00
2008/01/04	1825,00	1792,00	1775,00	1895,00	1757,00	1810,00
2008/01/07	1857,00	1747,00	1810,00	1893,00	1729,00	1830,00
2008/01/08	1835,00	1758,00	1825,00	1856,00	1760,00	1882,00
2008/01/09	1825,00	1713,00	1829,00	1886,00	1794,00	1949,00
2008/01/10	1775,00	1691,00	1850,00	1910,00	1845,00	1915,00
2008/01/11	1740,00	1646,00	1870,00	1900,00	1845,00	1971,00
2008/01/14	1810,00	1691,00	1865,00	1900,00	1800,00	2030,00
2008/01/15	1755,00	1736,00	1900,00	1900,00	1815,00	2037,00
2008/01/16	1785,00	1846,00	1930,00	1900,00	1783,00	2087,00
2008/01/17	1775,00	1827,00	1960,00	1904,00	1792,00	2155,00
2008/01/18	1780,00	1792,00	1970,00	1895,00	1730,00	2098,00
2008/01/21	1790,00	1777,00			1768,00	
2008/01/22	1750,00	1762,00			1767,00	
2008/01/23		1737,00				
2008/01/24		1719,00				
2008/01/25		1697,00				
2008/01/28		1742,00				
2008/01/29						

Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)					
Date	2008/07	2008/08	2008/09	2008/10	2008/11	2008/12
2008/07/01	2091,00	1817,00	1906,00	1824,00		1697,00
2008/07/02	2130,00	1720,00	1865,00	1810,00		1670,00
2008/07/03	2169,00	1651,00	1874,00	1769,00	1794,00	1680,00
2008/07/04	2172,00	1752,00	1867,00	1701,00	1782,00	1644,00
2008/07/07	2122,00	1755,00	1861,00	1680,00	1769,00	1561,00
2008/07/08	2057,00	1806,00	1865,00	1717,00	1744,00	1536,00
2008/07/09	2066,00	1832,00	1822,00	1780,00	1740,00	1540,00
2008/07/10	2066,00	1803,00	1839,00	1755,00	1735,00	1550,00
2008/07/11	2083,00	1852,00	1846,00	1765,00	1763,00	1537,00
2008/07/14	2020,00	1922,00	1828,00	1815,00	1802,00	1550,00
2008/07/15	2001,00	1906,00	1833,00	1804,00	1779,00	1653,00
2008/07/16	1936,00	1883,00	1824,00	1770,00	1784,00	1720,00
2008/07/17	1914,00	1870,00	1830,00	1825,00	1810,00	1740,00
2008/07/18	1817,00	1915,00	1875,00	1827,00	1790,00	
2008/07/21	1834,00			1793,00	1775,00	
2008/07/22	1837,00			1800,00		
2008/07/23						

2008 Total input cost	LTA	AVG / ton	Transport dif	Total cost/ ton	25%	35%	45%	55%
R 6 232,38	5,5	R 1 133,16	R 123,00	R1 256,16	R1 570,20	R1 695,82	R1 821,43	R1 947,05
				Colum 1	87	84	46	9
Public holidays	12			Colum 2	80	74	39	11
Weekends	104							
Trading days	249			Total	167	158	85	20
				Probability	66,8	63,2	34	8

Appendix B: Domestic future prices of white maize 2009

Domestic futures prices of white maize:

Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)					
Date	2009/01	2009/02	2009/03	2009/04	2009/05	2009/06
2009/01/01				1700,00		1556,00
2009/01/02	1820,00	1828,00	1637,00	1695,00		1560,00
2009/01/05	1774,00	1794,00	1647,00	1680,00	1578,00	1555,00
2009/01/06	1790,00	1766,00	1647,00	1692,00	1585,00	1546,00
2009/01/07	1810,00	1799,00	1649,00	1705,00	1610,00	1564,00
2009/01/08	1780,00	1797,00	1659,00	1710,00	1618,00	1563,00
2009/01/09	1800,00	1802,00	1695,00	1702,00	1632,00	1558,00
2009/01/12	1850,00	1800,00	1697,00	1675,00	1644,00	1566,00
2009/01/13	1825,00	1787,00	1706,00	1686,00	1659,00	1557,00
2009/01/14	1817,00	1735,00	1711,00	1664,00	1648,00	1560,00
2009/01/15	1835,00	1700,00	1716,00	1640,00	1614,00	1523,00
2009/01/16	1841,00	1711,00	1736,00	1590,00	1646,00	1485,00
2009/01/19	1874,00	1750,00	1750,00		1616,00	1503,00
2009/01/20	1865,00	1746,00	1750,00		1655,00	1508,00
2009/01/21	1855,00		1752,00		1631,00	
2009/01/22			1759,00			
2009/01/23						

Datum/ Date	e pryse/Average daily prices (R/t) 2009/07	2009/08	2009/09	2009/10	2009/11	2009/12
2009/07/01	1368,00		1406,00	1430,00		1580,00
2009/07/02	1362,00		1420,00	1428,00	1490,00	1582,00
2009/07/03	1370,00	1420,00	1432,00	1400,00	1520,00	1552,00
2009/07/06	1352,00	1379,00	1417,00	1423,00	1534,00	1575,00
2009/07/07	1368,00	1387,00	1409,00	1450,00	1505,00	1592,00
2009/07/08	1372,00	1390,00	1404,00	1439,00	1459,00	1566,00
2009/07/09	1374,00	1385,00	1367,00	1448,00	1470,00	1591,00
2009/07/10	1390,00	1405,00	1375,00	1487,00	1460,00	1620,00
2009/07/13	1370,00	1394,00	1373,00	1491,00	1525,00	1642,00
2009/07/14	1365,00	1436,00	1384,00	1490,00	1520,00	1649,00
2009/07/15	1361,00	1450,00	1380,00	1462,00	1560,00	1647,00
2009/07/16	1317,00	1407,00	1433,00	1490,00	1545,00	1705,00
2009/07/17	1305,00	1412,00	1441,00	1526,00	1555,00	1719,00
2009/07/20	1308,00	1421,00	1440,00	1540,00	1545,00	1683,00
2009/07/21	1270,00	1448,00		1543,00	1525,00	
2009/07/22	1220,00					
2009/07/23						
2009/07/24						

2009 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 6 047,98	5,5	R 1 099,63	R 135,00	R 1 234,63	R 1 543,29	R 1 666,75	R 1 790,22	R 1 913,68
				colum 1	77	46	17	0
				colum 2	18	3	0	0
				Total	95	49	17	0
				Probability	38	19,6	6,8	0

Appendix C: Domestic future prices of white maize 2010

Domestic futures prices of white maize:						
Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)					
Date	2010/01	2010/02	2010/03	2010/04	2010/05	2010/06
2010/01/01		1191,00	1142,00	1103,00	1140,00	1088,00
2010/01/02		1196,00	1117,00	1099,00	1136,00	1082,00
2010/01/03		1203,00	1130,00	1096,00	1140,00	1065,00
2010/01/04	1582,00	1188,00	1139,00	1110,00	1139,00	1077,00
2010/01/05	1560,00	1198,00	1124,00	1112,00	1148,00	1068,00
2010/01/06	1600,00	1220,00	1078,00	1102,00	1140,00	1037,00
2010/01/07	1595,00	1205,00	1093,00	1076,00	1125,00	1040,00
2010/01/08	1570,00	1190,00	1097,00	1090,00	1136,00	1050,00
2010/01/11	1575,00	1179,00	1120,00	1111,00	1127,00	1053,00
2010/01/12	1560,00	1158,00	1111,00	1100,00	1096,00	1069,00
2010/01/13	1492,00	1140,00	1118,00	1104,00	1071,00	1070,00
2010/01/14	1485,00	1126,00	1135,00	1095,00	1078,00	1067,00
2010/01/15	1437,00	1085,00	1160,00		1099,00	1052,00
2010/01/18	1357,00		1130,00		1109,00	1058,00
2010/01/19	1335,00		1143,00			
2010/01/20	1337,00					
2010/01/21						
2010/01/22						
2010/01/25						
2010/01/26						
2010/01/27						
2010/01/28						
2010/01/29						

Datum/ Date	pryse/Average daily prices (R/t) 2010/07	2010/08	2010/09	2010/10	2010/11	2010/12
2010/07/01	1087,00		1243,00	1214,00	1340,00	1321,00
2010/07/02	1093,00	1143,00	1239,00	1153,00	1349,00	1338,00
2010/07/05	1077,00	1109,00	1239,00	1220,00	1357,00	1341,00
2010/07/06	1098,00	1123,00	1274,00	1207,00	1365,00	1368,00
2010/07/07	1089,00	1134,00	1265,00	1197,00	1335,00	1375,00
2010/07/08	1091,00	1142,00	1279,00	1185,00	1355,00	1353,00
2010/07/09	1101,00	1129,00	1269,00	1304,00	1330,00	1355,00
2010/07/12	1107,00	1125,00	1285,00	1236,00	1350,00	1345,00
2010/07/13	1100,00	1141,00	1300,00	1265,00	1335,00	1300,00
2010/07/14	1097,00	1164,00	1295,00	1281,00	1316,00	1310,00
2010/07/15	1124,00	1190,00	1311,00	1285,00	1280,00	1312,00
2010/07/16	1134,00	1185,00	1301,00	1290,00	1298,00	1320,00
2010/07/19	1135,00	1214,00	1319,00	1257,00	1249,00	1348,00
2010/07/20	1107,00	1241,00	1310,00	1278,00	1266,00	1358,00
2010/07/21	1118,00	1219,00			1302,00	
2010/07/22						
2010/07/23						
2010/07/26						
2010/07/27						
2010/07/28						
2010/07/29						
2010/07/30						

2010 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 6 692,72	5,5	R 1 216,86	R 148,00	R 1 364,86	R 1 706,07	R 1 842,56	R 1 979,05	R 2 115,53
				colum 1	0	0	0	0
				colum 2	0	0	0	0
				Total	0	0	0	0
				Probability	0	0	0	0

Appendix D: Domestic future prices of white maize 2011

Domestic futures prices of white maize:						
Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)					
Date	2011/01	2011/02	2011/03	2011/04	2011/05	2011/06
2011/01/01		1450,00	1588,00	1620,00		1725,00
2011/01/02		1470,00	1588,00	1620,00		1734,00
2011/01/03	1317,00	1498,00	1570,00	1595,00	1639,00	1750,00
2011/01/04	1282,00	1530,00	1600,00	1583,00	1621,00	1748,00
2011/01/05	1256,00	1572,00	1648,00	1610,00	1652,00	1726,00
2011/01/06	1305,00	1547,00	1625,00	1615,00	1610,00	1745,00
2011/01/07	1274,00	1605,00	1619,00	1605,00	1603,00	1778,00
2011/01/10	1281,00	1603,00	1576,00	1600,00	1655,00	1805,00
2011/01/11	1300,00	1645,00	1506,00	1590,00	1663,00	1812,00
2011/01/12	1291,00	1675,00	1483,00	1595,00	1621,00	1770,00
2011/01/13	1335,00	1611,00	1503,00	1594,00	1653,00	1773,00
2011/01/14	1305,00	1600,00	1493,00		1686,00	1716,00
2011/01/17	1323,00	1584,00	1480,00		1680,00	1718,00
2011/01/18	1348,00		1588,00		1726,00	1755,00
2011/01/19	1375,00		1570,00		1713,00	
2011/01/20	1370,00					
2011/01/21						
2011/01/24						

Date	2011/07	2011/08	2011/09	2011/10	2011/11	2011/12
2011/07/01	1672,00	1853,00	2187,00		2395,00	2443,00
2011/07/02		1865,00	2180,00		2438,00	2406,00
2011/07/03		1907,00	2230,00	2090,00	2435,00	2364,00
2011/07/04	1730,00	1921,00	2221,00	2128,00	2453,00	2334,00
2011/07/05	1741,00	1913,00	2251,00	2140,00	2478,00	2376,00
2011/07/06	1725,00	1923,00	2220,00	2159,00	2500,00	2384,00
2011/07/07	1730,00	1986,00	2215,00	2124,00	2516,00	2446,00
2011/07/08	1749,00	2023,00	2216,00	2118,00	2510,00	2438,00
2011/07/11	1756,00	2069,00	2201,00	2118,00	2480,00	2458,00
2011/07/12	1744,00	2069,00	2200,00	2194,00	2495,00	2498,00
2011/07/13	1788,00	2050,00	2210,00	2200,00	2486,00	2475,00
2011/07/14	1815,00	2064,00	2192,00	2228,00	2518,00	2525,00
2011/07/15	1821,00	2067,00	2174,00	2216,00	2510,00	2525,00
2011/07/18	1816,00	2065,00	2217,00	2230,00	2478,00	
2011/07/19	1866,00	2138,00	2230,00	2271,00	2460,00	
2011/07/20	1851,00			2278,00		
2011/07/21						
2011/07/22						
2011/07/25						
2011/07/26						
2011/07/27						
2011/07/28						
2011/07/29						

2011 Total input cost	LTA	AVG / ton	Transport dif	Total cost / t	25%	35%	45%	55%
R 6 692,72	5,5	R 1 216,86	R 206,00	R 1 422,86	R 1 778,57	R 1 920,86	R 2 063,15	R 2 205,43
				colum 1	2	0	0	0
				colum 2	78	68	63	42
				Total	80	68	63	42
				Probability	32	27,2	25,2	16,8

Appendix E: Domestic future prices of white maize 2012

Domestic futures prices of white maize:							
Datum/	Gemiddelde daaglikse pryse/Average daily prices (R/t)						
Date	2012/01	2012/02	2012/03	2012/04	2012/05	2012/06	
2012/01/01		2570,00	2270,00			2039,00	
2012/01/02		2491,00	2361,00	2393,00	2110,00	2018,00	
2012/01/03	2710,00	2483,00	2468,00	2390,00	2060,00	2014,00	
2012/01/04	2699,00	2410,00	2430,00	2386,00	2062,00	1981,00	
2012/01/05	2729,00	2310,00	2457,00	2395,00	2023,00	1972,00	
2012/01/06	2723,00	2390,00	2482,00	2432,00	2092,00	2010,00	
2012/01/09	2735,00	2483,00	2565,00	2445,00	2098,00	2042,00	
2012/01/10	2735,00	2505,00	2587,00	2420,00	2061,00	2026,00	
2012/01/11	2733,00	2575,00	2560,00	2370,00	2025,00	1996,00	
2012/01/12	2780,00	2545,00	2530,00	2330,00	2052,00	1995,00	
2012/01/13	2751,00	2445,00	2546,00	2270,00	2055,00	2002,00	
2012/01/16	2800,00	2401,00	2556,00	2293,00	2087,00	1978,00	
2012/01/17	2840,00	2367,00	2624,00		2098,00	2039,00	
2012/01/18	2820,00	2345,00	2686,00		2078,00	2050,00	
2012/01/19	2830,00				2115,00		
2012/01/20	2800,00				2088,00		
2012/01/23							
2012/01/24							
2012/01/25							

Date	2012/07	2012/08	2012/09	2012/10	2012/11	2012/12
2012/07/01		2712,00		2370,00	2506,00	
2012/07/02	2199,00	2716,00		2381,00	2485,00	
2012/07/03	2228,00	2695,00	2536,00	2415,00	2497,00	2411,00
2012/07/04	2230,00	2666,00	2594,00	2510,00	2460,00	2417,00
2012/07/05	2295,00	2711,00	2560,00	2497,00	2432,00	2422,00
2012/07/06	2326,00	2693,00	2511,00	2499,00	2457,00	2426,00
2012/07/09	2425,00	2751,00	2493,00	2455,00	2451,00	2435,00
2012/07/10	2411,00	2703,00	2530,00	2421,00	2424,00	2423,00
2012/07/11	2403,00	2697,00	2503,00	2428,00	2401,00	2403,00
2012/07/12	2462,00	2685,00	2457,00	2475,00	2432,00	2369,00
2012/07/13	2538,00	2699,00	2460,00	2396,00	2462,00	2322,00
2012/07/16	2634,00	2705,00	2454,00	2412,00	2425,00	2300,00
2012/07/17	2613,00	2707,00	2430,00	2390,00	2431,00	2326,00
2012/07/18	2587,00	2725,00	2355,00	2433,00	2431,00	2297,00
2012/07/19	2688,00	2737,00	2397,00	2506,00	2439,00	2221,00
2012/07/20	2728,00	2681,00	2390,00	2487,00	2452,00	
2012/07/23	2738,00	2670,00		2471,00	2470,00	
2012/07/24	2722,00			2510,00		
2012/07/25						
2012/07/26						
2012/07/27						
2012/07/30						
2012/07/31						

2012 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 7 183,17	5,5	R 1 306,03	R 206,00	R 1 512,03	R 1 890,04	R 2 041,24	R 2 192,45	R 2 343,65
				colum 1	82	68	53	48
				colum 2	96	96	96	86
				Total	178	164	149	134
				Probability	71,2	65,6	59,6	53,6

Appendix F: Domestic future prices of white maize 2013

Domestic futures prices of white maize:						
	Average daily prices (R/t)					
Date	2013/01	2013/02	2013/03	2013/04	2013/05	2013/06
2013/01/02	R 2 182,00	R 2 090,00	R 2 192,00	R 2 110,00	R 2 179,00	R 2 299,00
2013/01/03	R 2 142,00	R 2 046,00	R 2 307,00	R 2 170,00	R 2 193,00	R 2 222,00
2013/01/04	R 2 187,00	R 2 054,00	R 2 277,00	R 2 195,00	R 2 121,00	R 2 284,00
2013/01/07	R 2 159,00	R 2 036,00	R 2 244,00	R 2 143,00	R 2 123,00	R 2 261,00
2013/01/08	R 2 158,00	R 2 048,00	R 2 215,00	R 2 134,00	R 2 121,00	R 2 290,00
2013/01/09	R 2 121,00	R 2 059,00	R 2 269,00	R 2 140,00	R 2 092,00	R 2 327,00
2013/01/10	R 2 134,00	R 2 044,00	R 2 339,00	R 2 172,00	R 2 120,00	R 2 360,00
2013/01/11	R 2 103,00	R 2 040,00	R 2 328,00	R 2 182,00	R 2 100,00	R 2 311,00
2013/01/14	R 2 161,00	R 2 098,00	R 2 364,00	R 2 199,00	R 2 147,00	R 2 307,00
2013/01/15	R 2 132,00	R 2 188,00	R 2 312,00	R 2 170,00	R 2 140,00	R 2 255,00
2013/01/16	R 2 166,00	R 2 184,00	R 2 342,00	R 2 162,00	R 2 160,00	R 2 319,00
2013/01/17	R 2 134,00	R 2 221,00	R 2 347,00	R 2 190,00	R 2 160,00	R 2 284,00
2013/01/18	R 2 154,00	R 2 166,00	R 2 400,00	R 2 171,00	R 2 171,00	R 2 363,00
2013/01/21	R 2 186,00	R 2 165,00	R 2 401,00	R 2 150,00	R 2 129,00	R 2 315,00
2013/01/22	R 2 216,00	R 2 182,00		R 2 206,00	R 2 141,00	
2013/01/23	R 2 186,00	R 2 141,00		R 2 159,00	R 2 183,00	
2013/01/24	R 2 169,00				R 2 186,00	
2013/01/25						

	Average daily prices (R/t)					
Date	2013/07	2013/08	2013/09	2013/10	2013/11	2013/12
2013/07/01	R 2 168,00	R 2 320,00	R 2 336,00	R 2 308,00	R 2 401,00	R 2 585,00
2013/07/02	R 2 163,00	R 2 310,00	R 2 339,00	R 2 328,00	R 2 450,00	R 2 622,00
2013/07/03	R 2 209,00	R 2 271,00	R 2 315,00	R 2 351,00	R 2 450,00	R 2 671,00
2013/07/04	R 2 207,00	R 2 289,00	R 2 301,00	R 2 345,00	R 2 437,00	R 2 682,00
2013/07/05	R 2 232,00	R 2 287,00	R 2 306,00	R 2 339,00	R 2 404,00	R 2 723,00
2013/07/08	R 2 204,00	R 2 278,00	R 2 306,00	R 2 334,00	R 2 431,00	R 2 766,00
2013/07/09	R 2 219,00	R 2 251,00	R 2 306,00	R 2 347,00	R 2 449,00	R 2 766,00
2013/07/10	R 2 241,00	R 2 276,00	R 2 326,00	R 2 353,00	R 2 466,00	R 2 725,00
2013/07/11	R 2 260,00	R 2 246,00	R 2 321,00	R 2 317,00	R 2 438,00	R 2 722,00
2013/07/12	R 2 310,00	R 2 277,00	R 2 324,00	R 2 335,00	R 2 428,00	R 2 697,00
2013/07/15	R 2 260,00	R 2 284,00	R 2 293,00	R 2 336,00	R 2 429,00	R 2 686,00
2013/07/16	R 2 299,00	R 2 297,00	R 2 304,00	R 2 352,00	R 2 424,00	R 2 762,00
2013/07/17	R 2 340,00	R 2 301,00	R 2 284,00	R 2 354,00	R 2 443,00	R 2 800,00
2013/07/18	R 2 328,00	R 2 301,00	R 2 277,00	R 2 365,00	R 2 471,00	R 2 824,00
2013/07/19	R 2 318,00	R 2 314,00	R 2 281,00	R 2 372,00	R 2 483,00	
2013/07/22	R 2 295,00	R 2 300,00		R 2 387,00	R 2 493,00	
2013/07/23	R 2 312,00			R 2 394,00		
2013/07/24	R 2 288,00			R 2 410,00		
2013/07/25						

2013 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 7 435,63	5,5	R 1 351,93	R 217,00	R 1 568,93	R 1 961,17	R 2 118,06	R 2 274,95	R 2 431,85
				colum 1	94	81	21	0
				colum 2	97	97	84	24
				Total	191	178	105	24
				Probability	76,4	71,2	42	9,6

Appendix G: Domestic future prices of white maize 2014

Domestic futures prices of white maize:						
Datum/	Average daily prices (R/t)					
Date	2014/01	2014/02	2014/03	2014/04	2014/05	2014/06
2014/01/02	3030,00			2860,00	2133,00	1812,00
2014/01/03	2991,00	3300,00	3139,00	2885,00	2072,00	1833,00
2014/01/06	3034,00	3225,00	3210,00	2835,00	2068,00	1851,00
2014/01/07	2979,00	3230,00	3296,00	2855,00	2040,00	1833,00
2014/01/08	3004,00	3251,00	3399,00	2852,00	2021,00	1825,00
2014/01/09	3000,00	3170,00	3560,00	2795,00	2037,00	1832,00
2014/01/10	3003,00	3100,00	3730,00	2707,00	2033,00	1851,00
2014/01/13	3040,00	3064,00	3765,00	2634,00	2090,00	1867,00
2014/01/14	3028,00	3111,00	3641,00	2645,00	2089,00	1869,00
2014/01/15	3018,00	3154,00	3570,00	2680,00	2020,00	1871,00
2014/01/16	3116,00	3159,00	3320,00	2757,00	2015,00	1846,00
2014/01/17	3159,00	3235,00	3300,00	2955,00	2006,00	1846,00
2014/01/20	3233,00	3304,00	3330,00	3130,00	1984,00	1837,00
2014/01/21	3261,00	3250,00	3330,00	2510,00	1978,00	1832,00
2014/01/22	3289,00	3350,00	3422,00		1926,00	1843,00
2014/01/23	3239,00	3186,00	3620,00			
2014/01/24	3231,00					
2014/01/27						

Datum/	Average daily prices (R/t)					
Date	2014/07	2014/08	2014/09	2014/10	2014/11	2014/12
2014/07/01	1765,00	1771,00	1682,00	1765,00		1983,00
2014/07/02	1763,00	1723,00	1674,00	1764,00		2002,00
2014/07/03	1762,00	1725,00	1656,00	1800,00	1906,00	2010,00
2014/07/04	1761,00	1772,00	1629,00	1865,00	1894,00	2042,00
2014/07/07	1767,00	1743,00	1668,00	1831,00	1910,00	2085,00
2014/07/08	1745,00	1764,00	1674,00	1851,00	1940,00	2155,00
2014/07/09	1728,00	1757,00	1691,00	1849,00	1979,00	2124,00
2014/07/10	1688,00	1753,00	1712,00	1874,00	1972,00	2144,00
2014/07/11	1658,00	1736,00	1706,00	1891,00	1970,00	2140,00
2014/07/14	1611,00	1717,00	1716,00	1939,00	1992,00	2155,00
2014/07/15	1660,00	1720,00	1722,00	1905,00	1989,00	2175,00
2014/07/16	1672,00	1730,00	1759,00	1922,00	2009,00	2167,00
2014/07/17	1690,00	1701,00	1749,00	1941,00	2011,00	2121,00
2014/07/18	1694,00	1692,00	1755,00	1930,00	2001,00	2137,00
2014/07/21	1648,00	1709,00	1750,00	1922,00	1965,00	2114,00
2014/07/22	1675,00	1722,00	1755,00	1922,00	1973,00	
2014/07/23	1698,00			1901,00	1991,00	
2014/07/24	1712,00			1905,00		
2014/07/25						

2014 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 8 331,69	5,5	R 1 514,85	R 251,00	R 1 765,85	R 2 207,32	R 2 383,90	R 2 560,49	R 2 737,07
				colum 1	61	61	60	56
				colum 2	0	0	0	0
				Total	61	61	60	56
				Probability	24,4	24,4	24	22,4

Appendix H: Domestic future prices of white maize 2015

Domestic futures prices of white maize:

	Average daily prices (R/t)					
Date	2015/01	2015/02	2015/03	2015/04	2015/05	2015/06
2015/01/02	2081,00	2180,00	2668,00	2603,00	2570,00	2718,00
2015/01/05	2120,00	2270,00	2569,00	2559,00	2570,00	2720,00
2015/01/06	2129,00	2226,00	2576,00	2525,00	2594,00	2716,00
2015/01/07	2114,00	2312,00	2639,00	2497,00	2631,00	2716,00
2015/01/08	2020,00	2410,00	2658,00	2546,00	2681,00	2727,00
2015/01/09	1974,00	2362,00	2670,00	2594,00	2780,00	2775,00
2015/01/12	1985,00	2485,00	2678,00	2624,00	2760,00	2860,00
2015/01/13	2010,00	2616,00	2689,00	2585,00	2730,00	2843,00
2015/01/14	1910,00	2639,00	2623,00	2540,00	2770,00	2850,00
2015/01/15	1913,00	2752,00	2601,00	2553,00	2787,00	2837,00
2015/01/16	1918,00	2998,00	2579,00	2542,00	2844,00	2818,00
2015/01/19	2015,00	2894,00	2651,00	2560,00	2799,00	2935,00
2015/01/20	1999,00	2700,00	2652,00	2543,00	2809,00	2982,00
2015/01/21	1999,00	2715,00	2655,00	2529,00	2801,00	2925,00
2015/01/22	2010,00	2682,00	2697,00		2830,00	2927,00
2015/01/23	2002,00		2718,00			2954,00
2015/01/26			2734,00			
2015/01/27						

Date	2015/07	2015/08	2015/09	2015/10	2015/11	2015/12
2015/07/01	3151,00		3095,00	3121,00		3425,00
2015/07/02	3009,00		3094,00	3159,00	3285,00	3503,00
2015/07/03	3071,00	3131,00	3084,00	3223,00	3216,00	3555,00
2015/07/06	3123,00	3142,00	3066,00	3227,00	3217,00	3478,00
2015/07/07	3173,00	3138,00	3072,00	3201,00	3295,00	3695,00
2015/07/08	3164,00	3125,00	3073,00	3238,00	3200,00	3699,00
2015/07/09	3250,00	3073,00	3089,00	3196,00	3256,00	3735,00
2015/07/10	3259,00	3124,00	3103,00	3188,00	3254,00	3950,00
2015/07/13	3338,00	3074,00	3121,00	3191,00	3150,00	3992,00
2015/07/14	3302,00	3011,00	3158,00	3168,00	3070,00	3901,00
2015/07/15	3243,00	2987,00	3129,00	3123,00	3075,00	3958,00
2015/07/16	3197,00	2969,00	3137,00	3070,00	3055,00	4115,00
2015/07/17	3181,00	2941,00	3110,00	3121,00	3069,00	4200,00
2015/07/20	3259,00	2960,00	3097,00	3162,00	3180,00	4206,00
2015/07/21	3235,00	3024,00	3086,00	3128,00	3260,00	4129,00
2015/07/22	3197,00	3068,00	3131,00	3126,00	3214,00	4118,00
2015/07/23	3090,00	3011,00		3094,00	3301,00	
2015/07/24	3075,00					
2015/07/27						
2015/07/28						
2015/07/29						
2015/07/30						
2015/07/31						

2015 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 8 676,06	5,5	R 1 577,46	R 251,00	R 1 828,46	R 2 285,58	R 2 468,43	R 2 651,27	R 2 834,12
				column 1	74	71	43	12
				column 2	97	97	97	97
				Total	171	168	140	109
				Probalitity	68,4	67,2	56	43,6

Appendix I: Domestic future prices of white maize 2016

Domestic futures prices of white maize:						
Gemiddelde daaglikse pryse/Average daily prices (R/t)						
Date	**2016/01**	**2016/02**	**2016/03**	**2016/04**	**2016/05**	**2016/06**
2016/01/01		5140,00	5041,00	4641,00		4860,00
2016/01/02		5014,00	4970,00	4647,00		4783,00
2016/01/03		5115,00	4935,00	4668,00	4496,00	4801,00
2016/01/04	4865,00	5001,00	4917,00	4710,00	4610,00	4766,00
2016/01/05	4900,00	4972,00	4825,00	4711,00	4710,00	4746,00
2016/01/06	4860,00	5109,00	4864,00	4667,00	4718,00	4818,00
2016/01/07	4777,00	5091,00	4852,00	4520,00	4695,00	4767,00
2016/01/08	4670,00	5020,00	4770,00	4430,00	4799,00	4787,00
2016/01/11	4621,00	5019,00	4770,00	4485,00	4844,00	4898,00
2016/01/12	4605,00	4910,00	4810,00	4445,00	4844,00	4916,00
2016/01/13	4830,00	4938,00	4837,00	4434,00	4839,00	4954,00
2016/01/14	4935,00	4910,00	4865,00	4451,00	4878,00	4909,00
2016/01/15	4965,00	4937,00	4745,00	4395,00	4990,00	4850,00
2016/01/18	5120,00	4860,00	4762,00	4374,00	5076,00	4773,00
2016/01/19	5151,00	4880,00	4803,00	4477,00	5036,00	4772,00
2016/01/20	5280,00	4960,00			4946,00	4638,00
2016/01/21	5175,00				4862,00	
2016/01/22	5084,00				4887,00	
2016/01/25						

Average daily prices (R/t)						
Date	2016/07	2016/08	2016/09	2016/10	2016/11	2016/12
2016/07/01	4587,00	4080,00	4096,00		3635,00	3976,00
2016/07/04	4455,00	4110,00	4108,00	3450,00	3560,00	4186,00
2016/07/05	4540,00	4078,00	4026,00	3409,00	3514,00	4130,00
2016/07/06	4635,00	4069,00	4041,00	3474,00	3609,00	4010,00
2016/07/07	4698,00	4059,00	4092,00	3449,00	3529,00	3976,00
2016/07/08	4661,00	3920,00	4075,00	3415,00	3446,00	3935,00
2016/07/11	4594,00	3914,00	4179,00	3405,00	3580,00	3977,00
2016/07/12	4505,00	3999,00	4309,00	3550,00	3670,00	4012,00
2016/07/13	4579,00	4101,00	4232,00	3645,00	3740,00	4023,00
2016/07/14	4591,00	4052,00	4080,00	3500,00	3746,00	4090,00
2016/07/15	4531,00	4175,00	3973,00	3485,00	3706,00	4142,00
2016/07/18	4485,00	4300,00	3859,00	3432,00	3773,00	4205,00
2016/07/19	4443,00	4297,00	3841,00	3514,00	3950,00	4073,00
2016/07/20	4347,00	4264,00	3798,00	3482,00	4040,00	4135,00
2016/07/21	4390,00	4182,00	3837,00	3618,00	3952,00	3957,00
2016/07/22	4311,00	4295,00	3845,00	3702,00	4014,00	
2016/07/25			3832,00	3730,00	4110,00	
2016/07/26						

2016 Total input cost	LTA	AVG / ton	Transport dif	Total cost /ton	25%	35%	45%	55%
R 9 062,11	5,5	R 1 647,66	R 265,00	R 1 912,66	R 2 390,82	R 2 582,09	R 2 773,35	R 2 964,62
				colum 1	93	93	93	93
				colum 2	97	97	97	97
				Total	190	190	190	190
				Probability	76	76	76	76

Appendix J: Domestic future prices of white maize 2017

Domestic futures prices of white maize:						
	Average daily prices (R/t)					
Date	2017/01	2017/02	2017/03	2017/04	2017/05	2017/06
2017/01/01		2940,00	2536,00			1749,00
2017/01/02		3140,00	2500,00		1966,00	1731,00
2017/01/03	3687,00	2985,00	2369,00	2067,00	1934,00	1707,00
2017/01/04	3600,00	2900,00	2160,00	2109,00	1940,00	1731,00
2017/01/05	3617,00	2917,00	2228,00	2094,00	1935,00	1751,00
2017/01/06	3687,00	2942,00	2351,00	2094,00	1943,00	1790,00
2017/01/09	3650,00	2905,00	2344,00	2086,00	1940,00	1768,00
2017/01/10	3704,00	2886,00	2293,00	2089,00	1895,00	1753,00
2017/01/11	3660,00	2780,00	2195,00	2105,00	1873,00	1730,00
2017/01/12	3665,00	2800,00	2157,00	2102,00	1866,00	1736,00
2017/01/13	3614,00	2877,00	2170,00	2069,00	1839,00	1741,00
2017/01/16	3470,00	2881,00	2146,00	2019,00	1815,00	1728,00
2017/01/17	3375,00	2940,00	2179,00	1980,00	1803,00	1742,00
2017/01/18	3415,00	3070,00	2115,00	1939,00	1830,00	1754,00
2017/01/19	3505,00	3157,00	2007,00		1791,00	1727,00
2017/01/20	3483,00		1969,00		1797,00	1703,00
2017/01/23	3414,00		1750,00		1784,00	
2017/01/24	3232,00				1781,00	
2017/01/25						

	Average daily prices (R/t)					
Date	2017/07	2017/08	2017/09	2017/10	2017/11	2017/12
2017/07/01		1806,00	1808,00		2003,00	1879,00
2017/07/02		1800,00	1797,00	1840,00	1997,00	1884,00
2017/07/03	1805,00	1797,00	1804,00	1822,00	2011,00	1850,00
2017/07/04	1786,00	1819,00	1804,00	1806,00	2038,00	1870,00
2017/07/05	1815,00	1856,00	1813,00	1836,00	2001,00	1886,00
2017/07/06	1826,00	1863,00	1811,00	1863,00	2005,00	1900,00
2017/07/07	1854,00	1881,00	1815,00	1877,00	2001,00	1898,00
2017/07/10	1918,00	1859,00	1831,00	1878,00	2025,00	1862,00
2017/07/11	1940,00	1820,00	1843,00	1864,00	2074,00	1869,00
2017/07/12	1879,00	1813,00	1856,00	1851,00	2049,00	1877,00
2017/07/13	1810,00	1792,00	1859,00	1856,00	2007,00	1862,00
2017/07/14	1799,00	1807,00	1859,00	1874,00	1984,00	1816,00
2017/07/17	1777,00	1815,00	1841,00	1876,00	1982,00	1818,00
2017/07/18	1844,00	1819,00	1833,00	1884,00	2012,00	1814,00
2017/07/19	1844,00	1844,00	1823,00	1882,00	2027,00	
2017/07/20	1837,00	1828,00		1905,00	1982,00	
2017/07/21	1835,00	1810,00		1911,00	1979,00	
2017/07/24	1802,00			1936,00		
2017/07/25						

2017 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 9 129,90	5,5	R 1 659,98	R 293,00	R 1 952,98	R 2 441,23	R 2 636,52	R 2 831,82	R 3 027,12
				colum 1	33	31	29	19
				colum 2	0	0	0	0
				Total	33	31	29	19
				Probability	13,2	12,4	11,6	7,6

Appendix K: Domestic future prices of white maize 2018

Domestic futures prices of white maize:						
	Average daily prices (R/t)					
Date	2018/01	2018/02	2018/03	2018/04	2018/05	2018/06
2018/01/01		1792,00	1872,00			2123,00
2018/01/02	1965,00	1805,00	1852,00		2070,00	2078,00
2018/01/03	1971,00	1787,00	1878,00	1926,00	2070,00	2070,00
2018/01/04	1976,00	1785,00	1851,00	1891,00	2091,00	2081,00
2018/01/05	2034,00	1782,00	1884,00	1917,00	2093,00	2072,00
2018/01/08	1991,00	1825,00	1896,00	1940,00	2109,00	2084,00
2018/01/09	1956,00	1827,00	1940,00	1967,00	2111,00	2083,00
2018/01/10	1963,00	1814,00	1953,00	1988,00	2094,00	2056,00
2018/01/11	2031,00	1803,00	1955,00	1969,00	2057,00	2087,00
2018/01/12	2032,00	1786,00	1965,00	1954,00	2046,00	2065,00
2018/01/15	2044,00	1776,00	1930,00	1964,00	2085,00	2045,00
2018/01/16	1944,00	1777,00	1937,00	1967,00	2110,00	2032,00
2018/01/17	1932,00	1776,00	1936,00	1978,00	2093,00	2048,00
2018/01/18	1911,00	1785,00	1925,00	1975,00	2122,00	2058,00
2018/01/19	1902,00	1779,00	1887,00	1968,00	2143,00	2065,00
2018/01/22	1830,00			1970,00	2119,00	2090,00
2018/01/23	1853,00				2128,00	
2018/01/24	1843,00				2146,00	
2018/01/25						

	Average daily prices (R/t)					
Date	2018/07	2018/08	2018/09	2018/10	2018/11	2018/12
2018/07/01		2152,00		2272,00	2384,00	
2018/07/02	2080,00	2168,00		2340,00	2381,00	
2018/07/03	2040,00	2160,00	2353,00	2350,00	2443,00	2470,00
2018/07/04	2020,00	2188,00	2429,00	2385,00	2454,00	2393,00
2018/07/05	2006,00	2204,00	2487,00	2402,00	2431,00	2458,00
2018/07/06	2006,00	2215,00	2444,00	2423,00	2448,00	2499,00
2018/07/09	2014,00	2281,00	2417,00	2445,00	2502,00	2610,00
2018/07/10	2008,00	2274,00	2429,00	2387,00	2487,00	2789,00
2018/07/11	1998,00	2235,00	2440,00	2370,00	2470,00	2809,00
2018/07/12	1991,00	2284,00	2431,00	2358,00	2397,00	2974,00
2018/07/13	1979,00	2311,00	2372,00	2363,00	2440,00	2772,00
2018/07/16	1958,00	2378,00	2340,00	2372,00	2396,00	2741,00
2018/07/17	1998,00	2329,00	2390,00	2380,00	2352,00	3042,00
2018/07/18	2018,00	2317,00	2380,00	2374,00	2324,00	3015,00
2018/07/19	2024,00	2318,00	2352,00	2380,00	2290,00	3004,00
2018/07/20	2055,00	2311,00	2312,00	2370,00	2308,00	
2018/07/23	2080,00	2286,00		2360,00	2284,00	
2018/07/24	2087,00			2334,00		
2018/07/25						

2018 Total input cost	LTA	AVG / ton	Transport dif	Total cost / t	25%	35%	45%	55%
R 9 867,18	5,5	R 1 794,03	R 307,00	R 2 101,03	R 2 626,29	R 2 836,39	R 3 046,50	R 3 256,60
				colum 1	0	0	0	0
				colum 2	8	4	0	0
				Total	8	4	0	0
				Probability	3,2	1,6	0	0

Appendix L: Domestic future prices of white maize 2019

Domestic futures prices of white maize:						
	Average daily prices (R/t)					
Date	2019/01	2019/02	2019/03	2019/04	2019/05	2019/06
2019/01/01		2739,00	2876,00	2770,00	2607,00	
2019/01/02	2746,00	2850,00	3007,00	2820,00	2625,00	
2019/01/03	2701,00	2877,00	2934,00	2789,00	2585,00	2886,00
2019/01/04	2800,00	2832,00	2953,00	2747,00	2570,00	2930,00
2019/01/07	2985,00	2782,00	3047,00	2705,00	2518,00	2861,00
2019/01/08	2871,00	2771,00	3025,00	2675,00	2457,00	2836,00
2019/01/09	2912,00	2665,00	2894,00	2641,00	2487,00	2886,00
2019/01/10	2925,00	2632,00	2879,00	2588,00	2554,00	2820,00
2019/01/11	2997,00	2724,00	2910,00	2615,00	2594,00	2771,00
2019/01/14	3185,00	2717,00	2894,00	2631,00	2588,00	2788,00
2019/01/15	3081,00	2662,00	2866,00	2604,00	2682,00	2844,00
2019/01/16	3100,00	2698,00	2798,00	2637,00	2704,00	2876,00
2019/01/17	3250,00	2786,00	2814,00	2650,00	2689,00	2834,00
2019/01/18	3249,00	2756,00	2851,00	2658,00	2604,00	2829,00
2019/01/21	3155,00	2724,00	2914,00	2576,00	2665,00	2775,00
2019/01/22	3009,00				2680,00	2859,00
2019/01/23	3053,00					
2019/01/24	2977,00					
2019/01/25						

	Average daily prices (R/t)					
Date	2019/07	2019/08	2019/09	2019/10	2019/11	2019/12
2019/07/01	2893,00	2863,00		2896,00	2795,00	
2019/07/02	2867,00	2879,00	2758,00	2848,00	2714,00	2755,00
2019/07/03	2857,00	2882,00	2749,00	2867,00	2691,00	2727,00
2019/07/04	2925,00	2922,00	2747,00	2865,00	2667,00	2685,00
2019/07/05	2938,00	2947,00	2746,00	2832,00	2610,00	2671,00
2019/07/08	2979,00	2991,00	2703,00	2882,00	2610,00	2687,00
2019/07/09	2957,00	3032,00	2634,00	2928,00	2598,00	2606,00
2019/07/10	2923,00	2875,00	2700,00	2937,00	2636,00	2585,00
2019/07/11	2899,00	2932,00	2736,00	2907,00	2677,00	2635,00
2019/07/12	2937,00	2923,00	2739,00	2948,00	2692,00	2631,00
2019/07/15	2980,00	2933,00	2769,00	2943,00	2752,00	2683,00
2019/07/16	2914,00	2922,00	2790,00	2956,00	2740,00	2711,00
2019/07/17	2905,00	2911,00	2797,00	2955,00	2763,00	2689,00
2019/07/18	2933,00	2836,00	2789,00	2944,00	2710,00	2708,00
2019/07/19	2903,00	2800,00	2798,00	2961,00	2696,00	2733,00
2019/07/22	2862,00	2763,00	2830,00	2884,00	2705,00	
2019/07/23	2899,00			2859,00		
2019/07/24	2906,00			2840,00		
2019/07/25						

2019 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 10 145,58	5,5	R 1 844,65	R 319,00	R 2 163,65	R 2 704,56	R 2 920,93	R 3 137,29	R 3 353,66
				Colum 1	61	18	4	0
				colum 2	76	24	0	0
				Total	137	42	4	0
				Probability	54,8	16,8	1,6	0

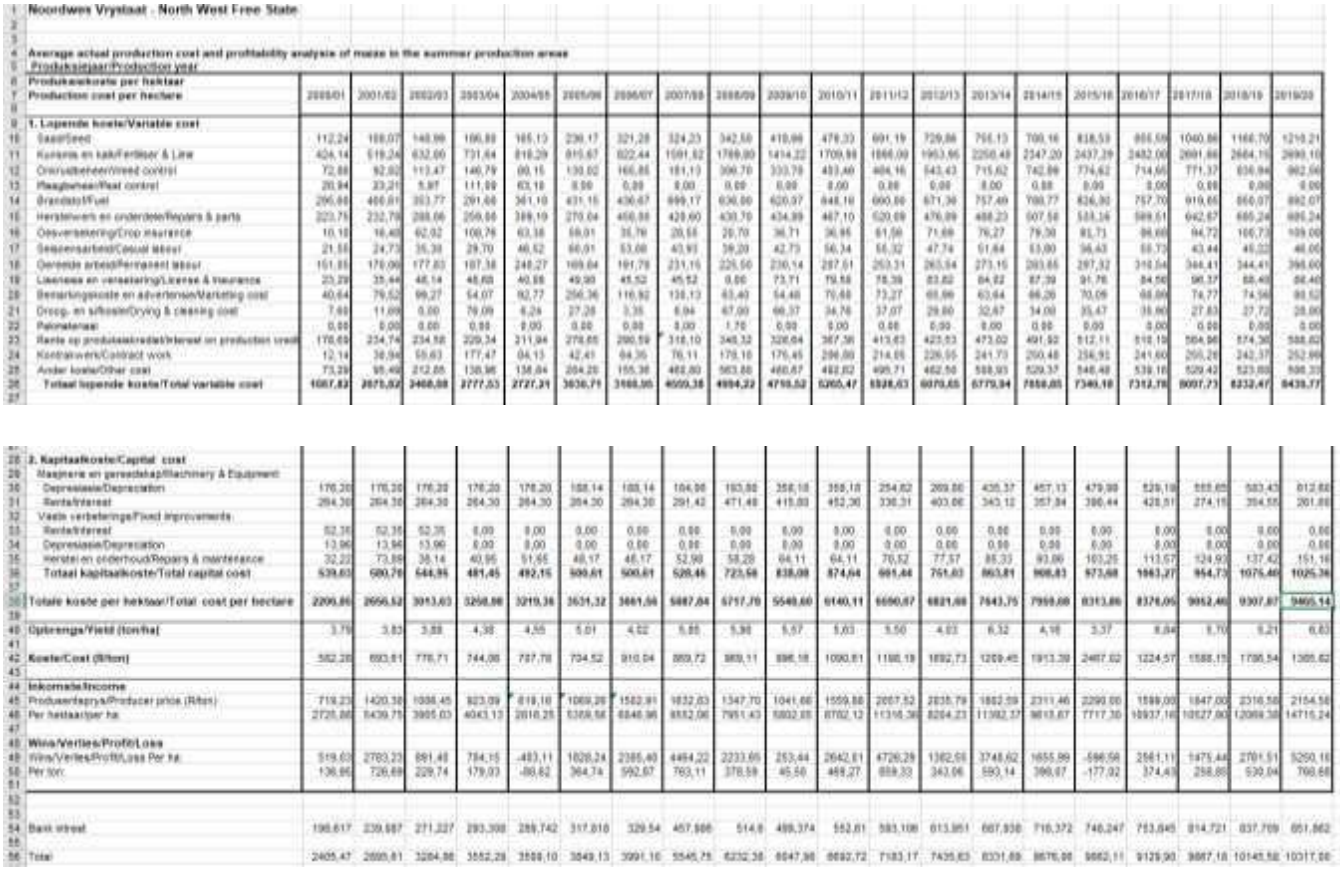
Appendix M: Domestic future prices of white maize 2020

Domestic futures prices of white maize:						
	Average daily prices (R/t)					
Date	2020/01	2020/02	2020/03	2020/04	2020/05	2020/06
2020/01/01	0,00	0	0	3195,00	0	2410,00
2020/01/02	2570,00	0	2664,00	3239,00	0,00	2384,00
2020/01/03	2619,00	3044,00	2901,00	3393,00	2535,00	2360,00
2020/01/06	2634,00	3040,00	2893,00	3320,00	2557,00	2374,00
2020/01/07	2651,00	3055,00	2944,00	3289,00	2612,00	2381,00
2020/01/08	2766,00	3094,00	2919,00	3466,00	2637,00	2387,00
2020/01/09	2830,00	3100,00	2925,00	3596,00	2651,00	2421,00
2020/01/10	2829,00	3061,00	2930,00	3690,00	2632,00	2407,00
2020/01/13	2838,00	2967,00	2948,00	3868,00	2636,00	2395,00
2020/01/14	2853,00	2870,00	2930,00	3900,00	2612,00	2427,00
2020/01/15	2874,00	2897,00	2953,00	3836,00	2644,00	2465,00
2020/01/16	2900,00	2813,00	3032,00	3345,00	2667,00	2509,00
2020/01/17	2952,00	2730,00	3126,00	3329,00	2713,00	2562,00
2020/01/20	2974,00	2795,00	3144,00	3660,00	2732,00	2578,00
2020/01/21	3022,00	2743,00	3195,00	0,00	2750,00	2631,00
2020/01/22	3248,00	2699,00	3206,00	0,00	2682,00	2692,00
2020/01/23	3167,00	2743,00	3981,00	0,00	2823,00	0,00
2020/01/24	3163,00	0,00	3200,00	0,00	0,00	0,00
2020/01/27						

	Average daily prices (R/t)					
Date	2020/07	2020/08	2020/09	2020/10	2020/11	2020/12
2020/07/01	2588,00		3094,00	3327,00		3567,00
2020/07/02	2608,00		3093,00	3407,00	3490,00	3516,00
2020/07/03	2603,00	2784,00	3193,00	3379,00	3465,00	3560,00
2020/07/06	2639,00	2774,00	3113,00	3401,00	3433,00	3546,00
2020/07/07	2621,00	2763,00	3142,00	3488,00	3358,00	3523,00
2020/07/08	2609,00	2797,00	3195,00	3498,00	3361,00	3550,00
2020/07/09	2627,00	2827,00	3197,00	3480,00	3308,00	3481,00
2020/07/10	2646,00	2854,00	3255,00	3511,00	3389,00	3482,00
2020/07/13	2565,00	2804,00	3261,00	3498,00	3521,00	3380,00
2020/07/14	2569,00	2880,00	3256,00	3532,00	3490,00	3298,00
2020/07/15	2521,00	2890,00	3274,00	3622,00	3515,00	3220,00
2020/07/16	2521,00	2970,00	3230,00	3730,00	3510,00	3152,00
2020/07/17	2561,00	2948,00	3269,00	3762,00	3499,00	3305,00
2020/07/20	2552,00	2905,00	3311,00	3811,00	3418,00	3403,00
2020/07/21	2541,00	2974,00	3436,00	3730,00	3433,00	3336,00
2020/07/22	2545,00	3029,00	3412,00	3723,00	3415,00	3260,00
2020/07/23	2586,00	3021,00		3766,00	3445,00	
2020/07/24	2641,00					
2020/07/27						

2020 Total input cost	LTA	AVG / ton	Transport dif	Total cost / ton	25%	35%	45%	55%
R 10 317,00	5,5	R 1 875,82	R 303,00	R 2 178,82	R 2 723,52	R 2 941,40	R 3 159,29	R 3 377,17
				column 1	60	37	21	9
				column 2	80	70	60	41
				Total	140	107	81	50
				Probability	56	42,8	32,4	20

Appendix N: Grain SA input costs



Noordwes Vrystaat . North West Free State

Average actual production cost and profitability analysis of maize in the summer production areas

Produksiejaar/Production year

Produksiekoste per hektaar / Production cost per hectare	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
1. Lopende koste/Variable cost																				
Saad/Seed	112,24	108,07	140,99	166,88	165,13	236,17	321,28	324,23	342,58	418,99	478,33	691,19	729,86	756,13	700,16	818,53	865,59	1040,86	1166,70	1216,21
Kunsmis en sout/Fertiliser & Lime	424,14	519,24	632,00	731,64	818,29	915,67	922,44	1591,92	1769,80	1414,22	1709,98	1866,09	1953,66	2250,48	2347,20	2437,29	2482,00	2691,66	2684,15	2699,10
Onkruidbeheer/Weed control	72,88	92,02	113,47	146,79	99,15	130,02	166,85	181,10	306,70	333,79	483,46	484,16	543,43	715,62	742,89	774,62	714,65	771,37	836,94	982,56
Plaagbeheer/Pest control	20,94	23,21	5,97	111,99	63,18	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Brandstof/Fuel	295,66	466,61	353,77	291,66	361,16	431,15	436,67	899,17	836,00	620,97	848,16	660,86	671,36	757,49	788,77	826,90	757,70	919,65	860,07	892,07
Herstelwerk en onderdele/Repairs & parts	223,75	232,79	288,66	259,66	389,19	270,64	466,88	429,60	430,70	434,99	467,10	520,69	476,99	488,23	507,56	533,16	599,51	642,67	685,24	695,24
Oesversekering/Crop insurance	10,10	16,46	62,02	109,78	63,38	58,01	35,79	29,55	29,70	36,71	36,95	61,56	71,68	76,27	79,30	83,73	86,66	94,72	105,73	109,06
Seisoensarbeid/Casual labour	21,58	24,73	35,39	29,70	46,52	66,01	53,06	40,93	39,29	42,73	56,34	55,32	47,74	51,64	53,00	56,43	55,73	43,44	45,22	46,06
Gereelde arbeid/Permanent labour	151,85	176,06	177,83	187,38	248,27	169,64	191,78	231,15	225,50	230,14	287,51	263,31	265,54	273,15	283,65	297,32	316,54	344,41	344,41	398,60
Lisensies en versekering/Licence & insurance	23,29	35,44	46,14	48,68	40,88	49,99	45,52	45,52	0,00	73,71	79,58	78,39	83,82	84,82	87,39	91,76	84,58	96,37	88,40	86,40
Bemarkingskoste en advertensie/Marketing cost	40,64	79,52	99,27	64,07	92,77	256,36	116,92	135,13	63,40	54,48	70,68	73,27	65,99	63,64	66,26	70,09	68,66	74,77	74,56	93,52
Oesop- en silhoste/Drying & cleaning cost	7,69	11,09	0,00	79,09	6,24	27,28	3,35	6,94	67,00	66,37	34,76	37,07	29,80	32,67	34,00	35,47	35,90	27,83	27,72	28,06
Paloneterse/	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,76	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rente op produksiekrediet/Interest on production credit	178,65	234,74	234,58	229,34	211,94	278,65	280,59	318,10	348,32	328,64	367,38	413,63	423,53	473,02	491,92	512,11	518,19	584,96	574,36	588,62
Kontrakwerk/Contract work	12,14	38,94	55,63	177,47	94,13	42,41	64,35	76,11	178,10	176,45	296,80	214,65	226,95	241,73	250,48	256,91	241,60	255,26	242,37	252,99
Ander koste/Other cost	73,29	95,49	212,85	138,96	138,84	264,25	155,38	482,80	563,88	466,87	482,82	495,71	462,56	558,93	529,37	548,48	539,16	529,42	523,80	598,33
Totaal lopende koste/Total variable cost	**1667,82**	**2575,02**	**3468,08**	**3777,03**	**3727,31**	**3936,71**	**3988,06**	**4600,38**	**4994,22**	**4710,52**	**5260,47**	**5828,03**	**6070,65**	**6779,94**	**7058,05**	**7340,10**	**7312,78**	**8097,73**	**8232,47**	**8439,77**

2. Kapitaalkoste/Capital cost																				
Masjinerie en gereedskap/Machinery & Equipment																				
Depresiasie/Depreciation	176,20	176,20	176,20	176,20	176,20	188,14	188,14	184,96	193,80	358,18	358,18	254,62	269,80	435,37	457,13	479,99	529,19	555,65	583,43	612,60
Rente/Interest	264,30	264,30	264,30	264,30	264,30	264,30	264,30	291,42	471,48	415,83	452,36	336,31	403,06	340,12	357,94	386,44	428,51	274,15	304,55	261,65
Vaste verbeterings/Fixed improvements																				
Rente/Interest	52,35	52,35	52,35	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Depresiasie/Depreciation	13,96	13,96	13,96	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Herstel en onderhoud/Repairs & maintenance	32,22	73,89	39,14	40,95	51,65	48,17	46,17	52,90	59,20	64,11	64,11	70,52	77,57	85,33	93,86	103,25	113,57	124,93	137,42	151,16
Totaal kapitaalkoste/Total capital cost	**539,03**	**580,70**	**544,95**	**481,45**	**492,15**	**500,61**	**500,61**	**528,46**	**723,58**	**838,09**	**874,64**	**661,44**	**751,03**	**863,81**	**908,93**	**973,68**	**1083,27**	**954,73**	**1075,40**	**1025,36**
Totale koste per hektaar/Total cost per hectare	**2206,86**	**2656,52**	**3013,03**	**3258,08**	**3219,36**	**3631,32**	**3661,58**	**5087,04**	**5717,70**	**5548,60**	**6140,11**	**6690,07**	**6821,68**	**7643,75**	**7966,68**	**8313,86**	**8376,05**	**9052,46**	**9307,87**	**9465,14**
Opbrengs/Yield (ton/ha)	3,79	3,83	3,88	4,38	4,55	5,01	4,62	5,85	5,96	5,57	5,03	5,50	4,03	6,32	4,16	3,37	6,84	5,70	5,21	6,83
Koste/Cost (R/ton)	582,28	693,61	776,71	744,06	707,78	724,52	810,04	869,72	959,11	996,16	1090,61	1166,19	1692,73	1209,45	1913,39	2467,02	1224,57	1588,15	1786,54	1385,62
Inkomste/Income																				
Produsenteprys/Producer price (R/ton)	719,23	1420,30	1008,45	923,09	819,16	1069,28	1582,91	1632,63	1347,70	1041,66	1559,88	2057,52	2835,79	1882,59	2311,46	2299,00	1599,00	1847,00	2316,58	2154,56
Per hektaar/per ha	2725,86	5439,75	3905,03	4043,13	3816,25	5359,56	8246,96	9552,06	7951,43	5802,85	8702,12	11316,36	8264,23	11382,37	9613,67	7717,30	10937,16	10527,90	12069,38	14715,24
Wins/Verlies/Profit/Loss																				
Wins/Verlies/Profit/Loss Per ha	519,03	2783,23	891,48	784,15	-483,11	1828,24	2385,40	4464,22	2233,65	253,44	2642,61	4726,29	1362,55	3748,62	1655,89	-596,56	2561,11	1475,44	2761,51	5250,10
Per ton	136,95	726,69	229,74	179,03	-86,62	364,74	592,67	763,11	378,59	45,50	469,27	859,33	343,06	590,14	396,67	-177,02	374,43	258,85	530,04	768,68
Bank interest	196.617	239.987	271.227	293.308	289.742	317.819	329.54	457.866	514.8	499.374	552.61	593.106	613.951	687.938	716.372	748.247	753.845	814.721	837.709	851.862
Total	2405,47	2895,81	3284,86	3552,29	3508,10	3849,13	3991,16	5545,75	6232,38	6047,96	6692,72	7183,17	7435,63	8331,69	8676,06	9062,11	9125,90	9867,18	10145,56	10317,66

Appendix O: Tierfontein differential

SILO	OWNER	Year	R/TON
Tierfontein	SWK	1999/00	55
Tierfontein	SWK	2000/2001	61
Tierfontein	SWK	2001/2002	60
Tierfontein	SWK	2002/2003	67
Tierfontein	SWK	2003/2004	78
Tierfontein	SWK	2004/2005	88
Tierfontein	SWK	2005/2006	93
Tierfontein	SWK	2006/2007	98
Tierfontein	SWK	2007/2008	105
Tierfontein	SWK	2008/2009	123
Tierfontein	SWK	2009/2010	135
Tierfontein	SWK	2010/2011	148
Tierfontein	SWK	2011/2012	206
Tierfontein	SWK	2012/2013	206
Tierfontein	SWK	2013/2014	217
Tierfontein	SWK	2014/2015	251
Tierfontein	SWK	2015/2016	251
Tierfontein	SWK	2016/17	265
Tierfontein	SWK	2017/18	293
Tierfontein	SWK	2018/19	307
Tierfontein	SWK	2019/20	319
Tierfontein	SWK	2020/21	313
Tierfontein	SWK	2021/22	303

Appendix P:Language edditing

RENTIA MYNHARDT

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Reference number: **EvdW1 Date:** 2021/11/19

To whom it may concern,

LANGUAGE EDITING

This letter serves as proof that the following document was submitted for language editing in November 2021:

Author:	E van der Walt
Document type:	Dissertation: Master of Business Administration (MBA)
Title:	*INVESTIGATING THE PROBABILITY OF A SPECIFIC MARK-UP ON WHITE MAIZE ON SAFEX*

I applied all reasonable effort to identify errors and made recommendations about spelling, grammar, style and punctuation.

I attempted to be consistent regarding language usage and presentation.

The bibliography was also checked and corrections were made where necessary.

I confirmed the content as far as possible, but cannot be held responsible for this as all facts couldnot be confirmed. This remains the responsibility of the author.

Thank you very much.

Kind regards.

Rentia Mynhardt