

DRIVE FOR SHOW: PUTT FOR DOUGH? THE VALUE OF PERFORMANCE  
MEASURES FOR PROFESSIONAL GOLFERS ON THE SUNSHINE TOUR AND THE  
RELATIONSHIP WITH EARNINGS

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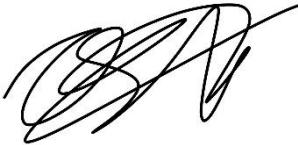
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## ABSTRACT

“Drive for show, putt for dough”. This controversial adage has been a prominent sentiment in the game of golf for decades. Empirical evidence investigating its robustness through determinant of earnings inquiries have identified that the most valuable measure of performance in golf is in fact putting. However, with the ever-perpetuating state of golf equipment and the technologies thereof, the distance debate in golf has thus gained traction. Recent investigations and evidence into the adage had identified a trend-shift with regards to the value associated with distance achievable and putting ability in golf. Therefore questioning the relevance of the adage in the modern form of the game. In conducting a determinant of earnings inquiry through the engagement of engineering “pure” performance measures as empirically identified, this investigation is aimed at recognising a similar trend in a South African perspective, on the Sunshine Tour. Utilising a generalised least square regression methodology, the analysis identifies how the value of the marginal product associated with both player and non-player explanatory measures influence real earnings on the Sunshine Tour. This determination is observed through the means of a comprehensive scenario analysis, demonstrating the effect of marginal performance differences to the degree of 1% and 5% increase in performance. A trend was therefore identified in which the value of the marginal product, and growth in real earnings associated to driving distance at the 5% level were in fact greater than the that of putting ability. The results further denote the robustness of the adage and the inherent value associated to putting vs. driving distance at the 1% level. The conclusion to this investigation demonstrates the importance of opportunistic positions player’s put themselves in within tournaments to encourage earnings accumulation. Identified through balanced return on investments for all performance measures to “drive for dough to putt for dough”.

## DECLARATION

This thesis has not been submitted to a university other than Rhodes University, Grahamstown, South Africa. The work presented here is that of the author, unless stated otherwise.



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Cameron Heathfield

8 November 2022

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Date

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## CHAPTER 1

### INTRODUCTION

This thesis investigates the determinants of earnings in professional golf. Investigating a South African perspective of the adage “drive for show, putt for dough”, which is relatively fresh in this field of literature. Empirically, studies conducted within the avenue of determinant of earnings in professional golf have been focused on the Professional Golfers Association (PGA Tour) and have used isolated performance measures in determining their value against earnings within professional golf. According to Berry (1999); Kern & Alexander (2005); Baugher, Day, Burford (2016), this empirical method is restricted in producing the most accurate results due to the open-endedness of the skill variables used. However, this is recognised and accounted for by the pioneers of “pure” performance measures. The adage “drive for show, putt for dough” is remarkably relevant in the modern form of the game as empirically, a study conducted on the PGA Tour accounts for a changing trend in respect performance measures, and the most valuable contribution to earnings. According to Golf.com (2015), the origin of the adage resonates from a South African professional golfer by the name of Bobby Locke. The late Bobby Locke was recognised as one of the best professional golfers in the world during his tenure throughout the world tours, in which he was able to secure 72 professional wins (Bisset, 2017). The success of Bobby Locke was attributed to his putting ability as Bisset (2017) mentioned that putting, is where Bobby Locke excelled. In accordance with his abilities on the greens, the adage was conceptualised in that players “drive for show and you putt for dough”.

Technology is a relatively modern factor in determinants of earnings significance as its true influence was only significantly noticed in the modern form of the game. Thus, an interesting avenue of exploration was created in investigating the ever-increasingly controversial dictum in the game of golf, as distance in the game had created a new point of inquiry. As noted by Bisset (2017), during the era of golf in which the likes of Bobby Locke dominated the sport alongside individuals such as Sam Snead, Ben Hogan, Byron Nelson as well as Gene Sarazen, putting was the most important performance measure in golf. The footprint of technology did not have the same influence on golf equipment as noticed in the modern game.

Sahota (2021) noted that the first noticeable breakthrough in golf broke the surface in the 1920’s with the experimentation of different materials in the shafts of golf clubs. This sparked the introduction of the steel shaft in golf clubs, closely followed by the graphite shaft. Not only did this make an exponential impact towards the performances of tour professional golfers with regards

to the durability as well as performance, but further promoted a great increase in popularity of the sport (Sahota, 2021). Technology in sport and the addition thereof, has contributed to an exponential increase in the popularity of sport as a whole, on a global level. According to Fuss, Subic, Ujihashi (2007); Kearny (2022), the global market for sport is made-up of a variety of facets, be it media, ticket sales, apparel, memorabilia, and equipment. Combined, accumulate the value of \$600-620 billion as a global net worth. It is noted that the global sports market in 2018 had a net worth of \$488.5 billion having a compound annual growth rate of 4.3% since the 2014 period (Business Wire, 2019). With an increase in the compound annual growth rate to 5.9%, the total net worth of the global sports market was projected to grow to a quantum of \$614.1 billion by 2022. Therefore, reinforcing the vast global value noted by Kearney (2022). The magnitude of the value associated with the global sports market as well as the ever-increasing nature of the global popularity of sport is reflected in the size of the growth. Kearney (2022) makes an additional note in identifying that the size of the market growth for the global sport industry is increasing at a greater pace than global GDP growth. Technology and the expansion thereof, is a major contributor to growth in the market for sport in which Omoregie (2016) outlines the vast scope and reach of technology, noticed in all aspects of global sport. The influence ranges from equipment, performance enhancement, movement technology as well as globalisation of sport. All of which contribute to the growth of sport as well as the efficiency yield in sport. Most importantly, allow for an increase in the wealth of human capital capabilities.

The extent to which technology has impacted the game of golf is noticed on both a revolutionary and alarming scale. The Distance Insights Report which was published by golf's regulating body the (USGA – United States Golf Association) and the (R&A- Royal & Ancient Golf Club of St Andrews) identified key concerning notions which have presented themselves. This is noticed by the increases in distance which are characteristic of the effects of technology, which modern training methods indirectly perpetuate. However, most noticeably, the technologically driven modifications to golf equipment which create an unsustainable trend to the projections of the game (USGA, 2020). Training methods utilised in modern golf allow for a greater understanding of the golf swing through the ability in analysing and understanding the statistics produced. An example of this are training aids such as launch monitors, which aim to utilise such statistical and visual feedback to correct inefficient movements and improve efficiency of the golf swing through processes such as club fitting and modification. Furthermore, “Golf Fitness”, identified by Bearley, Coughlan, Wells (2019) allows for players to make more efficient movements throughout the golf swing. Coupled with the aid of the feedback methods, efficiency in the golf swing is given the best opportunity to

be maximised. The evolution of technology in golf equipment has further contributed to the increase in performance in the game. Modern golf clubs have evolved from a degree of simplicity in design and materials used to highly complicated, technology-rich tools that generate increased control, distance, and accuracy. This technology drive is additionally evident in golf balls in which extensive research and development create the components for efficiency and performance maximisation. This is evident in the control professional golfers can elicit from various shot scenarios as well as more noticeably, the distance the golf ball is able to travel. The research and development within golf equipment has sparked a distance orientated race which inherently brings with it a ripple effect, felt throughout the game. Regrettably, an increase in the length of golf courses is required to keep up with the increasing length achievable. Naturally raising environmental and capital concerns. Thus, the distance insights report suggesting a point of diminishing returns has been reached (USGA, 2020). However, conversely, the distance factor has positively encouraged and sparked a growth in the game through an entertainment factor provided by the spectating of long-hitting professionals internationally. Within a South African perspective, the growth in golf is noted by an increase in official golf handicaps and rounds of golf completed within a year (Complete Golfer, 2020). Additionally, South African professional golfers are highly influential contributors to the growth of the game through their participation and noticeable performance on world-wide tours.

The economic and theoretical underpinning of this thesis is routed in an earnings function, represented through a production function. The earnings function utilised is derived from Mincer (1958) in which human capital factors of production determine earnings within a labour market. By virtue of the labour market rewarding differing levels of human capital stock, as well the return on investment (ROI) with regards to knowledge. This notion of earnings determination can be applied to sport through the production function. In substituting human capital factors of production for those relevant to success in sport, a blueprint for success as well as earnings is determined. An empirical background for the investigation of production functions in sport demonstrates a notable scope of different sports, namely baseball, cricket, and soccer to mention a few. Therefore, the representation of the inherent relationship is illustrated through earnings as a function ( $f$ ) of its separate human capital factors of production. In this regard, investigations into production functions in sport have had a greater frequency in team sport, not to say its presence is not noticed in individual orientated sports such as golf. To the contrary in fact. However, still a relatively new avenue of inquiry especially in the South African perspective. Professional golfers, according to the dictum, dedicate their time accordingly in terms of building their practice schedule and routine to correspond. Players are advised by coaching staff as well as self-interest to dedicate a greater

amount of time on the putting green than on the driving range. Given what technology has to offer in the modern form of the game, coupled with the success seen with focus on increasing distance, does this still hold true?

Although limited, there are multiple empirical investigations into the determinants of earnings in professional golf. The majority are routed in the American PGA Tour, due to the vast availability of statistical data pertinent to analysing the determinants of success and earnings. Furthermore, the PGA Tour holds the status of being the pinnacle platform of global professional golf, attracting the best players in the world identified through the world golf ranking structure.

Early investigations include those conducted by Davidson and Templin (1986); Jones (1990); Belkin, Gansneder, Pickens, Rotella, and Streigel (1994); Shmanske (1992) as well as Moy and Liaw (1998). The basis of methodology within the studies aforementioned, all utilise the production function in which the factors of production comprise player-performance measures inherent to the game of golf. These include variables such as driving ability, iron-playing ability, chipping ability and putting ability. However, the regression methodologies range from linear to stepwise regression analyses. Shmanske (1992), additionally, introduced the element of a non-player performance variable to determinants of earnings in which the experience of a player was utilised as an input variable within the regression analysis. More recently, determinants of earnings investigations conducted by Scully (2002) and Callan and Thomas (2007) shift focus from the observable player performance measures of which empirically, comprised the factors of production. However, for Scully (2002) a question mark was placed on such a direct relationship. Instead, an indirect relationship presented itself as factors which are influenced by the individual performance of professional golfer's such as stroke average, age and the quantum of tournaments played, and expressed in a linear manner. For Callan and Thomas (2007), factors such as ranking, stroke average, shot making ability, experience as well as tournaments played and entered are expressed through the means of a multi-equation regression analysis in the determination of earnings.

Determinants of earnings in professional golf within a South African perspective is a relatively new avenue of inquiry. Fraser, Botha, Fraser (2015) and Botha, Fraser, Rhoads (2020) pioneered this investigation in utilising the production function and human capital factors of production towards determining success and earnings. Fraser et al. (2015) modelled an empirical study based on the multi-equation approach implemented by Callan and Thomas (2007), however, with a further addition of specific player-performance measures. Botha et al. (2020) investigated the value of the marginal product for player-performance measures and the inherent relationship with real earnings using a quantile regression approach derived from Kahane (2010). Therefore, this thesis aims to

contribute to the limited literature available in South African professional golf in creating an addition to the inquiry into determinants of earnings studies conducted on the Sunshine Tour.

In identifying and measuring performance variables in golf, Berry (1999) noticed a shortfall with regards to the methodologies involved in the collection and interpretation of necessary statistical data from the PGA Tour. As noted, a true representation of such was overlooked. Berry (1999) therefore identified specific player-performance measures in which the accuracy thereof had the capacity for improvement. Through the process of conducting linear regressions with player-performance measures displaying an influence upon others. Therefore, engineering “pure performance measures”. Kern and Alexander (2005) adopted the theory proposed by Berry (1999) and applied it into a PGA Tour determinant of earnings study. However, emphasising the scope of the study towards the adage “drive for show, putt for dough”, in which the phrase held its strength. Subsequently, Baugher et al. (2016) adopted the methodology proposed by Kern and Alexander (2005) in revisiting the “drive for show, putt for dough” controversy through an updated lens on the PGA Tour. Interestingly, a trend was identified, contrary to prior findings by Kern and Alexander (2005). Driving distance had surpassed putting ability with regards to significance and value as a determinant of earnings. In the context of objectivity, this finding encourages an array of questions. One of which, is whether this trend can be identified outside of a PGA Tour context, such as the Sunshine Tour. This is a noteworthy observation given the main determinant of distance is technological influence which professional golfers globally, share exclusive access to the abundance of technology-rich equipment.

### 1.1. Problem Statement

“Drive for show, putt for dough” is one of the most contested riddles in the game of golf. Subjectively, the skill attached to putting is widely viewed as the most important performance measure in the game. Coupled with evidence by Broadie (2014) in respect of most, if not all defining moments in golf tournaments being subject to ones putting ability. Objectively, the value of the marginal improvement in putting ability is widely recognised through empirical literature into determinants of earnings in professional golf. However, the nature of technology in golf’s 21<sup>st</sup> century, supported by recent literature suggests to the contrary with regards to the debate. Evidence to this effect has been investigated and observed on the PGA Tour in paving a modern sentiment which is identified in the value of marginal distance achievable by professional golfers opposed to putting ability. Thus, challenging the strength of the adage. Therefore, the question emerges. Is this modern sentiment present in a South African perspective, on the Sunshine Tour? Through utilising the determinant of earnings methodology pioneered by Kern and Alexander (2005) of utilising “pure” performance variables to measure the relative value of the marginal product (VMP) inherent to

each player performance variable and explanatory (non-player) variable of performance. Furthermore, to investigate whether the findings of Baugher et al. (2016) are identified on the Sunshine Tour.

## 1.2. Aim

With that being said, the context of this investigation adopts the aim and methodology utilised by both Kern and Alexander (2005) and Baugher et al. (2016). However, investigating the nature of “drive for show, putt for dough” in a South African perspective on the Sunshine Tour. Furthermore, exploring the presence of a shift in trend to the dictum as introduced by Baugher et al. (2016). Therefore, determining the relative contribution, significance, and value of the marginal product (VMP) of both driving distance and putting to real earnings on the Sunshine Tour.

## 1.3. Objectives

- To construct “pure” measures of performance with reference to Berry (1999); Kern & Alexander (2005) and Baugher et al., (2016) through identifying, isolating, and conducting linear regressions with interrelated player performance measures.
- Identifying explanatory non-player performance measures which have an indirect nature of influence involved in earnings determination of professional golfers.
- Conduct an analysis of the residuals from the linear regressions which isolate the “pure” performance measures and determine the value and significance of the variables involved in each regression.
- Using the player and explanatory non-player performance measures, explore both the relevance of the adage, and their relative value of marginal product (VMP) as determinants of earnings for professional golfers on the Sunshine Tour. Utilising an unbalanced generalized least square panel data regression analysis.

In conducting the empirical study, as per Berry (1999), “pure” performance measures were generated to improve the accuracy of the performance variables. However, a number of adaptations were made to the specificities regarding which statistical datasets were used in the construction of the “pure” performance measures Kern and Alexander (2005) and Baugher et al. (2016) had the freedom to customise “pure” player performance measures as seen fit through utilising the PGA Tour’s ShotLink Intelligence System which is a well-established statistics database comprising a wealth of empirical as well as recent player statistics records. However, albeit the Sunshine Tour having a relatively extensive statistics archive, the sheer magnitude and variety as compared to the

ShotLink Intelligence System is second to none. Subsequently, this posed as a limitation to the investigation as well as a unique opportunity as adaptations were made in alignment with what was available and accessible by the Sunshine Tour. Furthermore, due to the nature of the Sunshine Tour statistics database, a limitation was realised in the size of the panel data sample as the datasets available prior to the 2018 season were incomplete, thus not viable for the investigation.

This investigation will explore the determinants of earnings for professional golfers on the Sunshine Tour from the 2018/19 playing season to the 2021/22 playing season. Utilising the “pure” performance measure methodology pioneered by Berry (1999) and utilised by Kern and Alexander (2005) as well as Baugher et al. (2016). Specifically, paying close attention to the player-performance measures of driving distance and putting ability with reference to the adage “drive for show, putt for dough”. Therefore, unpacking whether the adage is still relevant in the modern form of the game. The investigation is a production function analysis. However, adapted to an earnings function, utilising a GLS (*generalised least squares*) regression analysis in estimating the determinates of earnings which comprise factors of production represented by two vectors. The first vector within the model comprises player-performance measures which directly affect performance of a player and thus earnings potential. The second vector comprises non-player performance variables, characterised by having an indirect impact on performance and thus earnings potential as investigated by Kern and Alexander (2005); Baugher et al. (2016).

The results from the GLS regression are subsequently interpreted and analysed. The first analysis unpacks the summary (*descriptive*) statistics, whereby a thorough account is established for both *vector* (X) and *vector* (Y) performance variables. In addition, reference is made to empirical South African determinant of earnings studies by Fraser et al. (2015) and Botha et al. (2020). A comparative account is made of the observed similarities and difference within the performance measures over the course of time in which interesting observations are noticed regarding the scope of particular statistics empirically as opposed to the most recent accounts.

In addition, as performed by Kern and Alexander (2005), a statistical measure known as the coefficient of variation is calculated which accounts for the degrees of dispersion around the mean for each performance measure. This is an interesting insight towards understanding the various performance measures. It demonstrates the skill variance which is present among the player performance measures as well as provides an explanatory account for the observed variance of the non-player performance measures in illustrating to what degree the representative statistical data differs. It is therefore observed that the degree of variance for some performance measures is much greater than others, which is too the case for Kern and Alexander (2005).

The analysis of the unbalanced panel regression model begins with a discussion regarding the different parameters and combinations thereof. Kern and Alexander (2005) as well as Baugher et al. (2016) utilised a random effects generalised least square regression model as this was the best-fit for their panel data. This investigation embarks on an inquiry into the different combinations of parameters. Identifying the reasoning as to why particular parameters are not considered to be best-fit for this investigation. Furthermore, utilising various effects testing methods in aid of the determination of the best-fit regression model for this research. Following this, a scenario analysis investigating the individual Sunshine Tour seasons utilised in the data sample. As empirical investigations show, the mean determination is analysed with regards to the impact marginal improvements in performance measures endorse towards real earnings. The scenario investigation utilises a similar premise in terms of the observed marginal impact to real earnings elicited by “pure” performance measures to real earnings. However, adopting a specified percentage increase in performance and inherent assumption to performance to determine the value of the marginal product (VMP) for both player and non-player performance.

## CHAPTER 2

### THE DISTANCE DEBATE

The distance debate in golf is not a modern concept, in fact, the debate has been argued for the greater part of one hundred years in highlighting the endangerment of the way golf is played as the technological footprint continues to expand (Chamblee, 2021).

The USGA conducted research into the ever-advancing effects of modern technology in golf equipment called the Distance Insights project (USGA, nd). The project was launched in 2018 which focused on the increase in length elicited from modern equipment as well as the ripple effect on golf courses worldwide. The latest conclusions to the study were established at the beginning of February 2020, with recent adjustments to the objectives as of the beginning of February 2021 (USGA 2021). A much-anticipated review of the Distance Insights Project was released in the beginning of 2021. Paving a path for the future of the game in terms of technology and the major influence it has played towards the increase of distance achievable. Furthermore, addressing the plan of action going forward. The projected influence of the project was encouraging a prospective rollback of technology in golf equipment as well as how it is tested to explore the distance challenge and promote the maintenance of competitiveness in golf. According to Rapaport (2022), a statement was made by the USGA's senior managing director of governance in noting that the equipment standards of golf equipment has reached the beginning of the solution phase. The governing bodies involved in the Distance Insights Project have notified interest areas (AoI's) in respect of the mitigation of increased distances achievable through focusing on three rule change proposals which govern equipment ruling in the game of golf (USGA, 2021).

According to Dusek (2020), regulation adjustments and amendments to the nature of the inner and outer make-up of golf equipment may be announced in the future. These proposal rulings outlined by the USGA (2021) are highlighted clearly by Kerr-Dineen (2021) whereby the Distance Insights Project proposes four changes. Namely, a change in the way golf equipment is tested in focusing on the true effectiveness, validity, and reliability. Secondly, an adjustment to the modern specifications of golf equipment as well as conformance of golf equipment. (USGA, 2021). The governing body propose for six areas of emphasis ranging from the reduction of the initial velocity of the golf ball, the size and weight of the golf ball, the adjustment of clubhead size, specification on the "spring-like" effect golf clubs have to the moment of inertia and, the creation of a ceiling in relation to the maximum length of golf clubs to 46 inches. Lastly, allowing for a local rule whereby committees of local golf courses as well as committees involved in the execution of professional golf tournaments have the ability to implement tournament or golf course specific

equipment standards. Thus, shorter distances achievable in relation to the length of the golf course (Kerr-Dineen, 2021); (USGA, 2021). However, the proposals which have been brought forward are not of a blanket nature towards the rules of golf, rather, a new avenue of regulation rules. The debate surrounding the rolling back of the golf ball began as far back as the 1930's and was re-established in 1991 by one of the greats of the game, Jack Nicklaus (Rapaport, 2019). Therefore, reinforcing the importance and subsequent impact the perpetual increase in the technology comprising the golf ball has to the very nature of the game. This notion carries a popular sentiment among professional golfers on the PGA Tour whereby 62% of players agree with the creation of a new avenue within the rules which allows for a professional golf ball rollback (Golf Wire, 2017).

In a statement made by Tiger Woods (*Tiger Woods is a professional golfer on the PGA Tour and renowned golf course designer who is considered to be the greatest golfer of the modern age and second of all time*), it was suggested that the distance problem has been in circulation for a period of 20 years. However, the solution phase should have presented itself at a much earlier stage (Rapaport, 2022). Secondly, consequentially, with the perpetually increasing length achievable, golf courses, some iconic, are having to undergo monumental renovations. This resultant consequence creates a ripple effect throughout the entire golfing community from professional golfers to the beginner golfer. The focus of the game thus shifts from skill and shot making, to power and length of which many amateur golfers, as well as professional golfers do not have (USGA, 2020). Over the course of 100 years the length of golf courses and the distance achieved by golf balls have dramatically increased, and encourage a concerning outcome (USGA, nd). Given modern societal pressures, the golf industry has identified the need to adapt to concerns such as environmental impact as well as natural resource scarcity. The pressure which actively builds towards the scarcity of natural resources is outlined by the United Nations whereby it is projected that by 2030, the world's water supply would be 40% lower than the projected water demand (USGA, 2020). This places perpetual pressure on golf courses in limiting and decreasing the amount of water which is currently being used. Furthermore, to decrease the amount of chemicals such as nutrients, herbicides, pesticides and fungicides in alignment with the environmental pressures (USGA, 2020).

Land use becomes problematic given that population size is on an accelerated trajectory, the value of land has thus experienced an increase through the process of urbanization (USGA, 2020). Property developers therefore see greater value in the potential of the land-use for further development, thus adding pressure on golf courses. In some cases, a resultant closure of golf courses occurs (USGA, 2020). Furthermore, wildlife and habitat protection create added pressure against the lengthening of golf courses.

The use of energy increasingly becomes an issue with regards to the increase in the fleet of maintenance vehicles and the quantity of fossil fuels being emitted. The cost which is associated in the lengthening as well as the renovation of golf courses have the potential to reach an exponential quantum, exceeding hundreds of thousands of dollars. Excluding the prospect of acquiring new property. According to State of the Industry Report (2016), in the span of one year from 2015 to 2016, the total average costs dedicated to golf course maintenance increased by \$53 000, increasing from \$697 000 to \$750 000. Golf courses in 2020 worked on a budget of approximately R7 500 000 per annum whereas exclusive golf courses worked an approximate budget of around R15 000 000 per annum. It is noted that 50-60 percent of the cost to play golf is determined by the labour-intensive maintenance of the golf courses (Sullivan, 2020). As more staff would be required with an increase in length in golf courses, recreational golf would experience an impactful consequence of less foot traffic through the golf course as the price to play would increase. In addition to this, the lengthening of golf courses comes with major concerns which carry significant societal burden. However, it is noted by the USGA (2020) that the new reality of lengthening golf courses presents itself as one of many aspects which have an influential impact on the economic as well as the environmental challenges that are perpetually mounting. Tiger Woods further proposed the notion of an unsustainable solution in increasing the length of golf courses as it was stated that “there is only going to be a small amount of property that we can do” (Rapaport, 2022).

Thus, the lengthening of golf courses carries great significance towards this as, *ceteris paribus*, the longer the golf course is, the greater the costs which are involved. This is true as increased and perpetuated maintenance requirements entail an increased capital expenditure in addition to the capital requirements for the acquisition of new land as well as recourse requirements (USGA, 2020). The lengthening of golf courses can be observed from the following statistic which puts the length increase of golf courses into perspective as seen from Golf History Today, (nd). The iconic Augusta National golf course, in the year 2000 had a total yardage of 6 985, whereas as of the year 2010, the yardage had increased to 7 435. South Africa has also been affected by an increase in the length of golf courses. The Gary Player Country Club was 7 163 yards in length in 1979 and it has been lengthened to 7 831 yards, boasting 8000 yards from the extreme championship teeing grounds (Golf History Today, nd); (Golf Pass, 2022). The USGA governing body noted that 11 golf courses have been lengthened from 2018 to 2020. Thus, causing in an increase in range from 100-600 yards per course. As a result, a number of golf courses will have a total length of above 7 500 yards (USGA, 2020). Newly constructed golf courses have followed the perpetual increase in length. However, as aforementioned, many golf courses have had to increase their length in order to retain the element of skills-based golf following aspects of risk versus reward as well as shot

value (Dusek, 2020). The importance of maintaining distances of golf courses is premised on obsolescence whereby golf courses which are considered to be short in length, face the threat of power dominating the essence of the golf in ignoring aspects such as shot making ability, value of the shots hit as well as risk versus reward (Dusek, 2020). In respect of the proposed solution offered by Tiger Woods, the drastic changes made to not only the adjustments in the length of golf courses, but to the proposed and forecasted impact the Distance Insights Project will have on manufacturing, research, design and application, could be mitigated. An industry-wide “roll-back” could be avoided through an adjustment to the spin specifications of the golf ball (less spin for long-game facets) which have contributed to the immense increase on the distance which the golf ball is able to travel through the air as well as on the fairway once grounded.

Rapaport (2022) notes an additional observation suggested from Tiger Woods in offering a solution to the distance problem. The suggestion made proposed increasing the spin rate of the golf balls instead of reducing it. The impact of this adjustment will result in a golf ball which spins at a higher rate of revolutions, reducing the distance achievable. Chamblee (2021) further insinuates this as a possible solution into the distance problem in golf in order to shift the focus away from distance and the effects associated.

On the PGA Tour in 2020 the average driving distance increased by 15%, and the average score recorded over the past forty years has decreased by 2.7%, or the equivalent of 2.03 shots. This demonstrates that there has been a sizable increase in the length achievable, however, their efficiency and overall performance as professional golfers has only increased marginally (Chamblee, 2021). A noticeable improvement is demonstrated in the ability of playing out of thick rough whereby over a forty-year time span, 12% more greens are hit as a result of having the opportunity of using a shorter iron. Therefore, attributed to the distance achievable as golfers are able to cut through the long grass with greater ease (Chamblee, 2021). A point noted by Chamblee (2021), when players are held accountable for missing fairways due to heavy, thick rough or a relatively tight angle into the green from the approach shot, the resultant scores are similar to those which were recorded long before the distance debate was as influential as it is in the 21<sup>st</sup> century.

The distance insights report suggests for a rollback of the golf ball resulting in a 6-12-yard reduction in distance achievable. However, Chamblee (2021) suggested for a heightening of the green elevation as well as a lengthening of the rough height. This imposition into the layout of golf courses would not only reintroduce strategy and positioning in golf, but also create a solution and remedy to the insights of which the distance insights report proposes (Chamblee, 2021).

An interesting observation is noticed in the solution offered by Chamblee (2021) with regards to the third annual Major Championship, the United States Open Championship (U.S Open).

Traditionally, the U.S Open has been regarded as the most difficult Major Championship of every year. Power and Coffin (2022) note that a typical U.S Open course layout boasts characteristics which encourage very difficult scoring conditions such as playing the longest setup of the golf course, narrow fairways, firm greens and thick rough. This translates to an average score of even par for the tournament, whereas the average winning score on the PGA Tour outside of the U.S Open sits at around 16.56 under par, as determined from the 2017/18 PGA Tour season and 17.2 under par for the 2020/21 PGA Tour season (Feinstein, 2018); (PGA Tour, 2022). This therefore raises an interesting argument of course layout mentioned by the Distance Insights Project, and which reinforces the aforementioned; is a “rollback” entirely necessary to the extent that the Distance Insights Report is suggesting? In increasing degree of difficulty with regards to the layout of golf courses and creating course conditions which are not as conducive to low scoring opportunities, the advantage of distance off the tee of taken away and replaced with the perpetually insignificant core foundational concepts of shot creating, risk vs. reward and shot value.

It is important to note that the governing bodies are applying the argument to recreational golf as well as professional level golf. However, a sole application to golf on a competitive and professional level and exclusion of the “weekend” golfer is required. To grow the game further, creating a disheartening experience on the golf course caused by the difficulty in which the golf course is playing will only discourage growth in the game. Therefore, creating difficult course conditions, similar to the U.S Open will encourage a mitigation of the distance advantage. In addition, with an amendment to spin characteristics of the golf ball through an increased spin rate, the distance the golf ball can travel through the air would be subtly altered. Thus, resulting in a slight decrease of distance, as well as elicit an increase in difficulty as the greater spin rate would create a greater degree of dispersion of the golf ball. This regulation could be applied industry-wide as on a professional level, coupled with a difficult course layout, distance achievable would be reduced and the degree of difficulty would be restored. Therefore, mitigating the obsolescence factor currently plaguing championship golf courses. On an amateur “weekend” golfer level, the same characteristics would present themselves in terms of flight characteristics of the golf ball, however, to an exaggerated degree. Therefore, not only, subtly decreasing distance but placing equal significance on all variables of the game.

Nevertheless, an updated statement of the Distance Insights Project was released on the March 16, 2022. Outlining the revisited areas of interest (AoI) which were established in the 2021 release of the Distance Insights Report as previously mentioned. Additionally, as of the 1<sup>st</sup> January 2022, a model local rule with regards to the maximum length of golf clubs was addressed and implemented by the USGA and R&A which restricted the length of golf clubs to a maximum length as

to not exceed 46 inches. Therefore, the AoI's mentioned in the latest release were focused on the potential changes to the testing methods of golf balls as well as golf club performance characteristics (USGA, 2022). According to the USGA (2022), in testing for the conformance of the golf ball to that of the overall distance standard (ODS), the Distance Insights Project is launching an investigation into the replacement of testing of the golf ball using ALC (actual launch conditions) with that of OLC (optimum launch conditions). Therefore, adjusting the launch angle as well as spin rate within reason. An exploration into the increase of clubhead speed used in the testing of golf balls from 120mph to 125mph is ongoing, reflecting the clubhead speeds of the top 10 longest hitters on the PGA Tour for the 2020/21 season.

As per the Distance Insights Report 2021 release, technology orientated characteristics in golf clubs are further under scrutiny. The USGA (2022) note that the pendulum test, which tests the spring like effects of golf clubs (specifically drivers) is currently at a tolerance of 18 microseconds. However, it was discovered that the actual tolerance for this test was found at 6 microseconds, prompting an investigation into the reduction of the current tolerance for the pendulum test. Additionally, the USGA (2022) are investigating a proposed amendment to the moment of inertia (MOI- *a physics term which determines how much resistance a golf club has to twisting, a greater MOI translates to greater forgiveness*) limit in drivers. The amendment in question is considering adopting a model local rule for competitive, professional golf and removing an MOI limit for recreational golf. The introduction of such ruling would be a welcome addition to recreational golf as more forgiveness within drivers would allow players to hit the golf ball straighter, resulting in lower scoring which could attract greater growth in the game and make the game easier for the "weekend" golfer. Implementing a model local rule for competitive, professional golf would require players to make more precise movements through the golf swing in avoiding off-centred striking of the ball, therefore, eliciting a decrease in distance as well as dispersion of the golf ball.

However, as per the USGA (2022), there have been no decisions finalised regarding the AoI's. A further release of the Distance Insights Report is scheduled for a release date in the latter part of 2022, of which decisions will be made and proposals implemented regarding the AoI's in question.

CHAPTER 3  
LITERATURE REVIEW

3.1. THE INVALUABLE RELATIONSHIP BETWEEN TECHNOLOGY AND SPORT

In the 21<sup>st</sup> century era of sport it is evidently clear that there are more people playing sport on a global scale than ever before. This new and highly expansive increase in the interest surrounding sport is attributed to the exponential increase in worldwide coverage of sport in all forms of media platforms. Thus, the exposure and heightened interest towards sport naturally increases. So much so, that it is noted by Fuss, Subic, Ujihashi (2007) that global sport as a business has reached a net worth of \$600 billion. Branching off, one can see the different aspects of sporting retail such as apparel, shoes, and equipment, as well as all the different kinds of sporting accessories which are unique to every sport. Fuss, Subic, Ujihashi (2007) point out that the marriage of sport and that of equipment cannot be separated. Wide varieties of knowledge bases and platforms have allowed the evolution of sport, unique to each sporting code. This shapes how sport is conducted in today's modern era where sport as a whole has become not only more enjoyable for an increased interest group of the global population, it has become safer as well. Technology in sport has allowed for the increase in performance through the integrated knowledge disciplines which in turn, create innovating ways to increase the performance of an athlete through new technology advances (Fuss, Subic, Ujihashi, 2007). This has created a noticeable focus on regulating bodies within existing competitive sporting codes as the impact of technology exhibited through the increase of athlete performance, requires regulation as to mitigate the advantages of technology in sport replacing the fundamental basis of difficulty. Furthermore, aspects which are routed in political and economic interest of sport are taken into consideration in promoting the continuation of related traditions unique to sporting codes as well as vested economic interests in capital of sport.

The aim of which is to ensure that a degree of over-performance is limited to encourage the competitive continuity of healthy competition and capital accumulation in sport (Fuss, Subic, Ujihashi, 2007). According to Ross (2010), global sport has experienced two revolutions which have changed the way it is conducted. Additionally, altered the complexities associated throughout sporting codes. First, the incorporation of widespread support of professional sport whereby large crowds of patrons would gather into stadiums and experience a first-hand experience of sport at a professional level. Secondly, technological capabilities of the 21<sup>st</sup> century advocated for an advancement in sport for all aspects through the improvement of globalisation and performance capabilities in professional sport (Ross, 2010). The aspect of technology in sport has altered

training methods and regimes as well as the competition itself through providing a platform which encourages efficiency growth in sport and supports an optimal environment for profit maximisation through human capital accumulation.

Technology in sport was explored by Omoregie (2016) in identifying five categories. The first category is self-technologies. This category is premised on actions which athletes take to artificially allow for an improvement in performance in addition to the artificial construction of limbs and body parts which allow athletes the opportunity to take part in different sports. Through the sophisticated design and construction capabilities seen utilising new, innovative technological apparatus, remarkable devices can be conceptualized and constructed, taking into account highly unique specifications found for each prosthetic device which is produced (Baragaru, Dekker, Geertzen, 2012). In connection to golf, prosthetic devices according to Burkett et al. (2011) are found with the use of upper and lower limb prostheses. The golf swing being a highly complicated, dynamic movement demands great flexibility when performing the movement. Therefore, amputees and those with lower limb disabilities may experience difficulty, attributed to limited flexibility. Thus, a device known as a torsion adapter is utilised which encourages a greater range of hip motion in the swing allowing for a more complete, efficient golf swing. The upper limb prosthetic device attaches to the golfer thus allowing for a golf swing to be performed. However, with a consequential loss in speed and power through the golf ball. Nevertheless, a golf swing can be performed (Burkett et al, 2011).

Performance enhancement in competitive sport is a controversial topic as the usage of such substances is highly regulated and continuously monitored by the World Anti-doping Agency (WADA) to prevent any unwarranted advantage which may occur among athletes. Albeit promoting intellectual capabilities used in training and competition in fair performance and efficiency enhancement (Omoregie, 2016). Outram (2013) suggests the aforementioned reside on separate ends of a spectrum. One end of the spectrum represents performance enhancement as a threat to sport. Opposed to performance enhancement as a natural part of competitive sport (Outram, 2013). Performance enhancement was determined as a violation to the spirit and nature of sport itself which goes against the collective consciousness around sporting values and norms. However, in the modern age, increasing sporting efficiency, movement capabilities, endurance and performance is invaluable to competition. Athletes can realize greater achievement from modern training regimes and equipment which previously was not available, made possible through the advanced capabilities of technology. For Outram (2013), performance enhancement promotes healthy and necessary competition in encapsulating the spirit of competitive sport.

The modern game of golf has changed in the manner of what is capable as professional golfers and amateur golfers are able to hit the ball further than ever before. Bearley et al. (2019) refers to the term “Golf Fitness”, with a new focus on a healthy lifestyle and strength within the game. Performance enhancement is applied with the implementation of such regimes, aiming to improve endurance, strength, mobility as well as fitness. This promotes an increase in athleticism which in turn, impacts the ability to transfer the new athletic traits into the golf swing. The benefits are noticed in tournament fitness and the distance the golf ball travels. This notion, reinforced by literature which revolutionised the understanding of golf authored by Mark Broadie “Every Shot Counts”, states that the stroke average of a golfer decreases (*an increase in strokes gained*) by three strokes per four-day tournament with the increase of 20-yard in driving distance (Bearley et al, 2019). Performance enhancement further expands the training ability of professional golfers through preventative injury measures, which support the increase in performance and ability (Bearley et al, 2019).

Landscape technologies refers to the globalisation of sport through the exponential growth in its popularity. The subsequent sporting population has thus followed suit. Statista (2020) noted this growth, as well as the market size of global sport. From 2011 to 2018, the global market size of sport experienced an increase of \$147 billion. This market size is expected to grow by an additional \$146,47 billion at a compounded annual grow rate of 41.3%, which will place the net total at \$501,43 billion for 2022 (Cision, 2022). The globalisation of sport has introduced methods of broadcast such as big screen monitors in sports complexes as well as fly-over cameras conveying unique point of view action-shots from the perspective of the athletes. This creates an integrative perspective of what the athlete experiences in real time which adds great value to the entertainment factor of modern sport and a great contributor to the increase in interest towards sport worldwide.

Omoregie (2016) refers to equipment used in sport as implement technologies. According to Ross (2010), performance-spec equipment is greatly influential to the performance of the athlete. With the advent of the Distance Insights Project, the golf ball as well as golf clubs (*irons and woods*) have the potential to become throttled in terms of their technological potential by the overall distance standards (ODS), as distance in golf has become a threat to the sustainability of golf (Ross, 2010). The performance measure of putting has been less transformative with regards to technology implementation in comparison to the golf equipment aforementioned. Hence, the investigation into a change of trend for the determinants of earnings study. Silverman (2014) noted a design advancement within putting occurred as a highly impactful technology of putter weight balance emerged within the modern era of the game allowing for an increase in forgiveness and efficiency of the putting stroke.

Omoregie (2016) introduced rehabilitative technologies which comprise substances or procedures used in the rehabilitation of athletes recovering from injury or in aiding training regimes. The subsequent treatment processes thus provide the necessary modifying and monitoring process towards recovery of an athlete. These processes include techniques such as bracing and electrotherapy, manual therapy, targeted massage therapy as well as strategic taping of an athlete in combating complications such as chronic pain, back pain, post-operative rehabilitation as well as repetitive strain injuries (BASRaT, 2020). Movement technologies analyse efficiency of an athlete's body in performing a given sport, generating knowledge which is used in the correction of athletic movements and the maintenance of peak performance. This is done through focusing on the mechanics of the movement, aesthetics of the movement as well as the optimal efficiency load of performing the movement. Therefore, providing a holistic manner towards the improvement of efficiency of an athlete (Omoregie, 2016). The Barcelona football club innovation hub (FCBIH) note that real-time information of the players is accredited to highly sophisticated monitoring devices which provide crucial data. The device records the players position on the field, heart rate as well as speed which is further analysed to identify trends and possible outcomes for each player with the aim of improvement and increased efficiency (FCBIH, 2020).

Common movement technologies include video systems based on multiple semi-automatic cameras (VID), local positioning systems based on radar technology (LPS) as well as global positioning systems (GPS). The market size for movement technology in this regard was projected to grow at a rapid pace. In 2018, a valuation of \$280 million was determined with future expectations to reach \$2.05 billion by 2024. The projected growth of the market for movement technologies was reinforced by Fuentes (2019) of the Guardian in recognising the top three categories for technology investment. These categories were media and content-based platforms, measurement platforms for data analytics and biometrics. Thus, introducing database technology (Omoregie, 2016). Database technology constructs a virtual platform, expressing movements and fitness analytics through the collection of data (Fuentes, 2019). The use of such technology has presented a transformational change to how athletes conduct and approach training and performance, adopting a manner which had previously not been available (Fuentes, 2019).

For professional golf and most professional sport, the training process and technology cannot be separated due to the reliance which players and coaches alike have on the capabilities of technology. Technology has given the training process a new perspective due to the now customizable fit in individualising specific needs and abilities of athletes. According to Liebermann, Katz, Hughes, Bartlett, McClements and Franks (2002), when feedback is provided to athletes, an improvement in motor skills is realised. Therefore, the utilisation of such information technology processes

involved in the training promotes a better comprehension of feedback provided. Processes are thus enhanced and adjusted to individualistic specifications which demonstrates great versatility (Liebermann et al, 2002). Information technology is therefore seen as an invaluable tool in modern sport.

Golf is a sport which relies greatly on such technologies in the quest for improvement. Video playback information was noted to be one of the most important and useful technological feedback mechanisms. According to Taylor (2017), when considering different methods of knowledge acquisition and mechanisms of learning, a study conducted demonstrated that a total of 65% of individuals prefer methods of visual stimuli learning opposed to learning through listening. Broker & Crawley (2001) looked at the state of advanced technology and the relationship between Olympic performance and the utilisation of such technology. Video-Overlay Feedback is one of such tools which are used whereby microsensors, accelerometers and cameras can capture variables which are exerted by athletes. The compiled data is then combined with the video feedback, creating a video-overlay, generating a simulation that the athlete and coach can review and analyse towards improving efficiency of movements (Broker & Crawley, 2001). On the field or within the sporting arena, athletes are responsible for identifying and correcting errors and incorrect movements they make through experience acquired knowledge and basic knowledge. Video feedback allows players to accurately identify errors or aspects of their performance in need of improvement (Liebermann et al, 2002). Therefore, the learning capabilities are greater in providing a technology-based understanding of movements through learning from video feedback rather than merely listening to verbal, observed instruction (Taylor, 2017).

Video technology empirically originates from the 1950's, however, the use of such technology in sport and training methods is relatively modern aged (Liebermann et al, 2002). The attractiveness of video feedback is premised on its accessibility as well as its mobility. Mobility allows for interaction with content through compatible platforms. Accessibility is premised on utilising equipment which allows for the engagement of such content, having the capability of compatibility to any piece of common technology equipment (Liebermann et al, 2002). Golf is inherently technical as the movements required in piecing together a golf swing are uniquely dynamic. Golf coaches can video record player's unique movements using accessible handheld devices such as a cellular phone or video camera. Coaches are then able to manipulate video content using specifically tailored software with the aim of analysing any possible flaws which are noticed. Using the analysed video playback, players and coaches are able to learn from the exhibited movements which the video is able to capture. The feedback recorded is stored and made available for future use to continually

offer point of reference to further improve a player's swing along the course of their career as well as for a comparative point of reference (Liebermann et al, 2002).

Information technology and the utilisation thereof, has allowed for major advances in how athletes and coaches view training and the complicated dynamics involved. Video feedback sets the tone for what technology in sport is capable of, setting the stage for new, innovative methods of training. According to Farley, Spencer, Baudinet (2019), the use of data recording and athlete performance tracking is an essential tool to have in the competitive arena of modern sport and is invaluable with regards to edging out competitors. In the Olympic setting, data analysis has proven invaluable due to turnover time in its breakdown and analysis. Examples of this are observed with rowing as well as cycling whereby data tracking techniques which are utilized provide real-time, immediate feedback (Broker & Crawley, 2001). Immediate feedback utilizes data acquisition systems (DAS), eliciting real-time feedback to the coaching staff where simultaneous multi-athlete data is gathered and immediate corrections can be directed to achieve a more efficient movement (Broker & Crawley, 2001). Another aspect of innovative information technology which has altered the dynamic of modern sports training is virtual reality. Liebermann et al. (2002) demonstrate that virtual reality environments which emulate realistic settings of which athletes find themselves have great benefit. A platform to manipulate different variables and aspects within a simulation allow the athlete the opportunity to adapt and become familiar to different situations on command. Therefore, through manipulation of variables effecting perception such as speed, direction and movement dynamics, athletes can significantly improve their skill sets and apply them to situations found in the reality of competitive sport. In addition, the very nature of virtual reality training being repeatable simulation and highly adaptive, allows athletes to practice mental repetition and therefore increase efficiency and performance (Farley et al, 2019). Performance data which technology tools such as virtual reality simulation produce, allow coaches themselves to identify specific areas within the dynamics and complications of movement. Therefore, generating a blueprint towards improvement for each unique athlete (Farley et al, 2019). However, Farley et al. (2019) indeed point out that for such technologically inclined instruments to become effective in its use, the features and results experienced should elicit an accurate, realistic-feeling and outcome. This is invaluable for mental repetition as the sense of reality portrayed using a virtual setting, allows for the quality of training to improve. Dickson (2016), demonstrates the invaluable impact that virtual reality training techniques have on teams as well as individual athletes. Particularly so, as virtual reality training material can be gathered from an individual point of view. Therefore, providing athletes with a naturalistic, repetitive training method through eliciting a visualized, feeling-based technique for real-time competition. Mental repetition is reinforced by Farley et al. (2019)

as this training method allows for accurate, repetitive simulations, subject to controllable variables which are adjusted in allowing for a wide range of training and situational reinforcement.

### 3.2. THE SCOPE OF GOLF IN THE 21<sup>ST</sup> CENTURY

Sport in the 21<sup>st</sup> century has presented itself in an unprecedented manner to the extent of what technological advancement and adaptation has been applied to sport. The result of this is noticed in a tremendous expansion in the capabilities of not only the technological processes, systems and operations involved with nutrition and training, but athletes themselves. The aspect of competition and what is now possible has created a proverbial curtain which has been drawn back, revealing modern thinking around improving competitiveness among athletes, but also what sport means in the 21<sup>st</sup> century. Golf, therefore, has undergone tremendous change in the way that athletes as well as coaches conduct conditioning and preparing in following the distance trend which has been placed under a microscope in the modern form of the game.

EconoTimes (2020) mentions that during the past decade, sport has undergone extensive change regarding acquisition and analysis of data thus contributing immensely towards growth and development of a new, technically inclined approach. Promoting a data driven platform for players to increase their efficiency. Stanley (2018) noted that the National Golf Foundation underwent an investigation focusing on the various innovative ways in which golfers utilise such technology. According to Stanley (2018), there are numerous devices and software application developments utilising data tracking, aimed at improving proficiency in the game by focusing on the technicalities of the golf swing. Stanley (2018) noted live GPS tracking for accurate play and practise, along with data tracking for equipment. in terms of unique specifications and methods used to improve proficiency through adjustments in equipment specifications. Stanley (2018) shows examples of technologies used within the game of golf which provide players with revolutionary data analysis, encouraging increased efficiency in the golf swing, greater distance, accuracy, and control of the golf ball.

Launch monitors are utilised by professional golfers and equipment fitting centres which provide feedback regarding specificities of the golf swing. Characteristics such as speed of both the swing and golf ball are measured. Furthermore, angles and path of the golf club which influence the flight, trajectory, and distance of the golf ball are also measured. The product of the characteristics aforementioned, generate a simulated real-time, data driven representation. Therefore, providing players and instructors with accurate visual feedback. Tremlett (2021) notes that the most widely

used launch monitors are the Trackman, Foresight GCQuad as well as the Skytrak. According to Trackman (2019) any radar technology used in the analysis of the golf swing is an integral part of modern golf instruction and provides the most accurate formula to play golf successfully. Launch monitors offer exceptional real-time feedback in determining the reaction of the golf ball in alignment with the golf swing in presenting visual feedback data pertaining to intricate details of the golf swing. In creating visual feedback of the golf swing itself, an artificial, virtual reality environment is created and utilised.

According to Kimpan, Rientrakulchai and Tangwongcharoen (2013), artificially generated visual feedback utilises motion sensors that are physically attached to players, artificially constructing a virtual representation of the golf swing itself. Specifically focusing on acceleration and rotation through the golf swing. This virtual representation of the golf swing is an important asset in creating a more efficient golf swing. The precision of the data recorded reflects accurate feedback information. Players can identify fundamental faults which may occur in the golf swing which are either missed in real-time or unidentifiable without the use of this method. Ghasemzadeh, Loseu, Guenterberg and Jafari (2009) furthermore demonstrated how technology involved in swing analysis proves to be invaluable in studying the movement of the human body through performing a golf swing. It was identified that microelectronics as well as wireless capabilities have experienced great adaptation, allowing swing motion sensory devices to become more advanced. It was further demonstrated that when analysing the golf swing, with reference to both Kelly, Healy, Moran and O'Connor (2010) as well as Ghasemzadeh et al. (2009), a body sensor network is used to track the path of the golf swing and create a three-dimensional visualisation in accurately analysing all aspects of the golf swing.

Through the utilisation of immersive three-dimensional coaching, an artificial visualisation environment allows for golfers to identify aspects in their game which hinder performance. Thus, corrections regarding their stroke mechanics are undertaken through the post analysis process. Therefore, the implicit movement of performing a golf swing is then verbally translated and demonstrated through explicit instruction (Kelly et al, 2010). The three-dimensional virtual environment is captured using anatomical landmarks, strategically placed on the body as well as on the golf club itself. Thereafter, using an infra-red motion capturing technology, the data which is recorded generates a virtual avatar providing a data driven virtual environment for analysis to take place. This tool is an invaluable asset to golf coaches and professional athletes. Kelly et al. (2010) demonstrate that unique golf swings can be compared for analysis purposes using a technically sound swing whereby visual feedback allows players to learn and become cognitive of their movements.

As previously mentioned, technology has fundamentally changed the way professional athletes and trainers shape their training regimes, given that technology has drastically improved the intricacies involved with training by introducing modern, precise methods of training. Technology has transformed the game. To promote and yield optimal performance in professional golf, an effective analysis is required in understanding the dynamics of movements which are associated with establishing a successful, efficient golf swing (Ghasemzadeh, et al, 2009). Farrally, Cochran, Crews, Hurdzan, Price, Snow and Thomas (2003) demonstrate the difference found in verbal and video feedback as the findings depict video feedback as superior to verbal feedback based on distance and accuracy tests. This was inherently evident as vision is the primary sensor for conducting sport. Therefore, vision has a direct effect on golfers and performance increase (Farrally et al, 2003).

Technology has provided the platform to create numerous innovative training methods and devices in promoting optimal performance to the golf swing. According to Hennessey (2019), Golf Digest conducted a review of training methods which support modern capabilities to golf coaching. The first of these methods is a mechanical swing generator, allowing players to grasp the movements and feelings of a technically correct golf swing (Hennessey, 2019). This device allows players to build a sense of muscle memory when performing the swing as well as promote visual feedback through the course of motion of a technically correct golf swing (Hennessey, 2019). Fundamentals which are observed and cognitively absorbed, aid golfers in improving the efficiency of the golf swing through the understanding provided by feedback towards correcting aspects of the golf swing which have fundamental imperfections and inconsistencies (Ghasemzadeh et al, 2009).

One of the most important aspects of the golf swing is weight transfer and cognisance of correct downward pressure exertion when performing the golf swing. A device is utilised which measures the downward pressure being exerted when performing the golf swing throughout the entirety of the swing through motion-analysis. Pressure mats are placed underneath a player and measure the transfer of weight and shift in pressure with the objective of creating the correct pressure ratios at each point of the swing. Allowing for a more efficient golf swing which yields greater distance when performing a golf shot as well as increased control of accuracy as the biofeedback promotes the improvement of balance (Hennessey, 2019).

Technical feedback in putting is an area in the game of golf which has, in recent time, experienced tremendous advancement in the utilisation of technology. Hennessey (2019) focused on two devices which allow for players to perform putting training with technology-orientated aid and guidance. The first of these is a device which attaches to the players putter and conducts real-time

analysis of the putting stroke being performed. Therefore, encouraging adjustment through visual feedback in correcting the rhythm of the putting stroke being performed (Hennessey, 2019). As mentioned, simulation technology in the game of golf has had an undeniable impact on technical adjustments in the golf swing in having the ability to construct controlled situational occurrences of which athletes might find themselves in during competition. A relatively new simulation tool which was recently developed provides the same capacity in controlling situational variables found in competition however, on a putting green (Hennessey, 2019). The artificial representation of a green has the capability of adjusting the slope factor in putting, allowing players the ability to simulate putts on a variety of undulation severities with the aid of a projected line to follow. Therefore, allowing visual feedback to occur as the slope severity dictates the line and the speed taken to the hole. For professional golfers, this training aid provides simulations of different conditions unique to golf courses around the world. Thus, players are able to tailor their training needs to tournaments which are upcoming and develop a cognisance of what to expect during competition. This technology promotes cognitive training in practising to follow a determined line to the hole and thus reinforcing the mental ability of putting to trust the established line to the hole.

A noteworthy application in golf technology is global positioning systems (GPS), which have contributed aid to the game. GPS based applications contribute towards the improvement of golfers as they provide real-time distances on the golf course through a mobile application. A buffer between how professional golfers play the game to how amateurs play is created in providing a platform to practise course management. Considering differences in elevations and distances to hazards on the golf course. Course management encourages golfers to use distance correctly given the differences found in golf course layouts, grasses used as well as altitude of the golf course in respect of the distance the golf ball travels in different altitude levels.

Tremendous advancement in the state of the modern golfing industry is noticed beyond the aforementioned. Equipment used in the game of golf has been on an evolutionary path towards creating opportunity for new capabilities. Coupled with the efficiency increases of the golf swing, a positive relationship is encouraged with the stroke average of professional golfers.

The first iteration of the golf club was created using a basic design, given the limitations of technology during the period. The evolution of golf club's date back to the manufacturing of crafted wooden designs with lead inserts at the back of the golf club to allow for increased weight and stability through moment of impact in the swing. The rise in the industrial revolution saw mass production of golf irons in following a uniform design through the process of "drop forging". A reduction in weight of the golf club generated greater distance of the golf ball through increased

swing speed as well as the ability to manipulate the golf ball's flight and shape (Jorgensen, 2006). Following this, grooves were carved onto the club face creating greater distance and control of the flight of the golf ball in producing higher revolutions of spin off the club face. A steel shaft was subsequently introduced to golf clubs which created more consistency in the performance, design, and manufacturing process (Jorgensen, 2006). An increasing nature of regulation in golf equipment presented itself, noting the intention of creating design uniformity among different manufacturers. Giving rise to the USGA regulations which govern the game of golf and the rules associated thereto. In addition, regulate the manner and specifications in which golf equipment is constructed. Naturally, the regulations imposed thereto, like golf equipment, evolve with the technological processes and capabilities available to ensure fairness and the sustainability of competitiveness (R&A, USGA, 2019).

The last two decades have proven greatly influential towards golf club design whereby innovative technology introductions have now created a technology-dependent game (Jorgensen, 2006). It is noted by Jorgensen (2006) that the two most influential design alterations to the golf club and the putter were perimeter weighting. Promoting a more balanced club face through impact, thus improving control of ball flight. In addition to perimeter weighting, oversize clubhead design was implemented which in turn increased the size of the "sweet spot" of the golf club, therefore aiding forgiveness of golf clubs.

Wallace, Kieran, Strangwood and Kenny (2008) suggest that an increase in distance ability is influenced by the use of high coefficient of restitution (CoR) drivers along with the introduction of the solid core Titleist Pro V1 and Pro V1x golf balls. The period of 1993 to 2000 saw a drastic increase in distance capabilities through using materials such as titanium-based alloy, hollow oversize heads in drivers, as well as forged metastable  $\beta$ -Ti alloys. These materials were used alongside new, dynamic designs of the golf club itself and resulted in a steadfast approach towards the R&A, USGA coefficient of restitution regulation limit. Therefore, the period of 2003 to 2007 the driving distance rate of increase suffered a significant decline as the technology input regulations were throttled (Wallace et al, 2008).

Heiny (2008) noted a drastic increase in driving distance during the period of 2001 and 2003, whereby the average driving distance yardage increased by six yards and seven yards respectively on the PGA Tour. The increase in overall distance was mainly attributed to the technology strides taken in golf equipment (Heiny, 2008). Furthermore, as the standard of player was becoming younger and stronger, their heightened physical and fitness capabilities were contributing to their performance. A study which identified technological breakthroughs in sport was applied to golf in

determining the influence in which technology has presented to efficiency (Heiny, 2008). For the study, the performance indicator was calculated for the period of 1992 through to 2003 and the results concluded great significance. For 2001, a 457% increase was observed over the average calculated from 1992 through to 2000 (Heiny, 2008). In 2003, a 380% increase was observed over the average, calculated through the periods of 1992 to 2002. The concluded results from the study deduce a significant technological influence in which the average driving distance on the PGA Tour experienced an increase of more than 25 yards. This, in conjunction with heightened physical and mechanical aspects involved. Modern golf club design utilises the most advanced technology available as to challenge the limits of modern engineering (Jorgensen, 2006). However, R&A, USGA regulation stipulate specificities of the manufacturing process in terms of the methods employed as well as the materials used. Such methods and processes need to follow a compliance standard and as such, new technology and materials have the potential to drastically revolutionise how golf is played (R&A, USGA, 2019). Diminishing returns is potentially realised as the R&A, USGA regulations dictate a threshold.

Golf ball technology, much like golf club technology, has altered the way in which the game is played as a new standard of capabilities in terms of distance achievable and control of the golf ball have been realised. The Titleist Pro V1 and Pro V1x revolutionized the distance factor of the game of golf itself, thus for the 21<sup>st</sup> century, an important example to grasp. The golf ball comprises a core, known as the engine of the golf ball, the cover of the golf ball as well as the dimple pattern of the golf ball. All three aspects are unique to every golf ball manufacturer. According to Complete Golfer (2021), the Titleist golf ball has been the most popular choice for professional golfers. The Titleist golf ball was seen as a revolutionary subject to golf equipment, allowing for an adjustment in how the game is played and therefore has since been the golf ball of choice for most professional golfers worldwide. Looking at a statistic published in Complete Golfer (2021), for every 100 professional golfers internationally, 69 players use Titleist golf balls. However, there is a wide pool of golf equipment manufactures with highly competitive products in the modern game. Modern golf balls are designed and produced in a very similar manner in terms of materials used as well as design technology, encouraging competitiveness in the market for golf balls. The different golf balls which are used by professional golfers internationally, apart from Titleist, include Taylor-Made, Srixon, Callaway as well as Bridgestone.

The most crucial factor that highlights the crux of the modern game is that golf balls are travelling further than ever, placing a great emphasis on the importance and change in trend towards distance in golf. A further divulgence into the Titleist Pro V1 demonstrates the success in the retainment of its tenure of being one of the most played golf balls among international professional golfers,

alongside its counterpart, the Pro V1x. An insight into the Titleist golf ball provides an understanding into how the make-up of the golf ball itself can contribute to greater distance as well as control achievable in the modern game. Thus, demonstrating a great influence into the aerodynamic performance as well as the playing performance of professional golfers.

The Titleist Pro V1 core is constructed using polybutadiene which an essential element of the core as it yields a high level of energy return (Lost Golf Balls, n.d). This coupled with 2.0 ZG Process Core Technology which in alignment with the characteristics of the Titleist Pro V1, promotes a tremendous amount of ball speed off the club face. Furthermore, a decreased rate of spin is produced for the long game, therefore greater distance is achieved (Titleist, 2020; Trusky, 2019; Lost Golf Balls, n.d). The core of the Titleist Pro V1 is noted to be one of the biggest breakthroughs in the history of golf ball technology. Impacting all aspects in the golf game, producing a consistent result. To promote increased speed of the golf ball, a 17% thinner cover was constructed in comparison to the previous models (Trusky, 2019). Additionally, the cover is constructed using a cast thermoset urethane elastomer, translating to a softer feeling golf ball upon impact as well as enhanced short game control. The ionometric casing layer which is found below the cover has increased in size by 14%, generating greater speed and therefore distance. Furthermore, promoting increased spin optimization (Titleist, 2020; Trusky, 2019). The dimple pattern of the Titleist Pro V1 comprises of 388 tetrahedral dimples in which pattern and placement of the dimples on the cover of the golf ball produce specific aerodynamic reaction traits. Such traits include a penetrating trajectory with greater consistency in length the golf ball travels, and control in how the golf ball reacts throughout movement (Titleist, 2020; Trusky, 2019; Lost Golf Balls, n.d). A specific characteristic which is promoted and continually improved upon in golf ball research and design is the minimising of spin in the long facets of the game. Therefore, encouraging distance and optimizing the control of spin in the short facets of the game, promoting a greater degree of control.

Technology and the application to training in golf has highlighted the importance of the technical aspect of the golf swing. The instruments which are available to professional golfers create a notion of technical perfection and promote efficiency in control of the golf ball in addition to the distance achievable. However, technical perfection does not necessarily refer to a complete recreation and replication of one's swing. Rather, an application and integration of the laws of the golf swing towards creating a golf swing which is more consistent and constitutes a more efficient movement (Smith, 2020). Stanley (2018) adds that using technology in golf creates a sense of connectivity throughout the golfing community. This reach extends towards individuals who are new to the game of golf such as the millennial generation. By utilising technology in this way, the game of golf is exposed to an extraordinary opportunity for growth and increased involvement. Furthermore,

it creates a wealth of opportunity for technological innovation within the sphere of the golfing industry and therefore encourages growth to the market size of the golf industry.

The ability for technology to grow the game to such an extent as observed over the past decade shows testament to the newfound popularity in the sport. It is noted that since the establishment of international golf broadcasters such as the golf channel in the United States, greater exposure to the game has been shown though a 7% increase in viewing in one year (EconoTimes, 2020). However, one of the biggest challenges with growing the game of golf was the generational aspect of the millennial. Thus, the increased exposure to the game has been shaped by technology. The increased interest in golf through the introduction of video games for both mobile and console use has contributed to widespread involvement in the game (EconoTimes, 2020). Albeit increased involvement in golf was observed to be multi-generational, the greatest involvement was noticed in the age group between 18 and 29 (EconoTimes, 2020).

With distance in the spotlight for modern golf, increased popularity has been attributed to the distances of which professional golfers are able to achieve. PGA (2021) noted the likes of Bryson DeChambeau, Rory McIlroy, Cameron Champ and Dustin Johnson being on display for their ability in achieving such great distance. This too has grown traction in the South African perspective whereby Myers (2021) noted Wilco Nienaber. Wilco Nienaber is a Sunshine Tour start-up player, being one of the longest distance players globally and the longest hitting player on the European Tour.

In addition, Complete Golfer, an accredited golf news platform, conducted an analysis on the accumulated statistics from 2018 going into 2019 regarding the total number of rounds of golf completed in South Africa. The evidence showed that the total number of completed rounds of golf entered into the HNA (Handicap Network Africa) handicap system were 3 798036. This represents 10 000 rounds of completed golf per day and reflects a 4.6% increase in participation from 2017 to 2018. Furthermore, the HNA handicap system comprises 138 105 registered HNA handicapped golfers in South Africa. An increase in HNA handicapped golfers of 29.2% was experienced in the age bracket of 35-49 in addition to an increase of 3.9% for junior HNA handicapped golfers in 2017, and a further 4.5% increase in 2018 (Complete Golfer, 2019). An updated study was conducted looking at the state of South African golf in 2019 moving into 2020 where the number of completed rounds of golf in 2019 were recorded at 3 910 151. Reflecting a 3% growth rate in completed rounds of golf. Additionally, the growth in HNA handicapped golfers in South Africa increased by a further 2.8% (Complete Golfer, 2020).

### 3.3. HUMAN CAPITAL, THE PRODUCTION FUNCTION AND DETERMINANTS OF EARNINGS AND SUCCESS IN SPORT

The nature of the earnings capacity in professional golf is an immense construct of wealth. Numerous corporate sponsorship contracts with relative global professional golf tours can collectively fund the lucrative remuneration inherent in the sport. The Sunshine Tour has various established corporate partnerships which not only enable the functioning and maintenance of the tour, but additionally, contribute to the prize money purse awarded to athletes upon good performances within tournaments (Sunshine Tour, 2022). To put this into perspective, Herrington (2022) illustrated a case of the 2022 PGA Tournament, the second Major Championship of the year (*throughout the year schedule there are four Major Championships which are the most valuable tournaments within a season, both traditionally as well as monetary*). From 2009 to 2022 the total prize purse has grown by \$7 515 500, a growth of \$3 000 000 from 2021 to 2022. Reflecting a winners pay-check of \$2 700 000. The growth in prize money has further been experienced on The Sunshine Tour as seen within the first four months of the 2022 season, R80 million was available in earnings (Sunshine Tour, 2022). Given the quantum of earnings available, players are continuously improving their wealth of human capital in pursuit of greater earnings. Therefore, to understand the source of success and quantify the production process, an investigation into inherent human capital factors of production is necessary.

Like all sporting codes, golf is a sport which is built on the foundation of practise. In order to advance the skill set associated with the inherent performance aspects which comprise the golf game, dedicated time is spent advancing these aspects to the greatest degree. Sullivan (2016) noted that professional golfers are solely dependent on their ability to perform whereby they have full autonomy over their performance and proficiency as professional athletes. Unlike other team orientated sports which athletes share responsibility of the performance achieved. Therefore, every improvement made is directly evident. This notion translates to human capital and the formation thereof in the pursuit of earnings. According to England (1972), both Becker and Mincer, reinforce the assumption that individuals are profit maximisers and the respective earnings theories of Becker and Mincer dictate maximising behaviour. Polachek (2008) noted that the outdated interpretation of labour economics has been replaced whereby individuals were seen as homogenous in nature, comprising an aggregate economy-wide production function. Instead, for Polachek (2008), an updated interpretation distinguishes labour as heterogenous beings with a varying ability in on-the-job productivity. This adaptation of the interpretation of labour market economics presented a notion of individualistic competitive advantage and disadvantage, given that the labour

market boasted heterogeneity. Professional golf is perfectly outlined by this notion as the scope of heterogeneity is vast. Performance measures provide a platform to illustrate this whereby, albeit professional golfers demonstrate adequate ability and efficiency in all aspects of the game, each player demonstrates unique heterogeneity. The determination of their efficiency level weighs heavily on human capital formation, as different allocations of focus and concerted effort produce a sense of homogenous heterogeneity. Subsequently, the notion of homogenous heterogeneity exposes the scope of the competitive advantage and disadvantage notorious to the game of golf.

Mirimuthu, Arokiasamy and Ismail (2009) describe human capital as any form of knowledge, expertise or skill which is accumulated through the process of training or education. This was regarded as the crucial investment in human capital. The investment into human capital, according to Mirimuthu et al. (2009), is broken down into three key assumptions, illustrated through a production function. The first assumption notes that the formation of human capital and the increase thereof, is a function ( $f$ ) of the related inputs, such as the acquisition of skills, training and the subsequent knowledge acquired, reflected through an increased state of learning. Secondly, an increased state of learning with regards to knowledge and skills acquired is reflected in an increased level of productivity, and hence, and increased capacity for productivity is reflected in an increased wage capacity. Crucially, as noticed in golf, long run yield is determined by the level of productivity, achieved and therefore with greater productivity, a greater return on investment (ROI) is attainable. In terms of the application to the game of golf, the more productively and efficiently a player practices, the greater the ROI will be. This is so as time, concerted effort and the application of human capital were utilised in the improvement and advancement of the knowledge base. Broadie (2014) developed a theory by the name of strokes gained in golf which is a measurement of an individual players statistics against the field average in all aspects of the game. Players utilise this statistic towards investigating and understanding which aspect of their game is eligible for improvement. Therefore, utilising the strokes gained statistic, players can identify performance measures of their game which have the capacity for improvement by assessing relative ROI as well as identifying the inherent opportunity cost of doing so.

Traditional production function theory dictated by Solow (1957) encourages a state of technical change, whereby the output of a firm changes with the same level of input. Technology and the capabilities thereof are noted to be the driving force of such adjustments in output which are noticed in the level of productivity, efficiency as well as profitability, given that firms are profit maximisers. In investigating performance measures in golf, a state of technical change is identified, however not assumed.

Various performance measures excluding driving distance, to an extent driving accuracy, and iron playing ability, require extensive practise and application of human capital in order to render sufficient increases in productivity. A quote which resonates to this notion and the nature of the game in its entirety was mentioned by Arnold Palmer as he noted, “golf is deceptively simple and endlessly complicated”. Beall (2015) reinforced this notion in identifying that there is no shot in golf that is straight forward, primarily pertaining to scrambling factors, iron playing ability as well as putting. However, to maximize the overall utility and efficiency of professional golfers, a trade-off is required. Measured by their marginal rate of transformation (MRT) in pursuit of profit maximisation in the form of earnings potential. Thus, in establishing how much of one or multiple performance measures to forfeit for another towards promoting a state of profit maximisation (Corporate Finance Institute, 2021). In order to “drive for show and putt for dough”, professional golfers identify their necessary trade-off. The magnitude thereof, is identified by the MRT of various performance measures with putting. Ensuring their value of marginal product (VMP) for putting is greater than the VMP’s for other performance measures. However, this notion does not satisfy technical change due to the change in composition of inputs (Solow, 1957). Driving distance, however, is a performance measure which demonstrates the process of technical change. This is evident as technology implementation in golf equipment is often, associated with the capabilities inherent with driving proficiency. Hence the distance debate initiated by the USGA (2020). In investigating the truthfulness of the adage, technology in golf equipment has created an environment in which a change in output (*earnings*) is achievable without a change in the level of input such as practise time or human capital creation (Solow, 1957).

Determinants of earnings in golf represents an earnings function which is constructed by the inputs inherent in the game. The inputs in question are derived through the process of human capital formation in which Lemieux (2006) and Heckman, Lochner, Todd (2003) demonstrated though the representation of an earnings function derived by Mincer (1958):

$$\ln[w(s, x)] = \alpha_0 + \rho_s s + \beta_0 x + \beta_1 x^2 + \epsilon$$

Two economic concepts are represented by Heckman et al. (2003). Firstly, capturing a pricing equation which demonstrates how the labour market rewards knowledge productivity through schooling and experience. And additionally, the ROI that is associated with schooling. This, according to Heckman et al. (2003), is compared to the interest rate as to decide the effectiveness associated with the inherent investment made towards the formation of human capital. The diagnostic of the Mincer earnings function is as follows;  $w(s, x)$ , denotes human capital accumulated through work experience,  $\rho_s$  and  $(X)$  is the denotation of the inherent assumption made that the

ROI is identical for all schooling (Heckman et al, 2003). In a traditional capacity, the Mincer equation applies as an orthodox function in the determination of earnings and wage capacity, considering the formation of human capital through empirically traditional avenues (Heckman et al, 2003; Lemieux, 2006). However, the principle of the earnings function can be applied to sport in both a team aspect as well as an individual aspect. Antonietti (2006) reinforces this through the notion of identifying that sport as a typology, can be classified as human capital investment. Professional athletes in nature possess physical, cognitive as well as psychomotor attributes of which when further developed, encourages increased earning benefits as the advancement in such characteristics formulate inherent, fixed capital assets (Antonietti, 2006). A crucial notion noticed by Antonietti (2006), which demonstrates great pertinence to this study, as observed through a microeconomic lens, the heterogenous capital stock of individuals contributes substantially towards the observed variance which exists with regards to the resulting wage structure. Thus, with this in regard, an avenue was paved for the investigation into estimations focused on the impact of which human skill have on earnings of a professional athlete. This was done through utilising an approach which focused on human capital earnings functions (Antonietti, 2006).

Empirically, numerous accounts investigating human capital as input variables into earnings and success have been conducted. However, to this end, primarily, the notion of inquiry has been to a greater degree focused on the element of team sport opposed to the individual account. The inherent relationship is therefore demonstrated through a production function as demonstrated by Solow (1957), in representing the traditional notion as follows:

$$Q = f(K, L, t)$$

Traditionally, the interpretation of the production function follows the sequence of the dependant variable Q, representing output yield and the independent variables of K and L representing the capital as well as labour inputs (Solow, 1957). The variable t, is a representation for time which allows for the process of technical change, as explored above. This therefore denotes that the level of output yield is a function of the quantity of its factors of production (Solow, 1957). The application of the production function and the use of human capital as factors of production, as aforementioned, has widely been used in sport, ranging from baseball (Zech, 1981) and cricket (Brock, Fraser and Botha, 2012), to basketball, hockey and soccer (Antonietti, 2006). The examples mentioned, represent an insight into some of the empirical inquiry. However, the scale in which the production function is explored in sport is vast. The application of the production function within the scope of the various sporting codes is very similar in nature. Adopting the traditional interpretation of the production function as either a quantifier for success or earnings, utilising human

capital factors as input variables in the subsequent determination. According to Rosen and Sanderson (2001), sport offers a unique perspective in having the ability to measure performance. As empirical proof suggests, higher earnings are afforded to those who perform better within professional sports. It was further noted that an individual's pay was proportional to their marginal productivity in a labour market which is competitive and open (Rosen and Sanderson, 2001).

Zech (1981) suggests that efficiency maximisation of any firm originates from the identification of its inherent production function. Identifying a firm's production function denotes the relationship which exists between output and the factors of production. Thus, providing necessary information regarding the scope of marginal productivity as well as the yield with regards to returns to scale (Zech, 1981). This allows for a selection of the most efficient production factors and becoming cognisant of any inherent trade-offs which may arise. The notion of production function identification can be applied to sport, in identifying efficiency in human capital factors of production. Antoneitti (2006) mentions that empirically, the first production function analysis in the determination of a player's salary in professional baseball was conducted by Scully (1974).

An investigation was conducted into the loss experienced by players due to the reserve clause (*According to Goddard and Sloan (2005) the reserve clause was a binding contractual clause which gave the right of baseball teams to retain a player through the renewal of a player's contract even upon expiration of the contract, removing free agency from player's. Therefore creating a labour market which is not inherently competitive*) through the estimation of the relationship between player predicted marginal revenue product and the player's predicted salary. This investigation was conducted in accordance with the determination of team revenue, under the following assumptions. Firstly, the performance of a player contributes to the win percentage of the team. The impact of this is reflected in the number of patrons in attendance as a heightened level of player performance creates a greater attraction. Secondly, players exhibiting a heightened skill level create a greater attraction for broadcast networks through an increase in ratings (Scully, 1974). In estimating the marginal revenue product, a two-step equation approach was adopted. This process involved estimating the impact that player performance measures have on the winning percentage of teams. Secondly, an earnings function was estimated through utilising human capital input variables such as player experience as well as performance related to hitting or pitching (Scully, 1974).

Zech (1981) further investigated the determinants of team success in professional baseball using the production function method approach. The inherent skill base used in this study consist of four categories comprising the following. Hitting, broken down into hitting frequency and hitting with power. Running, represented by the teams stolen base total. Defence, broken down into both

a player's fielding percentage as well as total chances accepted. Finally pitching, represented by the strikeouts to walks ratio (Zech, 1981).

Similarly, to Berry (1999); Kern and Alexander (2005), and further addressed in the following subsection of chapter 3, an observation was made which disputed the reliability of the performance measures. Therefore, measures were included in the study which isolated the true representation of the performance measures. Furthermore, to avoid multicollinearity within the regression analysis. Additionally, two measures, the managers lifetime won-lost percentage as well as the number of years managing within the Major League were included in the analysis. Pertaining specifically to the contribution of the team manager as this position within the team is greatly influential towards the team performance (Zech, 1981). A cross-sectional linear regression analysis was conducted in which multiple estimations were run to account for multicollinearity due to the nature of the performance variables.

An interesting analysis which emerged from the investigation into baseball was the money-ball analysis. This analysis was developed by Billy Beane, the general manager for the major league team the Oakland Athletics (Wassermann, Czech, Wilson, Joyner, 2005). The theory originated from the nature of the Major League baseball draft in which teams with a bigger balance sheet had more expendable funds used for the purchase of players. Player decisions were based on a heightened degree of human capital characteristics such as speed, arm strength, hitting ability, mental toughness as well as relative quickness. These characteristics observed, have little regard to conventional athlete performance based on statistics (Wassermann et al, 2005). However, an alternative approach was developed by Bill James, a sabermetrician (*sabermetrics, according to Albert (2010) refers to the science of baseball, through an objective analysis using statistics to evaluate player performance*) in paying close attention to statistics over traditional Major League draft notion. A statistical emphasis was placed towards the on-base percentage (OBP) calculated as,  $(Hits + Base on Ball + Hit By Pitch)$  divided by  $(At Bats + Base on Balls + Hit By Pitch + Sacrifice Flies)$  as well as the slugging percentage, calculated as,  $(Total bases divided by At Bats)$ . This together, generated a new statistic called on-base plus slugging (OPS) (Wassermann et al, 2005). Therefore, the means as well as range of standard deviation from the descriptive statistics was noted as a function ( $f$ ) of Major League slugging percentage, (OBP) as well as (OPS). Through utilizing statistics over traditional notion, The Oakland Athletics rose from last position and tied the American League win-streak record of 19 wins, to subsequently loose in the final game of the Major league.

Brock et al. (2012) further investigated the application of the production in sport through conducting a study of South African Cricket. Specifically, the Super Sport Series in examining the

relationship between a variety of inherent input variables and the output yield. Empirically, production function analyses were conducted in the perspectives of New Zealand four-day cricket, Australian four-day cricket as well as four-day cricket in England. Subsequently, utilising what has been empirically applied to the perspective of South African four-day cricket (Brock et al, 2012). Specifically, honing in on the input variables which have encouraged favourable match results in four-day cricket as well as identifying trends which were linked to specific match variables through econometric analysis (Brock et al, 2012). The study hypothesised that the input variable of batting would be a greater determinant of match success than bowling given the firm nature of the South African cricket pitches. Similar to the Australian perspective. The production function utilised match success as the dependant variable ( $S$ ) and the function ( $f$ ) of the input-independent variables for batting and bowling. Batting comprised total runs per innings ( $B_1$ ) and total runs scores per over ( $B_2$ ). Bowling comprised runs conceded per wicket taken ( $D_1$ ), balls per wicket ( $D_2$ ) and runs scored by opposing team per over ( $D_3$ ). It was noted that fielding as an input variable was excluded in the study due to multicollinearity. Similar to Kern and Alexander (2005); Baugher et al. (2016), external factors were further noted such as weather conditions, method of captancy as well as again, fielding. However, as these variables were difficult to measure, they were excluded from the study. The regression approach which was utilised was that of a stochastic frontier analysis (SFA), as conducting an OLS regression analysis was deemed inappropriate. However, with the use of a (SFA) approach, both efficiency estimates as well as the production function were subsequently determined (Brock et al, 2012).

Carmichael, Thomas and Ward (2001) utilised a production function approach in the analysis of association football (soccer) of which, empirically, had not been actively explored in comparison to other production function investigations in professional sport. The analysis looked at the estimation of a production function with regards to seasonal performances by association football clubs competing in the English Premier League during both the 1997 and 1998 seasons (Carmichael et al, 2001). The dependant variable for the study was noted to be the total number of points accumulated during a season, expressed as a percentage of the maximum number of points which are available to earn during a season. The input variables were gathered through the Opta Index (*The Opta Index was the official statistics provider for the English Premier League*) of which fifteen input variables were utilised such as goals scored, goals conceded and goalkeeper saves among others (Carmichael et al, 2001). For Carmichael et al. (2001), team success was estimated in a sequential manner through a series of six multiple equations using cross-sectional data. Subsequently, estimating a match-play production function by employing an aggregate function for the seasonal performance of associated football clubs. This was done with the utilisation of an error term,

allowing for the interpretation of efficiency in differentiating actual and predicted team performances (Carmichael et al, 2001).

Sánchez, Castellanos, Dopico (2008) noted that production function investigations in professional sport do not only offer an avenue of inquiry for the purposes of academic application. This is of practical relevance as rational decisions are made by managers in team sport and by athletes themselves in individually orientated sports. Having a sense of familiarity with technically efficient production processes has unquestionable relevance. Thus, the information provided by estimations of production functions is invaluable to the determination of success in professional sport, providing player performance appraisals, establishing strategies as well as identifying the level of remuneration in alignment with a player's performance (Sánchez et al, 2008).

In the following sub-section of this chapter, an empirical investigation into the determination of earnings in professional golf is explored in which the production function is utilised as an earnings function determined by human capital factors of production inherent to the game of golf.

#### 3.4. DETERMINANTS OF EARNINGS IN PROFESSIONAL GOLF; AN EMPIRICAL INSIGHT.

Determinants of earnings when applied to sport seeks to identify the value of skill attributes, which contribute towards and explain the real earnings of an athlete. Scully (2002) found that determinants of earnings studies which focus on team sports are far greater reaching than that of an individual based sport such as golf. However, a number of studies have been conducted which disregard the notion of a team and rather focus on the individual element in investigating determinants of earnings in professional golf. The method involved in determining the results are all based on a similar linear equation. Fraser et al. (2015) noted that throughout the mid 1980's as well as the early 2000's, all models involved in the determination of earnings through the production function methodology applied to professional golf were based off a linear, single equation approach. Amongst the pioneer authors investigating determinants of earnings studies in professional golf, Davidson and Templin (1986) were attentive to the PGA tour. Specifically, pertaining to the 1983 playing year whereby money earned as well as scoring average were used as independent variables.

Davidson and Templin (1986) used a stepwise regression modelling in determining which skill variable inherent to golf resulted in the greatest degree of variance, therefore the greatest significance. Greens in regulation carried the greatest significance as a performance measure, having the strongest relationship with both scoring average as well as earnings. Following that of greens in regulation, a performance measure derived by Davidson & Templin (1986) of driving

proficiency, comprising driving accuracy and driving distance proved to have second greatest significance with again both scoring average and earnings. The stepwise regression used, proved a significant result, portraying greens in regulation with the greatest degree of variance, followed by putts per rounds and driving proficiency. Davidson & Templin (1986) demonstrated how golf can be broken down into individual, isolated skill variables, depending on the level of proficiency towards certain aspects. Jones (1990) conducted a correlation analysis on the PGA Tour in 1988 in investigating 99 of the top 100 money winners on tour. The findings of the study demonstrated low yet significant correlations with the performance measure of putting as well as driving distance. However, putts per round resulted in a higher correlation opposed to driving distance. The conclusion drawn was in favour of putts per round as being the most important performance measure. Therefore, confirming the adage “drive for show putt for dough”. Greens in regulation, furthermore, resulted in a similar level of significance to that of putts per round (Jones, 1990). Subsequently, Belkin et al. (1994) embarked a similar investigation to that of Davidson & Templin (1986) and Jones (1990) whereby over the period of three years 1986, 1987 and 1988, investigated whether the relationships which were previously discovered prove to show stability towards the debate of skill variables effecting performance. Belkin et al. (1994) used a stepwise multiple regression methodology in determining the significance of relationships between the player-performance measures (*driving distance, driving accuracy, greens in regulation percentage, putts per round, sand save percentage*) as well as overall scoring average as regressor variables. The findings from this study and subsequent correlation matrix were seen to correspond with Davidson & Templin (1986) and Jones (1990) as a player’s ability in as well as ability to improve their proficiency in hitting greens in regulation demonstrates the strongest relationship with performance, success, and low scoring. This result demonstrated stability over the three years, from 1986 to 1988 which was an indication of the robustness of the regression model as well as the significance of greens in regulation as a performance measure.

An important notion to consider is that Belkin et al. (1994) mention a heightened significance associated with putting, which corroborated with Jones (1990). This was seen through the significance of the performance measure, as highlighted in the study by the higher degree of correlation to scoring average and earnings with slightly lower correlations present for driving distance. Therefore, a heightened significance for putting was established in comparison to the gradual increase in the importance of driving ability. For the purposes of this study, an evolving trend in the dynamics of the two performance measures was demonstrated. Davidson & Templin (1986) and Belkin et al. (1994), furthermore, highlighted the importance of shot making ability in golf as the variance associated with scoring average were 86% and 84% respectively.

Moy & Liaw (1998) determined that professional golf is characterised as unique among the vast variety of professional level sports through representing capital accumulation in its purest form. This reinforced by Scully (2002) in noting that golf is unique in nature by representing a pure prize economy. Professional golfers maintain sponsorship contracts, however, are not contracted to compete. Therefore, professional golfers are purely reliant on their current performance to earn a living by having complete autonomy towards which aspect of the game to focus on in the pursuit of improvement (Moy & Liaw, 1998).

Dissimilarly to the aforementioned, a linear regression model was conducted by Moy & Liaw (1998) for the PGA Tour, SPGA Tour (Senior PGA Tour) as well as the LPGA Tour (Ladies PGA Tour). Which, much like Davidson & Templin (1986), investigated determinants of earnings on the respective tour's, in focusing on the relative importance of skill variables in the game for each division of the PGA Tour. For the purposes of this study, the focus will be on the men's division of PGA Tour as this study is formulated around the men's Sunshine Tour in South Africa. Moy & Liaw (1998) determined that all player performance measures included in the regression modelling were significant, except for the skill variable of sand saves. Sand saves hold a unique position as a performance measure in showing partial insignificance towards its importance in the determination of earnings. However, this does not imply the lack of its importance, instead, that all PGA Tour professionals demonstrate good bunker play and cannot be separated in terms of differing standards or levels in sand playing ability. Significant results were identified with performance measures such as driving distance, greens in regulation and putting ability in demonstrating increases of 9.3%, 10% and 33.7% in earnings respectively, as per a 1% improvement in performance (Moy & Liaw, 1998). It was identified that putting as a performance measure was invaluable on the PGA Tour towards financial success. Furthermore, driving distance and greens in regulation were noted to be significant performance measures as success, with reference to Moy and Liaw (1998) requires professional golfers to have the ability in achieving distance as well as have good iron playing ability. Moy and Liaw (1998) make note of the crucial role posed towards financial success on the PGA Tour. An increase in earnings was recognised through the improvement of the performance measures aforementioned. Therefore, a notion is reinforced and encouraged further in stating that success as a professional golfer stems from a proficiency in all skill variables. Having greater skill in a wider range of performance measures encourages an increased competitive advantage among professional colleagues.

For Shmanske (1992), a commonality which occurred throughout statistical work in sports economics pertained to the investigation into the measurement of the marginal product of professional athletes. In which, skills involved in specific sport codes were used as variable inputs in

regression models to determine relationships with the dependant variable. Determinants of earnings in this regard are noted in percentages of team earnings (Shmanske, 1992), and in this case, individual earning on the Sunshine Tour. Similar to Moy and Liaw (1998), a linear multiple regression model was used in the determination of relative performance measure importance towards greater earnings on the PGA Tour. For Shmanske (1992), earnings as the dependant variable, was separated into two categories; winnings annually (WINNINGS), as well as winnings per tournament (WINPER). The independent regressor variables which comprise the regression model are player-performance measures; driving distance, driving accuracy, greens in regulation, sand saves, putts made in conjunction with greens reached in regulation and, short game scrambling. Furthermore, the non-player performance measure of experience was used in representing the number of years a player has been a professional. Experience in golf is an important factor as it takes the mental aspect of the game into consideration, such as the ability of the player to retain concentration and make sound decisions. This mentality impacts the players ability to perform during competition. From this, through an OLS (ordinary least squares) regression, Shmanske (1992) demonstrated that an increase in any of the regressor factors resulted in a direct increase in the level of earnings achieved by the player. As seen in determinant of earnings, all the regressor factors vary in terms of their relative significance towards earnings. Additionally, an important aspect of this regression modelling was noticed in which a misrepresentation of relative importance statistically vs. "in reality" may occur. An example of this is observed where an increase in driving distance corresponds to a greater influence towards earnings opposed to driving accuracy. Logic dictates that accuracy would bear greater importance than distance in a game which requires consistency in having the ability to demonstrate accuracy. The result from the study found that driving distance, greens in regulation as well as putting ability were the most significant skill variables. An increase by one yard of driving distance, an increase in one green in regulation percentage and one less putt achieved per round, correspond to an increase in respective earnings of \$6700, \$16 000 and \$3 million (Shmanske 1992).

Furthermore, a conversion of per tournament earnings was conducted for putting which translated into a quantum of \$2 270 per tournament. WINPER corresponds with WINNING as for the most part, the results were identical. Identified variables were driving distance as well as putting as they were still observed to be the most significant skill variables. Additionally, greens in regulation decreased in relative significance, where short game scrambling as well as experience gained in relative significance (Shmanske, 1992). Callan & Thomas (2007) pointed out that when looking empirically, determinant of earnings and success studies focused on golf did not include experience as a regressor factor until it was pioneered by Shmankse (1992). Experience is an

important non-player performance measure to consider and include as it holds a great contribution towards the ability for professional golfer's to be successful. Experience in the game of golf as an aspect of performance was identified to be influential as quoted by Bobby Jones, "golf is a game which is played on a 5-inch golf course, the distance between your ears" (Golf Digest, 2018). Given this, the more experienced a player is, the greater their ability in retaining concentration and making cognitively sound decisions under pressure. Therefore, those with more expansive experience have a stronger chance of posting low scores as well as earning a greater share of the winnings (Shmanske, 1992; Fraser et al. 2015). Experience as a non-player performance measure for earnings determination elicited a positive relationship as the greater wealth of experience a player has, an advantage in the determination of earnings is identified. However, players at a more advanced age experience a declining advantage in earnings capabilities due to the diminishing returns on experience as age increases (Shmanske, 1992; Dalton, Mizak, 2010).

Determinants of earnings in professional golf as seen through Scully (2002) demonstrate a shift in significance from the observed skill variables in golf, made evident through the empirical determinants of earnings regression models. Scully (2002) notes, alike many others, the pool of empirical knowledge and literature attached to determinants of earnings in golf is very limited. Given the limited knowledge available however, a critique on the findings of Shmanske (1992) was made in targeting the OLS regression model used. For Scully (2002), using the top 60 golfers from the 1983 playing year presented econometric concerns relating to selection bias, thus resulting in a conclusion which was flawed. Secondly, taking empirical research into account, the model demonstrated a specifically direct relationship through skill variables of the game and earnings, which according to Scully (2002), such a relationship does not exist. Instead, such regressor factors (X), directly affect scoring average (SA), and therefore score itself holds the greatest significance in determining a player's earnings. Furthermore, Scully (2002) noted the aspect of experience to hold great importance in earnings determination.

Naturally, not all PGA Tour players are exempt to play in tournaments throughout a given season, thus players who do not hold exemption receive invitations to compete in given tournaments. This for Scully (2002) and Shmanske (1992), suggested that the number of tournaments a player participates in holds significance as greater experience promotes a greater chance of making the cut (*a professional golf tournament is held over four days, the cut refers to a determined scoring threshold either giving players permission to attend the remainder of tournament play, or requiring them to forfeit play due to sub-standard performance or lack thereof for the specific tournament*). Therefore, producing a better scoring average through overcoming the mental strain related to high pressure situations seen in professional golf.

Callan and Thomas (2007) proposed an alternate, updated methodology regarding earnings determination among professional golfers. This method was based on a multi-equation approach in response to work produced by the likes of Davidson and Templin. The direct relationship from stroke-play abilities (*performance measures*) to earnings is denounced, and replaced with the notion of stroke playing abilities having an impact on a players score and subsequently determining earnings. Both methodologies have their positives as the single equation approach boasts its simplicity, whereas the updated multi-equation approach boasts thoroughness and increased accuracy through its complexity. Callan and Thomas (2007) therefore conducted a multi-equation approach, creating a scenario which tested for three separate dependant variables, score, rank and earnings. The production function theorised the equations as skill (*shot-making ability*) and experience being the function ( $f$ ) of score for the first equation. Score and events were the function ( $f$ ) of rank for the second equation. Rank and the number of tournaments competed in were the function ( $f$ ) of aggregate tour earnings (Callan and Thomas, 2007). Albeit the equations were separate in nature, each equation had a reliance on each other to narrow down the specificity of the outcome. The findings from the study elicit a stark contrast from putting to driving distance in the representation of the value of the marginal product (VMP) (Callan and Thomas, 2007). The VMP of driving distance proved an increase in tournament earnings of \$5 892 for an additional 1 yard of driving distance whereas a VMP of \$8.9 million per decrease in single putt per green hit in regulation per hole, PUTT (Callan and Thomas, 2007). In reducing the putts per green hit in regulation per hole by 1, the equivalent of this would be represented by 12 shots per round or 48 shots per tournament. In alignment with Shmanske (1992), the VMP for putting was converted to per tournament earnings by dividing the VMP by the number of shots per round which would be saved, in this case, 12 shots per round or 48 shots per tournament in generating the VMP for 1 less shot per round or tournament played. This translates to a VMP of \$ 656 395 and \$741 510 respectively (Callan and Thomas, 2007).

The Sunshine Tour is a men's professional golf tour which is based in South Africa, comprising a minority of foreign players and the majority players with a Southern African nationality (Sunshine Tour, 2022). The events which are hosted, for the most part, take place in South Africa, however a number of events are scheduled in and around the African Continent. The Sunshine Tour additionally boasts events known as co-sanctioned events which collaborate with its European counterpart, in providing a platform for Sunshine Tour players to compete on the world stage (Sunshine Tour, 2022).

Determinants of earnings studies in the Southern African perspective are scarce and relatively new as Fraser et al. (2015) noted that most studies done focus on the PGA Tour given the wide

availability of statistical data as well as the status in which the PGA Tour holds as the pinnacle of global professional golf. However, as seen previously, studies have been conducted on various professional circuits such as the Senior and Ladies PGA Tour through the work of Moy & Liaw (1998). It is important to note that the method used in determining performance variables on the Sunshine Tour differs to that of the PGA Tour. The Sunshine Tour utilise a system which executes and performs all calculations using a set of highly complicated equations. This is done through collecting input information from the Sunshine Tour players and transferring the information into the generation system. A method which is approved by the regulation body of world golf, the R&A. The PGA Tour utilise a sophisticated data collection and analysis system called ShotLink which was introduced after 1999 through the evolution of data capturing methodologies. The ShotLink system captures real-time data for every player, for every hole from every situation in a PGA Tour event (ShotLink, 2022).

The frequency of studies conducted on the PGA Tour reflect numerous reasonings. The majority of PGA Tour players hold high positions in the world golf rankings and therefore hosts a highly competitive environment among the best professional golfers in the world. Furthermore, the prospective profitability in which the PGA Tour holds immense in comparison to the counterparts such as the European Tour and Sunshine Tour. Nevertheless, it was noted by Fraser et al. (2015) that the Sunshine Tour is poised as a platform for which South African golfers are able to launch as well as maintain a competitive career. Additionally, the Sunshine Tour holds an extensive representation of international players reflected in the degree of competitiveness.

Fraser et al. (2015) conducted a multi-equation model approach, investigating the intermediate outcomes of the average score and ranking of players in determining earnings through focusing on the shot making abilities of players on the Sunshine Tour. To be successful, players are required to perform to a satisfactory standard to achieve a low score. This improves their ranking on the official order of merit and subsequently reflects into value of earnings achieved (Fraser et al, 2015). The multi-equation approach conducted was theoretically underpinned by the model used by Callan and Thomas (2007). It was noted that some of the variables which were utilised in empirical studies were not available for use due to the lack of statistical data. Such variables include sand saves and driving distance in addition to the reliability of the available data as the Sunshine Tour statistical database was in the process of becoming established (Sunshine Tour, 2022). The first regression analysis conducted was a single-equation OLS regression (Fraser et al, 2015). The single-equation OLS regression model was similar to the method used in the empirical determination of earnings studies assuming a direct link between earnings as the dependant variable with input player performance variables in golf. Following this, the second regression model

utilised was a three stage least squares. The purpose thereof, is estimating a set of simultaneous equations as per the theoretical underpinning outlined by Callan and Thomas (2007). Both variations of regression models were utilised with the aim of a results comparison analysis. The results emerging from the single-equation OLS regression confirm the *a priori* expectations which were predicted for the independent variables and earnings. However, apart from the independent variables of driving accuracy and experience (Fraser et al, 2015). In analysing the three-stage least squares regression, a similar determination was made in which driving accuracy as well as experience reflect little significance relating to the average score rendered. Instead, having the ability in hitting more greens in regulation reflects a lower score average (Fraser et al, 2015). Albeit greens in regulation as well as putts per greens in regulation demonstrated a great level of significance, the *a priori* expectation for driving accuracy would suggest a corresponding nature. The significance of driving accuracy would be expected to reflect a situation whereby increased accuracy off the teeing ground decreases the difficulty of an approach shot, and therefore demonstrating greater significance levels. (Fraser et al, 2015). Nevertheless, these results demonstrated that hitting a greater number of greens in regulation reflects greater earnings.

In utilising the three-stage least squares regression, an interpretation of how earnings, score and a player ranking are connected. It was shown that for an increase in a player's earnings to become achievable, having the ability to hit a greater number of greens in regulation in conjunction with a decrease in the number of putts made per green in regulation hit, a lower scoring average will become attainable and will reflect in the order of merit ranking (Fraser et al, 2015). In the context of "drive for show, putt for dough" as well as the limitations of the statistical data available, this finding reflected that the short game in golf holds greater significance to earnings than the long game. An interesting annotation, however, would present itself with the presence of the missing, unreliable statistical data, particularly regarding driving distance. The inclusion of such data would hold great significance in the distance debate as the sample group included in the study was during the period of 2011 to 2013. Baugher et al. (2016) conducted the rendition of the Kern and Alexander (2005) earnings determination study during the period of 2006 to 2013. The respective studies were however, conducted on different tours. Nevertheless, in 2011, Baugher et al. (2016) identified a shift in trend regarding the significance to earnings of which the performance measures of putting and driving underwent.

As aforementioned, literature for determinant of earnings studies on the Sunshine Tour, are limited in nature. Fraser et al. (2015) pioneered and focused the lens in the direction of the Sunshine Tour. A similar study was conducted by Botha et al. (2020) in focusing on the period of 2011 to 2019, however, adopting a different methodology. Botha et al. (2020) investigated an insight into

human capital formation on the Sunshine Tour, classified as a lower-tier professional golf tour. The study focused on identifying a contrast to top-tier golf tours with regards to human capital formation activities which promote the optimal combination of skills (*performance measures*). Top-tier golf tours such as the PGA Tour and the European Tour have a strong affiliation to endorsement schemes which promote constraints to players in managing their time efficiently. Thus, disallowing maximum human capital formation to occur due to the various corporate responsibilities which are inherent with endorsement schemes. According to Botha et al. (2020), skill acquisition and human capital formation for players who are members of the top-tier tours acquired their human capital earlier in their career, as such, the value of the marginal product (VMP) at current may not accurately reflect the present human capital formation due to off-course commitments. Therefore, in shifting the focus to the Sunshine Tour, which is not characterised by lucrative contractual agreements, players have more time available to them to develop the performance measures of their game (Botha et al, 2020).

A notion was made with regards to empirical literature in which the only research done in linking practise time of players to skill acquisition and earnings was conducted by Shmanske (1992). This study was, and remains unique in nature as it was the first study capable of measuring the VMP for the input towards skill acquisition. Whereas empirical research into earnings and success determination measured the VMP for the output of the performance measure (Botha et al, 2020). Shmanske (2000), however, did not include the impact of which practise demonstrates on skill in the latter of his research, although, maintained the same result of differing VMP's across skills (Botha et al, 2020). Further empirical research conducted into VMP's include Moya and Liaw (1998); Kern and Alexander (2005); Callan and Thomas (2007); Nero (2001), in which both non-linear as well as structured models were incorporated. Albeit different models were used in the methodology, the results from the studies were all similar. The results illustrated that VMP's differ across skills, with one exception expressing similarity across VPM's, but not all (Botha et al, 2020). With this in consideration, Botha et al. (2020) underwent an investigation into the determinants of success on the Sunshine Tour in estimating the VMP's of two performance measures using a sophisticated quantile regression approach, such as that of empirical research conducted by Kahane (2010). For Kahane (2010), by estimating the returns to skill on the PGA Tour through utilising a quantile regression methodology, identified that the subsequent results corresponded to the empirical literature.

As per the aforementioned, the process related to the acquisition of skills in top-tier professional golf have a missing element which is difficult to measure and empirically, has been excluded from the model methodology (Botha et al, 2020). Due to the obligation of corporate-player

responsibilities, the window for human capital formation is reduced. As a lower-tier tour such as the Sunshine Tour engages to a lesser degree towards corporate-player responsibilities, the majority of earnings are directly linked to tour remuneration. Thus, all off-course endeavours are directly linked to skill acquisition and human capital formation aimed at the improvement of skills (Botha et al, 2020). Additionally, as referred to by Hamal, Caudill, Mixon (2016), the barriers for entry into top-tier tours such as the PGA Tour and the European Tour became strengthened in their rigidity through tightening the qualification process from the developmental tours such as the PGA Korn Ferry Tour and the European Challenge Tour. It is therefore observed that a response to the inherent barriers to entry is revealed through the consistent development of their human capital as well as the development of new skills. Aimed towards targeting the entry barriers at the highest level of competitive golf (Botha et al, 2020).

The study conducted therefore focused on the Sunshine Tour, excluding players who are additionally members of top-tier tours, mainly, the European Tour. The exclusion of these players was informed by corporate-player responsibilities, as Sunshine Tour players maximise their off-course time developing their skills for the sole purpose of performance on the Sunshine Tour (Botha et al, 2020). The study was run through the Sunshine Tour seasons of 2011 to 2019, comprising the top 100 players for each year whereby success was measured in real earnings per tournament (*earn*). The performance measures utilised in the investigation were driving accuracy (*drive*), greens hit in regulation (*gir*), putts per green hit in regulation (*putt*), as well as the experience (*exp*) of the player. A quantile regression was utilised as player earnings were unevenly distributed given that a small group of players earn the majority of tournament remuneration (Botha et al, 2020). Therefore, a simultaneous quantile regression approach would allow for testing of the VMP's of skills across different quantiles. Specifically, the 10<sup>th</sup> – 25<sup>th</sup> – 50<sup>th</sup> – 75<sup>th</sup> – 90<sup>th</sup> quantiles (Botha et al, 2020). Similar to Fraser et al. (2015), the results from the regression demonstrate that driving accuracy was not significant towards earnings in any of the aforementioned quantiles. Furthermore, in the lower cluster of quantiles, experience did not show great significance towards increased earnings. However, significance levels were found in the 75<sup>th</sup> as well as the 90<sup>th</sup> quantiles, albeit a diminishing trend was noted after a period of 14 years (Botha et al, 2020).

The two remaining performance measures demonstrated significance in all quantiles, thus Botha et al. (2020) drew focus towards them, namely, GIR as well as putts per GIR. The results from Botha et al. (2020) agree with that of Kahane (2010) in that the coefficients for both performance measures are entirely different as earnings increased with skill across quantiles (Botha et al, 2020). It was subsequently observed that real earnings increase with not only fewer putts per green in regulation hit, but also through being able to hit a greater number of greens in regulation (Botha

et al, 2020). The VMP's for both greens hit in regulation as well as putts per green hit in regulation were calculated using the method of multiplying the skill coefficient with the standard deviation of the skill derived from the regression. The Sunshine Tour VMP's for greens hit in regulation ranged from R1 779.12 in the 10<sup>th</sup> quantile to that of R9 442.44 in the 90<sup>th</sup> quantile (Botha et al, 2020). The Sunshine Tour VMP's for putts per green hit in regulation ranged from R2 242.06 to R8 258.11. This denotes a deviation not greater than 20% for both performance measures (Botha et al, 2020). The findings from this study demonstrated a similarity to Fraser et al. (2015) shown by the insignificance found with regards to driving accuracy. Additionally, both Fraser et al. (2015) and Botha et al. (2020) demonstrate the significant relationship existing with earnings, regarding the ability to hit more greens in regulation as well as achieve fewer putts per green in regulation hit.

With reference to Kern and Alexander (2005), in recalling the adage “drive for show putt for dough”, the short game expressed significance towards increased earnings. However, driving distance excluded from the research conducted. Botha et al. (2020) mention that both sand saves as well as driving distance were potentially important to the study as both variables were empirically utilised in research conducted on the PGA Tour. Similar to Fraser et al. (2015), the statistical data for both performance measures were not available as the Sunshine Tour statistical database had not been thorough and well established in the data collection process and system.

### 3.5. DRIVE FOR SHOW, PUTT FOR DOUGH

Berry (1999) sought after an alternative approach to view performance measures in professional golf. A shortcoming was noticed with regards to how data is recorded and processed through the econometric modelling process on the PGA Tour. Berry (1999) made an observation in examining empirical determinants of earnings studies pertaining to the accuracy of the results. Similarly, to empirical research, Berry (1999) noted that golf was broken down into the six most important attributes of the game which are unique in nature. Driving distance, driving accuracy, iron-shot skill, chipping ability, sand-trap skill as well as putting ability. This, therefore, entails unique methods for data collection respectively. Driving distance as well as driving accuracy were noted as being accurate measures respectively with regards to the data collection method and procedure (Berry, 1999). Driving distance was measured by selecting two holes out of the eighteen on a given golf course. The holes selected are either par 4 holes or par 5 holes which demonstrate similar characteristics in terms of being relatively flat in layout as well as having an opposite orientation with regards to the direction to consider the natural layout of the terrain (Berry, 1999). The distance data which is gathered is subsequently averaged, reflecting the average length of a

player's drive off the tee box. Driving accuracy is measured using a similar method to that of driving distance. However, instead of isolating two holes for data collection, every par 4 and every par 5 hole out of the eighteen holes is utilized for this player-performance variable (Berry, 1999). The data gathered then notes whether each player hit the fairway on a given par 4 or par 5. This then reflected the percentage of occurrences a specific player is able to hit the fairway (*to get the ball to rest on the fairway from their tee shot*).

Berry (1999) noted that the method of recording putting ability however had changed. The change was reflected in recording putts hit, per green hit in regulation as opposed to the total number of putts per player within a full round. This change was welcome as the total number of putts per player did not accurately reflect a true comparison between the players themselves. Situations which players find themselves in dictate the length of putt and inherently the number of putts taken per round (Berry, 1999). The variable of chipping presented itself as a challenging variable to measure. When a green is not hit in regulation, chipping represents the percentage of times a par or better is achieved (*par is achieved when a player scores the given number of shots allocated to the length of a given hole, 3 shots, 4 shots or 5 shots*). This therefore, creates the player-performance variable of scrambling in representing the chipping ability of a player. Additionally, scrambling represents the putting ability of a player as well. This initiates a scenario whereby player's may be proficient at chipping but poor at putting and vice versa (Berry, 1999). Thus, for Berry (1999), in order for an accurate measure to be generated, a new variable was created with the aim of separating the two player-performance variables. This was done through conducting a linear regression estimation of scrambling and putting, thereby generating a new variable called, chipping. This estimation represents to what extent scrambling as a player-performance variable is explained by a player's putting ability through the residuals from the linear regression. This method of generating a new variable was applied to iron playing ability as well as sand saving ability respectively. Sand saving ability was noted to be recorded as the percentage of occurrences in which players are able to save a score of par on a hole when playing out of a green side sand trap (*bunker*). Similarly, to the chipping problem, putting weighs heavily on a player's ability to save par once positioned out of the bunker. Therefore, a linear regression estimation was conducted with sand-save percentage and putting from which the residuals illustrated to what extent the player-performance variable of sand save percentage is explained by putting and vice versa (Berry, 1999). Iron-playing ability was further recognized to have demonstrated a poor method of representation. The PGA Tour did not measure iron-playing ability through recording greens hit in regulation when playing from the fairway. Instead, utilised all four of the par 3 holes as a representation of iron-playing ability. This, given a green hit in regulation on a par 3 is one stroke off

the teeing ground. In adopting this methodology, the average score was calculated. However, a given score which is achieved on a par 3 is determined by three functions ( $f$ ), putting, chipping and sand player-performance variables (Berry, 1999). Thus, the average score on par 3 holes are regressed on the aforementioned functions of iron-playing ability to which the residuals represent the measure for iron play. Measuring the extent to which the functions account for the average score on par 3's (Berry, 1999).

Since player's do not all compete in the same tournaments, coupled with the fact that different golf courses have differing layouts and difficulties, Berry (1999) aimed to identify the inherent significance to scoring for each of the player-performance variables. The residuals were illustrated through a scatterplot in which the relationships between the varying player-performance variables could be visually represented. Putting presented a low variation among players in which putting reflected a standard deviation of .03 per green in regulation, an extra 10 greens hit in regulation per round would represent a .3 shot difference in shots per player per tournament round. It was found that putting was the most highly correlated player-performance variable with scoring whereby, driving distance was reported to have the second lowest correlation to score. However according to Berry (1999), the direction of the correlation as shown through the scatterplot is intuitive, as the longer a drive is, the less the average score is. Iron-playing ability was further noted to be uncorrelated with its functions of sand, chipping and putting. Berry (1999) found however, each of the payer-performance variables were highly significant with a residual standard deviation of .346 as well as an  $R^2$  value of .829.

Berry (1999) presented an example to demonstrate the importance of the player-performance variables through the introduction of seven hypothetical golfers. Median Mike represented the population median for these variables. Each of the hypothetical players fell within the median for each category except on. Therefore, with reference to this study, Berry (1999) established that putting and driving distance held the greatest significance as performance measures and therefore to "drive for show and putt for dough" holds true. If a professional golfer's game comprises mediocre performance variables, excluding putting, in which their proficiency is the greatest, they would be better off than being proficient in the remaining payer-performance variables.

In the 21<sup>st</sup> century, the controversial topic in golf literature pertaining to the distance vs. putting ability debate became greatly significant. Jones (1990); Berry (1999) and more recently Kern & Alexander (2005) demonstrated that this previously was the approach to the golf game. Putting positioned itself as the most important player performance variable in the game, having the strongest correlation to performance and thus earnings. However, this notion according to

Baugher et al. (2016) in which putting as a performance variable poised itself with the greatest significance was no longer the case. This transition in notion was supported though a magazine based in New Zealand which showed that in the 2001 PGA Tour playing year, the players who were recognised as the top 10 long hitters on Tour received 30% more in prize money than the top 10 putters on Tour. Suggesting a shift in significance and a shift in trend towards power in the modern form of golf. The gained attention to the long game stems from the evolutionary advancement in the performance of technology in golf which directly impacts and influences the increase in length of the modern golf course as well as the established golf course. Newly constructed golf courses are fulfilling the mandate of a greater total length. Older, established golf courses are undergoing renovations to lengthen them further such as Augusta National implementing a 300-yard total increase. The reason for this is not only to offset the more powerful golfer, but mitigate the improvement in golf equipment technology which has promoted greater distance (Kern & Alexander, 2005). Phil Mickelson, who was ranked second in the world in 2002 stated that players who are not able to achieve relative distance are at a severe disadvantage to those who have more power. The perception is that power in the modern game holds great significance in encouraging a modification to one's golf game. Predominantly, for aspiring professionals in allocating their practise time wisely to compete in the 21<sup>st</sup> century (Kern & Alexander, 2005).

A regression analysis investigation was undertaken to evaluate whether power indeed trumped that of putting ability, targeting the adage. The sample data used in the study comprised an unbalanced panel of golfers on the PGA Tour spanning over the period 1992 – 2001 with a total number of 1,718 observations. The PGA Tour tracks and records their own data over each event played, contributing to an end of year result pertaining to each aspect of the game. However, in accordance with Berry (1999), Kern & Alexander (2005) adopted a similar approach with regards to how the performance measures are represented. Kern & Alexander (2005) acknowledged that the statistics gathered by the PGA Tour were indeed inaccurate as they do not account for the correct degree of specificity. This implies that other empirical research conducted, contain data which represents “contaminated measures of skill”, including Shmanske, (1992); Rische, (2001); Moy & Liaw, (1998) (Kern & Alexander, 2005). The process involved with the generation of new variables in accordance with Berry (1999), followed a similar process. However, Kern & Alexander (2005) included in their analysis both player-performance measures (*vector X*), and non-player performance measures (*vector Y*). The player performance measures comprised the different facets which make-up the golf game. Similarly to empirical studies, however, adopting the notion introduced by Berry (1999) for the determination of scoring average and in turn, the determinants

of earnings in professional golf. For Kern & Alexander (2005), the change experienced within technology and its capabilities is assumed to be neutral.

Technology in golf has evolved in a drastic manner with the age of the 21<sup>st</sup> century. Technology is positioned on such a significant platform, testament to the investigation into a change in trend regarding the “drive for show and putt for dough” debate. Due to the influence technology has had shown in golf, performance variables are restructuring, given the altering nature of significance tied to each variable respectively. Kern & Alexander (2005) noted that performance improvements are further attributed to changes occurring within player fitness and strength. Encouraging an enhancement of attributes within the swing such as range of motion and power. Additionally, performance improvements were further attributed to better instruction. Advancements in technology, as aforementioned, have created an invaluable platform in golf instruction as coaches as well as players are able to break down the golf swing in a manner which was previously not available. Players are able to use such diagnostics for the purposes of being specifically fitted to golf equipment. An invaluable asset to their game as a golf swing varies in a multitude of ways. Thus, the process of fitting in terms of an individual’s posture, swing speed, attack angle, swing path and specific golf club’s or golf ball’s best suiting the individual, directly correlates to an improvement in performance.

For Kern & Alexander (2005), their dependent variable was inflation adjusted earnings, represented by the variable, (MONEY), which only included winnings earned during official PGA Tour events. Inflation adjusted earnings are important to determine how earnings were varied over time as well as how earnings vary among golfers (Kern & Alexander, 2005). The player-performance measures used were driving distance (DRIVEAVG), driving accuracy (DRIVEACC), iron-playing ability (IRON), putting ability (PUTT), sand-playing ability (SAND) and chipping (CHIP). Additionally, Kern & Alexander (2005) include non-player performance explanatory measures into the economic modelling which were believed to have an influence on earnings. These non-player performance variables include events (EVENTS), representing the number of events in which players compete. Events squared, a variable included in testing for diminishing returns for the number of events entered. A Time trend (TIME), represented as a proxy for technological change noticed in the golfing industry. Lastly, the value of the total purse (PRIZE), as the value of real and nominal earnings increase over time, and therefore Kern & Alexander (2005) accounted for this impact on player’s earnings.

Baughner et al. (2016) conducted a replication of the study done by Kern & Alexander (2005), however, the sample data which was used demonstrated a modern outlook towards the original

model. For Baugher et al. (2016), the notion undertaken by Kern & Alexander (2005) prompted a focus on the short game in terms of practice time, whereby allocating a greater amount of practice time to the long game was illogical. This impacted the way in which professional golfers allocated their practice focus. However, according to Baugher et al. (2016), the changing dynamics of the game promoted a shift in focus given the rise of technology in golf and the impact technology demonstrates. In addition to the lengthening of golf courses and the changing layout conditions of modern golf courses. For Baugher et al. (2016) the PGA Tour has undergone two adjustments which changed the dynamics of how competitive golf is played on a professional level. Furthermore, reordering of the adage as the performance measure of driving was noted to become the most important performance measure in the determination of earnings in professional golf. This change was observed in the lengthening of golf courses whereby the par 4 and par 5 holes were increasing in length through the movement of the tee box's farther back. Therefore, increasing the distance from the tee box to the green. The advantage noticed in the ability of driving the golf ball farther off the tee box was seen in the length of the approach shot. Whereby, the longer the drive, the shorter the distance into the green, and subsequently, the shorter the club required to reach the green. In addition, increased control of the golf ball, as shorter distance golf clubs allow for greater control of spin and distance cognizance as opposed to using a relatively longer distance club (Baugher et al, 2016). Furthermore, fairways have become narrower than before, highlighting the significance of accuracy off the tee box as missing the fairway is a great disadvantage due to inherent obstacles found on either side of the fairway (Baugher et al, 2016). Baugher et al. (2016) found that in 2008, the average length of golf courses on the PGA Tour increased by 37.4 yards (34.2 meters). Thus, a prediction was made noting that the relative significance of driving distance as a performance measure would increase. Baugher et al. (2016) further noted two additional changes pertaining to golf courses. The rough layer found adjacent to the fairway had decreased in length, therefore players who are able to hit the golf ball further would not be disadvantaged by previously thick rough conditions. Secondly, hole positions on the green were being positioned in sections of the green which require a short distance club in order to promote spin, height and distance control (Baugher et al, 2016). Like Kern & Alexander (2005), a determinant of earnings study of the PGA Tour was investigated which aimed to discover if an increased significance was found with the performance measure of driving ability opposed to putting. Therefore, exploring whether the adage holds its significance.

Data for the years of 2006 to 2013 was collected from the PGA Tour intelligence database (*Shot-Link*). The compiled data comprised the same variables collected by Kern & Alexander (2005) in which an identical model was created by Baugher et al. (2016). Thus, the residuals from each

linear regression representing the pure measurement of the skill variables and determining what extent of performance measures account for the “pure” performance measure in question. Baugher et al. (2016), conducted a balanced panel GLS regression as well as an OLS regression on the log of earnings per tournament. However, a consideration of Shmanske (2009) was noted in conducting a standardized regression analysis for the purposes of direct comparison. Demonstrating the relative significance associated with the performance measures and their relationship towards the determination of earnings. The standardized regressions were run separately for each year to illustrate a bi-yearly trend analysis.

With the origin of this investigation dating back to the 1980’s through the work of Davidson & Templin (1985), investigations into determinants of earnings on the PGA Tour were focused on shot-making skills of professional golfers opposed to the other performance measures such as long game factors. This study sparked a wave of investigations, predominantly on the PGA Tour, in investigating the various relationships between earnings of professional golfers and the variables responsible for proficiency and competitiveness at the highest level of golf. Since then, a variety, although limited number, of studies emerged in this field of literature in which different methodological approaches were utilised. The varying approaches illustrated an evolution of methodology. Early determinants of earnings literature conducted by authors such as Davidson & Templin (1985); Belkin et al. (1994) and Jones (1990) used a stepwise multiple regression in conducting their investigations which were succeeded by a change in methodology through Moy & Liaw (1998) and Shmanske (1992) in introducing a linear regression methodology. The *modus operandi* for the early studies focused on the direct link between the different aspects of the game and earnings accumulation. This however, was changed by virtue of Scully (2002), as the variables in question changed. It was recognised that the relationship between earnings and performance measures were not direct in nature, rather an indirect relationship exists through factors such as stroke average, events played and a player’s ranking on the order of merit. Thereafter, research methods such as multiple equation as well as quantile regression analyses were utilised by Callan and Thomas (2007) and Botha et al. (2020) respectively. In which, Callan and Thomas (2007) investigated the avenue created by Scully (2002) through an investigation of indirect earnings determination. Furthermore, Botha et al. (2020), in conducting a simultaneous quantile regression analysis focusing on direct VMP’s through the methodology proposed by Kahane (2010).

Throughout golfing history, and for the most part, determinants of earnings literature, putting has been in the for-front of significance with regards to the arsenal of a golfer. Bobby Locke, who is noted alongside Ben Crenshaw as attributing their success purely to their putting ability, were widely recognised as contenders for the title of the greatest of all time (Hawkins, 2021); (Silverman,

2012). Putting contributed greatly towards their success as during the time in which both players participated competitively, technology and the capabilities thereof did not influence the game to the same degree as in the 21<sup>st</sup> century. The modern game and the capabilities thereof, encourage a notion that challenges “drive for show and putt for dough”, introducing the thought of “driving for dough to putt for dough”. The technology drive in modern golf has initiated a movement, demonstrating the importance of distance as well as the returns associated with driving distance. Gill (2018) illustrates the value of driving distance through comparing the top 15 longest and shortest hitters on the PGA Tour. Stating that the average earnings per yard for the top 15 shortest hitters was \$9 833 whereas the average earnings per yard for the top 15 longest hitters was \$33 866, a vast difference with regards to ROI into distance in golf.

An important notion to consider was recognized by Broadie (2014) in the revolutionary book “Every Shot Counts”, pertaining to the often-misguided judgement in support of the adage. Broadie (2014) suggested that there are common misperceptions as to why putting, throughout the history of the game, has been recognized as the most important measure of performance. The misconceptions originate from the ability putting has in defining a moment in a tournament as inevitably, the last shot within a tournament or round of golf is taken on the green. It is commonly recognized that golfers can recover from a wayward drive but cannot retrieve a putt missed (Broadie, 2014). This however, is not accurate as the result from a hole comprises fractional losses and gains on each shot taken. Only scarcely does a one-shot determination define a result. This therefore, overvalues putting ability and disregards the importance of other performance measures responsible from the fractional gains or losses (Broadie, 2014).

The overvalued nature of putting is further noted through golf history’s most crucial moments, being recognized as pivotal putts made which according to Broadie (2014) demonstrate the presence of a confirmation bias. Selective information is gathered supporting a preconceived idea in disregarding information which favours the contrary such as the adage in question. The number of putts taken on the green is another misconception as identified by Berry (1999); Kern and Alexander (2005). All professional golfers display good putting ability whereby on average, 29 putts are taken per round per player, representing only 40% of total strokes taken. However, the defining factor is proximity to the hole as it makes the difference to scoring opportunities. Longer range putts account for differences in score as the make-percentage is less than short-range putts (Broadie, 2014). A misconception mentioned by Broadie (2014) which gives the adage considerable vulnerability, illustrates that PGA Tour winner’s driving distance statistic and ranking, trump that of their putting. Examples of this are seen in players such as Vijay Singh and Sean O’Hair. Vijay Singh, being a 9-time winner on the PGA Tour and in 2004, was ranked 1<sup>st</sup> in driving distance and

55<sup>th</sup> in putting for that year (Broadie, 2014). Similarly, Sean O’Hair, in 2009 after his victory at the Quail Hollow Championship was ranked 67<sup>th</sup> for putting after the conclusion of the week. Of which, 74 players advanced after the cut threshold was established. Broadie (2014) further notes the re-occurrence of this phenomenon not uncommon, thus challenging the overvalued importance which has been the stimulus of the adage throughout golf’s history.

The following chapter will provide a thorough account of the methods and procedures which were used in the empirical research. In doing so, provide comprehensive explanations of the “pure” performance measures in accounting for their purpose and contribution to the game of golf as well as *a priori* expectations which are to be established. Furthermore, a thorough account pertaining to the derivation of the “pure” performance measures thereof.

## CHAPTER 4

### RESEARCH METHODS AND PROCEDURES

For this investigation, an earnings equation is used, similar to that of Kern and Alexander (2005), which reflects a Sunshine Tour player's earnings with two vectors of control. The first *vector (X)* represents player-performance measures which are interpreted as the skill variables and comprise the fundamentals of a golf game. *Vector (X)* variables include proficiency measures of driving, iron-play, putting and chipping-ability. Secondly, *vector (Y)* represents the non-player performance measures which influence a player's earnings ability. *Vector (Y)* variables are external factors such as player experience, time and the natural growth in the quantum of the prize purse over time. This earnings function is represented as:

$$MONEY_{it} = \alpha + \mu i + \beta X_{it} + \gamma Y_t + \varepsilon_{it};$$

In an interpretation of the equation, both *vector (X)* and *(Y)* are represented. In addition to the specific-individual-residual term, as represented by  $\mu i$ . Furthermore, like Kern and Alexander (2005),  $\varepsilon_{it}$  is the representation of the normally distributed error term in the regression analysis, therefore,  $N(0, \sigma^2)$ . An assumption was determined by Kern and Alexander (2005) which neutralized the impact which technology displayed in noting that changes in the capabilities of technology in golf as well as length alterations to golf courses impact the proficiency of performance measures as well as how the relationship with earnings is affected. The basis of the assumption dictates the variance of return yield per specific performance measure as technology advancement does not affect all performance measures equally. Instead, measures such as driving distance and accuracy would yield greater returns to technology advancement than putting due to drastic performance improvements associated with relative equipment. Furthermore, an additional assumption was determined in notifying the impact on the aforementioned "golf fitness" aspect which is synonymous with modern professional sport. Performance and proficiency increases can further be noticed outside the scope of technology in equipment. Instead, are characteristic of improved physical capabilities of professional golfers and the advancement of golf instruction. This is aided by improved modern technological processes utilised in training and conditioning of the golf swing. In this study, an unbalanced panel GLS regression will be utilised whereby, Sunshine Tour earnings (MONEY) will be regressed on *vector (X)* and *vector (Y)* in an investigation of the VMP's of performance measures. Additionally, three tests will be conducted, namely the Chow test (*redundant fixed effects test*), Hausman test as well as the Lagrange multiplier test for the purposes of best-fit for the panel estimation.

#### 4.1. DATA AND SAMPLE SELECTION

Similar to Kern and Alexander (2005), the study sample comprise an unbalanced panel of individual golfers investigating the Sunshine Tour opposed to the PGA Tour. The individual golfers used in the unbalanced panel regression analysis are professional golfers on the Sunshine Tour spanning four periods, from the 2018/19 playing season to the 2021/22 playing season. The total number of cross-sections included in the study is 219 in which the total number of panel observations was (n=506). In noting Kern and Alexander (2005) and Baugher et al. (2016), the number of panel observations in this study are noticeably less as the number of periods included in both studies were ten years and eight years respectively. The nature of statistical restraint in this study is found from the lack of reliable data from the Sunshine Tour. Both Kern and Alexander (2005) and Baugher et al. (2016) utilised the comprehensive statistical data captured by the PGA Tour whereby Baugher et al. (2016) worked with the PGA Tour's ShotLink intelligence program. The utilisation of such statistical data ensured reliable statistics from the PGA Tour which are available from as far back as 1970. Thus, were able to include a more extensive cross-sectional period regression analysis.

The Sunshine Tour, however, does not utilise such a sophisticated data capturing and representation platform. As noted by Fraser et al. (2015) and Botha et al. (2020), certain performance variables could not be included in their analyses due to the lack and unreliability of the statistical content found. Therefore, a limitation was encroached upon in the number of complete, reliable periods which were available for use in the study. The unbalanced nature of the panel data reflects a bi-yearly change in the total number of players on the Sunshine Tour Order of Merit (OoM) per period. The range of the unbalanced panel is noted to be from 152 in 2018 to 70 in 2020. In accordance with Kern and Alexander (2005), reasons to influence the number of cross-sections further range from player injury, new entrants into the tour, players not qualifying on the OoM to return to the tour, as well as the global Coronavirus Pandemic having a strong influence over opportunity to participate and choice to compete.

#### 4.2. SUNSHINE TOUR EARNINGS

The dependant variable for this study is inflation adjusted annual Sunshine Tour earnings. It is important to determine how earnings vary over time. Therefore, adjusting nominal earnings to a real earnings value will demonstrate this change. With an empirical reference, inflation adjusted earnings (*real earnings*) is used by many studies including that of Moy and Liaw (1998); Kern and Alexander (2005); Callan and Thomas (2007); Fraser et al. (2015); Baugher et al. (2016) and Botha et al. (2020). As noted by Kern and Alexander (2005), individual players may earn additional

income from avenues outside the scope of what is being investigated such as competing on different worldwide professional golf tours, income earned through contractual endorsement agreements, as well as income earned through sundry events. However, Botha et al. (2020) demonstrated that unlike the PGA Tour competitors, the Sunshine Tour competitors are not involved to the same degree in sundry activities and earnings through endorsements. Thus, the real earnings of Sunshine Tour players reflect most of their annual income as a professional golfer.

This study investigates the return on performance measures for professional golfers on the Sunshine Tour. Specifically, whether the dictum “drive for show putt for dough” holds in the modern form of golf through the relationship with real earnings and the value of the marginal product (VMP) per performance measure. This investigation utilises inflation adjusted real earnings in using the South African consumer price index (CPI) headline figures, sourced from Statistics South Africa Consumer Price Index November 2021 Release (StatsSA, 2021). The full year headline CPI was only available from 2018 to 2020. However, the 2021 headline CPI was released from January to November, thus an average could be calculated for the 2021 headline CPI figure.

Table 1. The South African Headline CPI and Inflation Rate per Period.

Year	South Africa Headline CPI	Inflation Rate
2018	107.8	4.7%
2019	112.2	4.1%
2020	115.9	3.3%
2021	120.9	4.3%

Table 1 represents the headline CPI and inflation rates per cross-section of the sample data used in calculating inflation adjusted earnings. For Kern and Alexander (2005), a base year was selected of (base year = 1982-1984), and for Baugher et al. (2016), a base year of 2006 was selected. The base year for this study is the 2018 as it is the first cross-section data set in the time series.

#### 4.3. PLAYER PERFORMANCE MEASURES

With reference to empirical determinants of earnings in professional golf such as Davidson & Templin (1986); Jones (1990); Belkin et al. (1994); Shmanske (1992); Scully (2002) and others, performance measures were determined in an isolated nature from the direct relationship with earnings. Thus, illustrating the relationship of the scale of returns to earnings from a performance measure. This has long been the most recognised *modus operandi* in this specific field of literature

in investigating performance measures and earnings determination. Berry (1999), however, introduced a unique, dissimilar statistical approach to performance measures in establishing “true” variables. Identifying the inherent interaction existing between performance measures and how they convey a reliance on others. Berry (1999) recognised that the empirical method in measuring performance through utilising stand-alone variables was eligible for improvement to heighten the accuracy of the results. Both Kern and Alexander (2005) as well as Baugher et al., (2016) thus took cognisance of this, following the procedure pioneered by Berry (1999) in generating a measure of performance characterised by statistical accuracy, hence the terminology, “pure” performance measures. The pure performance measures were categorised into six fundamental variables, namely, driving distance, driving accuracy, iron-playing ability, chipping ability, sand-playing skill and putting ability (Berry, 1999); (Kern and Alexander, 2005); (Baugher et al, 2016).

#### 4.3.1. DRIVING DISTANCE

The PGA Tour measures driving distance using ShotLink intelligence in determining the length of a golf shot from the teeing ground to where the golf ball comes to rest (PGA, 2020). The Sunshine Tour uses a method which involves pre-tournament preparation whereby the two driving distance designated holes are chosen using a set of criteria. Firstly, selected holes are orientated in the opposite direction to mitigate factors such as the effect of wind in favour of one direction (PGA, 2020). Secondly, slope and undulation are accounted for as the landing area which is designated to the measurement of driving distance is required to be relatively flat as uneven topography can encourage an inaccurate reading (PGA, 2020). Lastly, the selected holes are required to be compatible with the probability of players selecting to use their driver (*the longest hitting golf club*). This is an important factor to ensure that the distance which is recorded off the teeing ground to the place where the ball comes to rest reflects the maximum distance achievable (PGA, 2020). Upon fulfilment of the criteria, incremental distances on either side of designated fairways are measured out by tournament officials. The determined distance increments are subsequently used as a distance scale whereby players, caddies, tournament volunteers and tournament officials can measure the total length of a drive (PGA, 2020).

Empirical literature utilised driving distance as a stand-alone performance variable in determinants of earnings studies in professional golf. Berry (1999); Kern & Alexander (2005) and Baugher et al. (2016) identified that driving distance as a player-performance variable is a stand-alone variable as it is non-reliant on any other variable. Thus, for this study driving distance will remain as an isolated variable represented as (DRIVEDIST). The *a priori* expectation for this player performance measure is expected to produce a positive sign as increased length achievable

off the teeing ground to the position to where the golf ball comes to rest, is advantageous to players as they play their second shots from a position which is closer to the green.

#### 4.3.2. DRIVING ACCURACY

Driving accuracy as a player-performance measure refers to accuracy off the teeing ground. According to Morton (2019), driving accuracy is referred to as the percentage of occurrences that players are able to drive the golf ball down the fairway to the point in which the golf ball comes to rest in the fairway per round of golf played. This statistic includes any golf club which is selected by a player from the teeing ground, unlike (DRIVEDIST). According to Tremlett (2020), the role of accuracy as a player-performance measure is not one to be overlooked. Tremlett (2020) adds that having the ability to hit the golf ball in the fairway off the teeing ground secures an advantage for players. A greater degree of golf ball control can be demonstrated as obstacles adjacent to the fairway are avoided such as obstructing foliage and flora; thick, difficult rough and terrain (*rough is grass found adjacent to the fairway which has purposefully been left to grow longer than the fairway in order to add difficulty to the golf course*), sand traps, and a variety of obstacles characteristic of professional golf tournaments. This is reinforced by Koehler (2020) as it is stated that the skill level of golfers is dramatically improved with approach shots from the fairway and the advantage is noticed in the ability of professional golfers to have maximum control of spin revolution and direction, trajectory control, distance control as well as ball striking ability. Hence, allowing for improved scoring averages to be achieved. (DRIVEDIST) and driving accuracy (DRIVEACC), are the only player-performance measures which are stand-alone, isolated performance measures as their impact towards the performance of professional golfers are not interdependent to any other performance measure. Instead, their impact is noted as isolated (Berry, 1999); (Kern & Alexander, 2005); (Baugher et al, 2016). The *a priori* expectation for (DRIVEACC) is predicted to produce a positive sign due to the advantage noticed in the ability for a much-improved opportunity of a quality approach shot into the green.

#### 4.3.3. IRON-PLAYING ABILITY

Iron playing ability is a player-performance measure which is empirically associated with great significance in the game of golf. According to Harman (2015), statistical analyses which have been conducted with regards to performance measures in golf, and more specifically greens in regulation show that the average score of players can be predicted in the long run based on the number of greens in regulation hit in a round of golf. Greens in regulation (GIR) refers to an instance in which any part of the golf ball is touching or comes to rest on the putting surface in a number of strokes which is two less than par (Sherman, nd). This player-performance measure

is further explained by SwingU, (2017) in illustrating that on a par five, par four and a par three, a green hit in regulation (GIR) is recorded as three shots, two shots and one shot respectively. Empirical evidence demonstrates (GIR) as an isolated player-performance measure in determinants of earnings analyses. Suggesting a determined statistical significance found between a higher (GIR) percentage with that of real earnings by professional golfers.

As mentioned by Berry (1999), iron-playing ability as measured by the PGA Tour does not reflect an accurate representation of the player-performance variable. Therefore, the method involved in recording and representing iron-playing ability was amended by Berry (1999). Kern & Alexander (2005) note that iron-playing ability is measured as a percentage, through recording greens hit in regulation when playing an approach shot into the green from the fairway. Therefore, iron-playing ability is presented as a function of both (DRIVEDIST) as well as (DRIVEACC). Players have an advantage when the approach shot into the green is played from a shorter distance as well as having the opportunity to play from the fairway due to obstacles and obstructions which present themselves when the fairway is missed. A “pure” measure of iron-playing ability was generated through conducting a linear regression whereby (GIR) was regressed on (DRIVEDIST) and (DRIVEACC). In this study, the same method is used whereby a linear regression is conducted and the “pure” performance measure for iron-playing ability (IRON) is represented as the residuals from the linear regression. (IRON) thus represents any variation in (GIR) which is not explained by (DRIVEDIST) or (DRIVEACC) (Kern & Alexander, 2005); (Baugher et al, 2016). The *a priori* expectation for (IRON) is predicted to produce a positive sign as greater accuracy in iron-playing ability would encourage greater earnings from a lower score per round (Kern & Alexander, 2005).

$$GIR = c + DD + DA + \varepsilon$$

$$R^2 = 0,25$$

$$IRON = \varepsilon = GIR - \widehat{GIR}$$

#### 4.3.4. PUTTING ABILITY

Empirically, putting ability as a performance measure in determinants of earnings studies for professional golf has time and time again proved to be the most significant variable with regards to the returns on the VMP. Literature spanning from Davidson & Templin (1982) to most recently Botha et al. (2020), putting as a performance measure consistently reflects the notion of the high value which is associated with the particular skill set and thus “drive for show putt for dough” has held its significance. Kern and Alexander (2005) investigated the adage in exploring

the VMP associated with putting opposed to driving distance given that technology has played an altering role in how golf is played in terms of the emphasis it has placed on the distance game. Baugher et al. (2016) revisited the study conducted by Kern and Alexander (2005) in adopting the same methodology of generating “pure” performance measures in seeking a change in trend regarding significance levels of the performance measures.

The PGA Tour records putting ability as the average number of putts taken per green hit in regulation. However, Berry (1999) identified that the measure of putting ability could be improved as a crucial aspect was not accounted for. Kern & Alexander (2005) noted that putting ability did not consider the distance left to the hole once a (GIR) was achieved. Therefore, to increase the degree of accuracy of the statistic, Kern and Alexander (2005) and Baugher et al. (2016) conducted a linear regression of putts per greens hit in regulation (PTGIR) on the “pure” performance measure of (IRON). This generated a “pure” measure of performance in which the residuals reflect “pure” putting (PUREPUTT), representing any variation in (PTGIR) which is not explained by (IRON). The *a priori* expectation for (PUREPUTT) is predicted to produce a negative sign as a lower scoring average translates to less putts per round, and therefore encouraging greater earnings (Kern & Alexander, 2005).

$$PTGIR = c + IRON + \varepsilon$$

$$R^2 = 0,02$$

$$PUREPUTT = \varepsilon = PTGIR - \widehat{PTGIR}$$

#### 4.3.5. SAND PLAYING-ABILITY

In professional golf, the ability to play the golf ball out of a sand trap (*bunker*) is a unique skill in nature as it is a non-conventional stroke in comparison to the other forms of play. With reference to empirical literature such as Heiny (2008), sand-playing ability among professional golfers is a widely shared competence in which it has been demonstrated that the player skill variance for this performance measure is minimal. Therefore, as a performance measure, all professional golfers are observed to be skilful when playing out of a bunker. It was noted by Moy & Liaw (1998) in the PGA Tour determinants of earnings study that there was a relative insignificance related the performance measure of sand playing ability. However, as per Heiny (2008), Moy and Liaw (1998), the inherent insignificance associated with sand-playing ability does not stem from outright insignificance. Rather, all professional golfers demonstrate a good standard of ability and thus cannot be separated in investigating relative player VMP's. Fraser et al. (2015) and Botha et

al. (2020) encountered similar limitations in utilising sand-playing ability within the studies conducted on the Sunshine Tour as the statistics database had not been thoroughly established.

For Berry (1999) the measure of sand-playing ability which is recorded by the PGA Tour does not reflect a true representation of a player's sand saving ability. Given that the statistic is recorded as the percentage of occurrences a player can save par when playing out from a green-side bunker. Kern and Alexander (2005) expand on this in highlighting the fact that putting, more often than not, always follows and thus in order to accurately measure a player's sand saving ability, putting needs to be accounted for. As such, Kern and Alexander (2005) and Baugher et al. (2016) generated a "pure" performance measure for sand-playing ability through conducting a linear regression whereby sand save percentage (SDSAVPER), was regressed on (PUREPUTT). In this study, the same method is utilised in accounting for putting ability. However, in advancing the accuracy of the "pure" performance measure, sand save percentage is regressed with (PUREPUTT) in which the residuals generate (SAND). (SAND) thus represents any variation in (SDSAVPER) which is not explained by (PUREPUTT).

The *a priori* expectation for (SAND) is predicted to produce a positive sign as a higher percentage of sand saves achieved, encourage a lower scoring average (Kern & Alexander, 2005).

$$SS = c + PUREPUTT + \varepsilon$$

$$R^2 = 0,03$$

$$SAND = \varepsilon = SS - \widehat{SS}$$

#### 4.3.6. CHIPPING ABILITY

The variable of chipping was measured through a statistic called scrambling (SCRAMBLE). This represents the percentage of times a player achieves a score of par or better when having missed a green in regulation (Berry, 1999); (Kern & Alexander, 2005). For Kern and Alexander (2005), (SCRAMBLE) is inherently a function of a variety of player-performance variables. Namely, putting, sand-playing ability as well chipping ability, albeit sand saves were not included in the determination of this performance measure. Therefore, for Kern and Alexander (2005) to generate a new, "pure" performance measure which accurately represent chipping ability, the number of greens missed by player's (MISSGIR) was subtracted by the number of bunkers hit (BNKHIT) as a method of determining how many greens were missed whereby the golf ball did not come to rest in a bunker. This determination was divided by the number of par's or better made by player's when a green in regulation was not achieved (SCRPAR), excluding their sand saves

(SDSAVPER). Following this, a linear regression was conducted in which the determined ratio was regressed on the “pure” performance measure of putting (PUTT). The residual results generated the “pure” performance measure for chipping, represented as (CHIP).

However, due to the capabilities and sophistication of the PGA Tour’s scope of data collection, for this study, an altered “pure” performance measure was generated using available statistics provided by the Sunshine Tour. Thus creating a limitation to the method as well as an opportunity for a different approach. For this study, a linear regression was conducted whereby scrambling percentage (SCRAMBLE) was regressed on “pure” putting (PUREPUTT), “pure” sand-playing ability (SAND) as well as “pure” iron-playing ability (IRON), towards the generation of a new “pure” (SCRAMBLE) measure of (CHIP). The residuals from this “pure” performance measure thus represent any variation in (PUREPUTT), (SAND) and (IRON) which is not explained by (CHIP). The *a priori* expectation for (CHIP) is predicted to produce a positive sign as an increased percentage of achieving a score of par or better from a missed (GIR) encourages a lower scoring average (Kern & Alexander, 2005).

$$SCRAMBLING = c + PUREPUTT + SAND + IRON + \varepsilon$$

$$R^2 = 0,21$$

$$CHIP = \varepsilon = SCRAMBLING - \widehat{SCRAMBLING}$$

#### 4.4 NON-PLAYER PERFORMANCE MEASURES

Through analysing early empirical literature on determinants of earnings in professional golf, investigations have been conducted through a direct, player performance lens in investigating attributes of the golf game which are directly related to the asset base of an individual player. However, the focus on direct player-performance measures as determinants of earnings in professional golf evolved with the addition of literature authored by the likes of Shmanske (1992); Scully (2002); Callan and Thomas (2007) in identifying alternative avenues of performance and the impact in which performance measures have on indirect outcomes such as score, ranking and earnings. Kern and Alexander (2005) identify such variables which are not directly related to the performance of players, but rather indirectly influence the earnings potential of players.

#### 4.4.1. EVENTS

Experience plays an important role in the performance of players. An important misconception with performance in golf implies that the only skill required to succeed in the competitive form of the sport is to master conventional player-performance variables. However, disregarding the importance of the mental capacity of professional golfers. This notion was reinforced by Bobby Jones, one of the most influential golfers in history, in stating that golf is a game which is played on a 5-inch course, a mental game (Golf Digest, 2018). Empirically, experience (EVENTS) has posed itself as a significant variable in earnings determination, as noted by Scully (2002); Callan and Thomas (2007) and Fraser et al. (2015). Experience comprised a significant variable in their multi-equation econometric models alongside ranking and earnings. Experience as a non-player performance measure is seen to influence earnings as player's do not typically enter all the events which are scheduled for a season for various reasons such as ineligibility, time off from competition or injury related reasoning (Kern & Alexander (2005). With a greater quantity of competitive tournaments entered by player's, mental as well as physical fatigue may begin to become apparent and therefore a negative impact on earnings may occur. Kern & Alexander (2005) and Baugher et al. (2016) thus investigated diminishing returns of (EVENTS) played through the calculation of (EVENTS<sup>2</sup>), determined by squaring the number of (EVENTS). For this study, the same method is utilized. The *a priori* expectation predicted a positive sign for this non-player performance variable as more events played leads to a potential growth in player's earnings, hence the importance in testing for diminishing returns of events played.

#### 4.4.2. TIME

Technology has demonstrated an invaluable contribution to the golf industry, noticed in the modern game and the heightened capabilities demonstrated in each variable of the game. Omoregie (2016) noted the scope of the technological influence through the various categories of technology found in sport in the 21<sup>st</sup> century. Earnings determination in golf has been impacted through changes in golf equipment, added length being introduced to golf courses, as well as the various ripple effects which are being identified (Baugher et al, 2016). Therefore, Kern and Alexander (2005) include a time-series proxy in their analysis to account for time-related technological adjustments. The *a priori* expectation for this non-player performance measure for Kern and Alexander (2005) was unknown due to contrasting variables. A positive sign would be expected for the capabilities of technology advances. However, for lengthening of golf courses, a negative sign is predicted due to the increasing degree of difficulty caused by the addition in length. In this investigation, a limitation to the time variable was noticed and subsequently

adopted with regards to the validity and unavailability of data within periods. Therefore, a restriction was placed on the number of periods utilised. Therefore, time is represented by the number of years a particular player has competed on the Sunshine Tour within the time parameters of the investigation and is included in the panel data.

#### 4.4.3. PRIZE MONEY

Each Sunshine Tour season, the total size of the prize purse is seen to increase due to the nature of inflation as well as an increasing wealth capacity of the Sunshine Tour sponsorship network. Creating growth to the total tournament earnings and season earnings. The Sunshine Tour noted that the growth in wealth stems from the addition of events such as co-sanctioned events, predominately with the DP World Tour (*formally the European Tour*). Furthermore, the strengthening of the relationships between current sponsorship partners. In addition, the formation of new relationships which contribute to the growth of the total season prize purse (Sunshine Tour, 2022). An additional note, the first four months of the 2022 season was approximately worth R80 million in prize money, reflecting the growing capacity of the Sunshine Tour and its partners (Sunshine Tour, 2022). Therefore, season earnings need to be adjusted for inflation as earnings increases both nominally as well as in real terms. Kern and Alexander (2005) predicted a positive sign, reflected in the growth of overall season earnings over time. However, an adaptation to this study will be adopted. Prioritizing the total potential winning prize purse per event played, per individual player on the Sunshine Tour to control for the varying prestige of events as the earnings weighting differs per event. The *a priori* expectation for this non-player performance measure is positive, reflected in the natural growth of prize money.

Kern and Alexander (2005) explored a unique study within determinants of earnings in professional golf. Through the perspective of Berry (1999), the introduction of a new methodology was encouraged in which performance measures can be manipulated, evaluated, and understood to account for a heightened degree of accuracy in their representation. Utilising the method pioneered by Kern and Alexander (2005), a better understanding of performance measures is encouraged through a comprehensive exploration of the specificity with regards to the degree in which remuneration in professional golf originates. Focusing on an isolated lens of the extent to which different performance measures interact with one another. Furthermore, golf in the modern age has encouraged major adaptation in respect of the golf industry, becoming particularly evident with regards to how the game itself is played. Baugher et al. (2016) noticed a change in trend with regards to the adage “drive for show and putt for dough” in replicating the study done by Kern and Alexander (2005). The observed changing trend identified a relinquishing of

position regarding the value associated with putting ability to the new-found value in the ability of driving distance on the PGA Tour. Thus, the mounting question was whether the same trend is identifiable on the South African Sunshine Tour.

The following chapter therefore explores this notion in a thorough analysis of the implementation of the research method in a South African perspective. Albeit several adaptations were necessary given the limitations to the Sunshine Tour statistical database, the research methodology and procedure follows that of Kern and Alexander (2005). Thus, the inquisition investigates the relevance of the adage in a South African perspective.

**CHAPTER 5**  
**EMPIRICAL RESULTS**

In this chapter, a comprehensive analysis will be conducted in exploring two plausible outcomes regarding the adage, namely, “drive for show, putt for dough”, or “drive for dough to putt for dough”. The determination utilises the methodology of “pure” performance measures pioneered by Berry (1999) and the interpretation to determinants of earnings in professional golf set forth by Kern and Alexander (2005) and Baugher et al. (2016) on the PGA Tour. This application was transferred to a South African perspective in investigating whether the driving distance trend and the newfound value in which it possesses, according to Baugher et al. (2016), applies on the Sunshine Tour.

An insight will be offered into the value of the marginal product (VMP) derived from both *vector* (X) and *vector* (Y) (*player performance measures and non-player performance measures*) towards an interpretation and understanding thereof. To what degree each performance measure impacts real earnings and the associated marginal value.

**5.1. EVALUATION OF THE DESCRIPTIVE STATISTICS**

Table 2. Summary Statistics of Original Performance Measures (n = 506 observations)

<b>VARIABLES</b>	<b>MEAN</b>	<b>STANDARD DEVIATION</b>	<b>MAXIMUM</b>	<b>MINIMUM</b>
<b>REAL EARNINGS</b>	R341 834.70	587 910.30	R7 244 725	R4170
<b>EVENTS</b>	17.68	7.423	30	1
<b>DRIVING DISTANCE</b>	295.94	16.94	373.07	243.21
<b>DRIVING ACCURACY %</b>	0.56	0.086	0.83	0.29
<b>GIR PERCENTAGE %</b>	0.66	0.058	0.84	0.39
<b>PUTTS PER GIR</b>	1.80	0.054	2	1.61
<b>SAND-SAVE PERCENTAGE %</b>	0.60	0.149	1	0.2
<b>SCRAMBLING %</b>	0.51	0.076	0.73	0.18
<b>PURSE</b>	R10 350 118.56	6 125 231.66	R49 041 464.25	R168 704.60

Table 3. Summary Statistics of Estimated Performance Measures (n = 506 observations)

VARIABLES	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
REAL EARNINGS	R341 834.70	587 910.30	R7 244 725	R4170
EVENTS	17.68	7.423	30	1
DRIVING DISTANCE	295.94	16.94	373.07	243.21
DRIVING ACCURACY %	0.56	0.086	0.83	0.29
IRON	0.00	0.051	0.12	-0.27
PUREPUTT	0.00	0.053	0.21	-0.2
SAND	0.00	0.147	0.46	-0.40
CHIP	0.00	0.067	0.21	-0.35
PURSE	R10 350 118.56	6 125 232,66	R49 041 464.25	R168 704.60

Table 2 represents the summary statistics of the variables used in the various regression models performed. To collate complete descriptive statistics, the isolated variables (*performance measures*) used in the series of regressions were required. The subsequent residuals are not descriptive in nature as they do not provide a sufficient explanatory summary of the panel data. The descriptive statistics from table 2 present interesting notions regarding the overall performance of Sunshine Tour players during the period from 2018 to 2021.

According to the descriptive statistics as shown in table 2, the average real earnings (*denoted in 2018 base year prices*) of Sunshine Tour players during the four-year period was observed at R341 834.70. The minimum earned is R4 170 and a maximum of R7 244 725 was achieved during the sample period. With reference to Botha et al. (2020), the level of real earnings on the Sunshine Tour are observed to be similar, as the mean and minimum value are separated by a variance of R26 145.70 and R397.32 respectively.

Events, which are presented in the table 2 descriptive statistics reflect the number of events that players qualify for and choose to participate in throughout each respective playing season from 2018 through to 2021. Additionally, events which were excluded from each player's total events include those whereby the qualifying threshold was not met as well as the occurrence of unforeseen withdrawals from a given golf tournament. According to the descriptive statistics, a Sunshine Tour professional on average participated in 18 events throughout a competitive playing season. A maximum of 30 events were entered and participated in, with a minimum of 1 event being participated in. The range observed within which Sunshine Tour events are participated,

correspond to the conditions of participation aforementioned. However, a greater contributor is noticed with the inability for players to qualify for events throughout the season. The mean number of events which were available for participation was not as high as expected. A partial explanation for this stems from the 2020 playing season due to the advent of COVID-19, negatively impacting the number of tournaments which were scheduled for the season.

Driving distance is a unique player-performance variable within the South African perspective as neither Fraser et al. (2015) nor Botha et al. (2020) were able to utilise the statistics as a regressor variable within their models. This was noted due to circumstances which highlight the developing nature of the Sunshine Tour information centre with regards to incomplete and unreliable data sets. However, as this study focused on the most recent performance measure statistics from 2018 to that of 2021, the Sunshine Tour information centre was able to accommodate the necessary information required to utilise the data sets. According to table 2, the average golfer on the Sunshine Tour was able to achieve a driving distance of 295 meters. Comparatively, the PGA Tour driving distance average was observed at 295 yards (270 meters) for the 2021 playing season. This demonstrates a 25-meter difference in the average distance recorded (PGA, 2021). An elevation change can be a partial explanation (*partial explanation since both the PGA Tour and Sunshine Tour incorporate events outside of the respective countries*) as South Africa and the United States of America are on average, 1034 meters and 760 meters above sea level respectively (WorldData.info, 2022). It is further observed that the maximum driving distance average was recorded at a monumental 373 meters with a minimum driving distance average of 243 meters in length.

With reference to Fraser et al (2015) and Botha (2020), driving accuracy demonstrated a similar variance with regards to the range in skill level. In fact, displaying a great similarity to Fraser et al. (2015). Table 2 demonstrates that the average driving accuracy percentage is found at 56%, indicating that driving accuracy is a skill in which most players on the Sunshine Tour do not necessarily excel in as their strength among the arsenal of performance measures. The maximum driving accuracy percentage was observed was 83% whereas the minimum percentage observed for driving accuracy was identified at 29%.

In interpreting a “pure” player-performance measure such as IRON, an accurate overview of the panel data was obscured due to the normal distribution  $N(0, \sigma^2)$  of the residuals generated from the inherent OLS regression. Consequential to an OLS regression, the generated “pure” performance measure of IRON resulted in a mean of 0.00. Therefore, descriptive statistics which do not offer an explanatory representation of the panel data, as noted in table 3. As aforementioned, in order to determine and interpret the descriptive statistics for the panel data, the isolated player-

performance measure of greens in regulation (GIR) percentage was utilised. As noted in table 2, on average, Sunshine Tour professionals are able to achieve a green in regulation 66% of the time. The maximum ability to do so is observed at an 84% success rate and the minimum ability to do so is observed at a 39% success rate.

The payer-performance measure of PUREPUTT is represented as the residuals from a linear OLS regression. Therefore, a mean of 0.00 was subsequently estimated given the nature of normal distribution  $N(0, \sigma^2)$ . Thus, descriptive statistics which are not summative of the panel data as observed in table 3. Furthermore, this player-performance measure, along with driving distance is inherently pivotal towards the assessment of the adage. In order to grasp a summative understanding of the player-performance measure, putts per green in regulation was utilised towards generating the necessary descriptive statistics. Table 2 demonstrates that on average, a Sunshine Tour professional plays 1.80 putts per green hit in regulation. An interesting observation is noticed with this statistic as it is an identical mean to that of Fraser et al. (2015) as well as Botha et al. (2020) for putts hit per green in regulation. In addition, the maximum number of putts per green hit in regulation is found at 2 whereas the minimum number of putts taken per greens hit in regulation is 1.61 putts.

Like that of PUREPUTT, the “pure” player performance measure of SAND had undergone a linear OLS regression. Therefore, the inherent results are represented through the residuals of the regression. A comprehensive descriptive account of the panel data was thus not achievable given a mean of 0.00 due to the nature of the OLS regression and the normal distribution  $N(0, \sigma^2)$  of the residuals as observed in table 3. Therefore, the isolated player performance measure of sand save percentage was utilised to illustrate a comprehensive summative account of the panel data. In accordance with table 2, professional golfers on the Sunshine Tour demonstrated a mean ability of saving a score of “par” on a hole when playing from a greenside bunker of 60%. The greatest ability to do so is represented in a maximum percentage of 100%. A sand save percentage of 100% reflects the ability to save a score of “par” when playing from a greenside bunker in every instance (*hole*) the performance variable was measured on the Sunshine Tour. Furthermore, the lowest ability to save a score of “par” when playing from a greenside bunker is observed at 20%.

The last player-performance measure utilised in the regression model is that of CHIP. Like IRON, PUREPUTT and SAND, the performance measure of CHIP too, had undergone a linear OLS regression. Thus, in accordance with the nature of an OLS regression, the residual results which comprise the player performance measure are normally distributed  $N(0, \sigma^2)$ .

Consequentially, a mean of 0.00 is rendered, along with compromised descriptive statistics as noticed in table 3. Therefore, the isolated player-performance measure of scrambling was utilised to account for the explanatory statistics. Scrambling represents the percentage of occurrences in which a green in regulation is missed from an approach shot (*this does not include greens missed in which the golf ball comes to rest in a greenside bunker i.e. sand saves*), however, still achieves a score of “par” or better on the given hole. Therefore, as observed in table 2, a professional golfer on the Sunshine Tour demonstrates a mean ability of 51% in this regard. This percentage level identifies that on average, a Sunshine Tour player displays the ability to achieve a score of “par” or better when a green in regulation is missed more than 50% of the time. Furthermore, table 2 illustrates that the greatest ability to do so is found at a maximum of 73%, followed by a minimum ability level of 18%.

The non-player performance measure of purse is the final performance measure which forms part of this model. The purse comprises the total quantum of earnings which were awarded to the winning Sunshine Tour professional per event entered and played, spanning the period of four years (*each playing season from 2018 to 2021*). As previously mentioned, the respective purse values for each Sunshine Tour player exclude the events with which players withdrew before the commencement of the tournament. However, include the events in which a withdrawal occurred post-commencement of a tournament. Additionally, the purse values exclude the events in which players failed to qualify.

The purse values were adjusted to the base year 2018 prices in which, as observed in table 2 and table 3, the mean purse value over the four-year period was observed at R10 350 118. Demonstrating that on average, Sunshine Tour professionals have an opportunity to win a total quantum of R10 350 118 in real earnings. Table 2 and 3 further demonstrate that the highest total purse value in which an individual player had the opportunity to win was observed at a maximum of R49 041 464.15, with a minimum quantum of R168 704.60.

In utilising the isolated (*traditional*) performance measures, a thorough explanatory account was achievable for the panel data set, demonstrating the observed range throughout the panel data.

## 5.2. COEFFICIENT OF VARIATION

In addition to the summative account of the performance measures, Kern and Alexander (2005) demonstrate the variation observed between the performance measures through an analysis of the coefficient of variation. The summative account demonstrates a high-performance level present on the Sunshine Tour. However, an interesting notion to consider is identified in exploring

the extent of variation among the player-performance measures. With the use of the coefficient of variation, an insight into the extent of the variability is achieved. Therefore, to calculate the coefficient of variation, the following equation was used:

$$CV = \frac{\sigma}{\mu} \times 100$$

In accordance with the above equation, where  $\sigma$  is the standard deviation and  $\mu$  is the mean for the player-performance measures, the coefficient of variation is determined. The results rendered demonstrate varying degrees of competitiveness throughout all aspects of player-performance.

Table 4. Coefficient of variation for player-performance measures.

PERFORMANCE MEASURE	COEFFICIENT OF VARIATION
DRIVING DISTANCE	5.73%
DRIVING ACCURACY	15.36%
GREENS IN REGULATION	8.79%
PUTTING	3%
SCRAMBLING	14.90%
SAND SAVES	24.83%
REAL EARNINGS	171.99%
PURSE	59.18%
EVENTS	41.99%

*Table 4. Observations of the coefficients of variation which have been calculated with use of the aforementioned equation pertaining to both vector X and vector Y (player-performance and non-player performance measures).*

The coefficients of variation for the *vector* (X) and *vector* (Y) performance measures are identified in table 4 above. These findings are particularly interesting in comparison to Kern and Alexander (2005) as the results suggest that putting as a performance measure has the least variability in skill level. This indicates that all Sunshine Tour players display a highly competitive ability with regards to putting. For Kern and Alexander (2005), putting elicited a coefficient of variation of 74.58%, indicating a great degree of skill level variation. Driving distance, although not to the same degree as putting, further elicited a coefficient of variation which indicates a substantial level of competitiveness with regards to the level of skill. Driving distance for Baugher et al. (2016) was found at 2.94%, a similar competitiveness to the 5.72% observed from the Sunshine Tour in this study. Interestingly, a coefficient of variation was observed at 27.47% for Kern and Alexander (2005). This change in degree of variation demonstrates the increase in emphasis shown throughout

professional golf towards the ability to hit the golf ball further. Along with the capabilities in which the advent of a technology-drive in golf has demonstrated, coupled with the nature of the concept of “golf fitness” as highlighted by Brearley et al. (2019), the length aspect in golf has become a highly contested space in which players realise and understand the value associated with distance in the game.

Additionally, an interesting observation is made with regards to the coefficient of variation for driving accuracy, with reference to both Kern and Alexander (2005) and Botha et al. (2020), a degree of similarity is found. Albeit higher, the coefficient of variation was observed at 15.36% for this study, as opposed to at 14.21% and at 14.23% respectively. Indicating that the skill level associated with driving accuracy is less saturated in comparison to driving distance. Although the coefficient of variation is relatively low, players elicit greater dispersion with regards to their ability to create the necessary shot for the golf ball to come to rest on the fairway from their tee-shot.

The *vector* (Y), non-player performance measures, further demonstrate interesting findings as it was observed that the coefficient of variation for events was found at 41.99%, the coefficient of variation for purse was found at 59.18% and the coefficient of variation for real earnings was found at a staggering 171.99%. The coefficient of variation for events played demonstrates the variability in the number of events played on the Sunshine Tour. As aforementioned, a major contributor which implicates this variable is the inability of players to qualify for events, as well as players who hold possession of multiple tour cards (*playing status for multiple worldwide tours*) as they can select events in which they do, and do not seek participation. An additional factor is noticed alongside the advent of the novel COVID-19 pandemic which decreased the number of events from a maximum of 30 to a total of 11. Coupled with a decrease in the number of participating players. In comparison with Kern and Alexander (2005) and Botha et al. (2020), coefficients of variation were found at levels of 17.23% and 29.20% respectively. Thus, demonstrating the aforementioned with regards to entry barriers to qualifying for events (*more so on the Sunshine Tour*) as well as schedule preferences. Both real earnings as well as purse are observed at interesting coefficients of variation, demonstrating the varying prestige of particular events and the rewards which are inherently attached.

The coefficient of variation for real earnings, in comparison to Kern and Alexander (2005), Baugher et al. (2016) and Botha et al. (2020) eliciting coefficients of 114.60%, 87.96% and 119.06% respectively, suggest that there is a vast dispersion in earnings on the Sunshine Tour and the PGA Tour, observed from 2005 to the present day. The dispersion in earnings is a consequential factor which is directly related to purse, in which a coefficient of variation of 59.18%

suggests that the quantum of the purse total, per individual tournament, is greatly varying. With reference to the aforementioned, due to the conditions of participation such as barriers to entry which players confront. Equal opportunity is not guaranteed for every player. This is an important explanatory factor as tournaments have differing weightings with regards to the prize quantum. Therefore, this has a direct impact on the opportunity of prospective earning, generating a greater degree of dispersion for both real earnings as well as purse.

### 5.3. ANALYSIS OF PANEL DATA ESTIMATIONS

In order to determine the value of the marginal product (VMP) for both player and non-player performance measures in the determination of earnings on the Sunshine Tour, the empirical model was estimated with the use of the panel estimation procedure in Eviews (*Eviews is a platform utilised in which econometric analysis is conducted*). The nature of the unbalanced panel data set was coupled with various limitations. Such limitations were noticed with regards to utilising combinations of modelling for the interpretation of the data in connection with the application of both fixed effects and random effects within the regression modelling, towards identifying a best-fit. In addition, for the purposes of best-fit analysis, the Hausman specification test, the Redundant fixed effects test as well as the Lagrange multiplier test were conducted to identify the most appropriate specifications for the regression model.

This study dictates a null hypothesis ( $H_0$ ) of *vector* (X) and *vector* (Y) performance measures assuming a stance of statistical insignificance to real earnings, with an alternative hypothesis ( $H_1$ ) to the contrary. Determining statistically significant relationships towards the dependant variable, real earnings.

### 5.3.1. FIXED EFFECTS

Table 5. Unbalanced Panel Generalised Least Squares Regression, Fixed Effects

VARIABLE	COEFFICIENT	STD.ERROR	T-STATISTIC	PROB.
C	-2553996.	1254293.	-2.036204	0.0427
DRIVING DISTANCE	5479.109	3797.459	1.442835	0.1502
DRIVING ACCURACY	1782755.	645549.9	2.761607	0.0061
IRON	2222969.	806791.4	2.755321	0.0063
PUREPUTTS	-5585479.	764823.5	-7.302965	0.0000
SAND	89909.47	240013.6	0.374602	0.7082
CHIP	3221531.	545218.0	5.908703	0.0000
EVENTS	32363.02	22980.56	1.408278	0.1602
EVENTSQRD	-648.0188	617.3533	-1.049673	0.2948
PURSE	-0.005495	0.006267	-0.876811	0.3814

#### Effects Specification

Cross-Section Fixed (Dummy Variable)			
Period Fixed (Dummy Variable)			
R-squared	0.672289	Mean dependent variable	341834.7
Adjusted R-squared	0.398204	S.D. dependent variable	587910.3
S.E. of regression	456074.4	Akaike info criterion	29.20198
Sum squared residual	5.72E+13	Schwarz criterion	31.13148
Log likelihood	-7157.100	Hannan-Quinn criterion	29.95873
F-statistic	2.452848	Durbin-Watson statistic	3.056200
Prob (F-statistic)	0.000000		

The first estimation as seen in table 5, was conducted utilising a fixed effects methodology for both cross-section as well as the period parameters. In accordance with the *a priori* expectations, all the coefficients demonstrate symmetry with regards to their expected relationships to the dependant variable. The fixed effects model offers a positive goodness-of-fit indication, identifiable through the  $R^2$  value of 0.672 (67%). Demonstrating that 67% of the variation's observable in the dependent variable of real earnings is explained by the *vector* (X) and *vector* (Y) independent variables. In addition, as observed through the F-statistic, the fixed effects model resulted in a value of less than 0.05 (5%). Indicating that the *vector* (X) and *vector* (Y) independent variables in conjunction which each other postulate that the probability of the null hypothesis ( $H_0$ ) being true is less than 5%. However, it is noticeable that the player performance measure of driving distance is observed to be statistically insignificant, therefore, the fixed effects methodology was disregarded given the nature of the research premise.

### 5.3.1.1. REDUNDANT FIXED EFFECTS TEST-LIKELIHOOD RATIO (CHOW TEST)

Table 6. Summary of the Redundant Fixed Effects Test

Effects Test	Statistic	Degrees of Freedom	Probability
Cross-Section F	0.975023	(218.275)	0.5761
Cross-Section Chi-Square	289.751901	218	0.0008
Period F	2.225068	(3.275)	0.0855
Period Chi-Square	12.135677	3	0.0069
Cross-Section/Period F	0.998434	(221.275)	0.5030
Cross-Section/Period Chi-Square	298.088035	221	0.0004

To thoroughly evaluate the fixed effects regression methodology, a redundant fixed effects test was conducted, as seen in table 6. The redundant fixed effects test investigates both fixed effects and common effects within the model as well as the respective goodness-of-fit associated with both cross-sectional and period parameters. The assumptions regarding the redundant fixed effects test (*chow test*) are identified by Zulfikar (2019). The null hypothesis ( $H_0$ ) promotes the use of common effects for the regression model. The null hypothesis ( $H_0$ ) is subsequently accepted if the P-value is greater than 0.05 (5%) and conversely rejected if the P-value is less than 0.05 (5%). As observed in table 6, the P-values for both cross-section as well as the period parameters are less than 5%. Therefore, rejecting the null hypothesis ( $H_0$ ) and accepting the alternative hypothesis ( $H_1$ ) of a fixed effects methodology. It is thus identified that a complete fixed effects model postulates a best-fit for this particular regression estimation. However, as aforementioned, for the purposes of this research, this methodology is not efficient given the insignificance attached to the crucial player performance measure, driving distance.

Therefore, upon observation of table 6, cross-section fixed effects demonstrate a goodness-of-fit P-value statistic which is statistically stronger to that of a period fixed effects model. Thus, a cross-section with fixed effects is most efficient for this study.

### 5.3.2. RANDOM EFFECTS

Table 7. Unbalanced Panel Generalised Least Squares Regression, Random Effects

VARIABLE	COEFFICIENT	STD.ERROR	T-STATISTIC	PROB.
C	-1931976.	548421.5	-3.522794	0.0005
DRIVING DISTANCE	5536.142	1482.124	3.735276	0.0002
DRIVING ACCURACY	1237504.	262260.5	4.718606	0.0000
IRON	3163471.	415217.7	7.618824	0.0000
PUREPUTTS	-3526407.	412903.2	-8.540516	0.0000
SAND	141518.8	139494.9	1.014502	0.3108
CHIP	2097803.	314154.0	6.677624	0.0000
EVENTS	-17644.71	14174.22	-1.244845	0.2138
EVENTSQRD	330.3008	412.3588	0.801003	0.4235
PURSE	0.012954	0.004122	3.142863	0.0018

Effects Specification			
	S.D.	Rho	
Cross-section random	0.000000	0.0000	
Idiosyncratic random	459079.2	1.0000	

Weighted Statistics			
R-squared	0.409342	Mean dependent variable	341834.7
Adjusted R-squared	0.398624	S.D. dependent variable	587910.3
S.E. of regression	455915.2	Sum squared residual	1.03E+14
F-statistic	38.19345	Durbin-Watson statistic	1.911953
Prob (F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.409342	Mean dependent variable	341834.7
Sum squared residual	1.03E+14	Durbin-Watson statistic	1.911953

Table 7 represents the random effects regression estimation of the panel data. However, unlike the fixed effects methodology, inherent to random effects, a number of limitations presented themselves with regards to the combinations of effects modelling. The first of these is noticed in applying a fixed effect to the cross-section parameter of the panel data and a random effect to the period parameter, and conversely so. The limitation is noticed in the inability for such effects modelling to be utilised with unbalanced panel data. Furthermore, a complete random effects regression model is disallowed as two-way random effects is not compatible with unbalanced data. Lastly a common effects cross-section is not compatible with a random effects period estimation as a random effects estimation is required to consist of a greater cross-section to number of coefficients. Therefore, this regression model adopted a cross section of random effects with a period

of common effects. As with the fixed effects model, all *vector* (X) and *vector* (Y) coefficients displayed symmetry with regards to the *a priori* expectations and the inherent relationship to the dependant variable of real earnings. However, unlike the fixed effects model, the R<sup>2</sup> goodness-of-fit indicator reflected a value of 0.409 (41%). Therefore, denominating that only 41% of the variation's observable in the dependent variable of real earnings are explained by the *vector* (X) and *vector* (Y) independent variables, thus indicating a differential of 26%. In observation of the F-statistic, similar to the fixed effects methodology, a probability value which is less than 0.05% (5%) was generated. Thus, the dependent variable, coupled with the *vector* (X) and *vector* (Y) independent variables provide an indication that the probability of the null hypothesis (H<sub>0</sub>) holding true is less than 5%. Therefore, the alternative hypothesis (H<sub>1</sub>) is accepted.

### 5.3.2.1 CORRELATED RANDOM EFFECTS - HAUSMAN TEST

Table 8. Summary of the Hausman Test

<b>Correlated Random Effects – Hausman Test</b>			
<b>Test Cross-Section Random Effects</b>			
TEST SUMMARY	CHI-SQUARE STATISTIC	CHI-SQUARE DEGREES OF FREEDOM	PROBABILITY
CROSS-SECTION RANDOM	40.644563	9	0.0000

<b>Cross-Section Random Effects Test Comparisons</b>				
VARIABLE	FIXED	RANDOM	VARIANCE(DIFF)	PRABABILITY
DRIVING DISTANCE	9757.736...	5536.141537	8202366.6...	0.1405
DRIVING ACCURACY	1911052....	1237504.0...	28917322...	0.2104
IRON	1674304....	3163471.0...	43669525...	0.0242
PUREPUTTS	-5224799...	-3526406....	39159140...	0.0066
SAND	148296.5...	141517.79...	38186881...	0.9723
CHIP	3288883....	2097802.5...	19092296...	0.0064
EVENTS	10244.09...	-17644.71...	240070956...	0.0719
EVENTSQRD	-109.002121	330.300833	164712.10...	0.2791
PURSE	-0.004299	0.012954	0.000017	0.0000

The Hausman test was conducted with the purpose of identifying which regression methodology, either fixed effects or random effects, is identified to be the best fit for the regression model. The underlying assumption of the Hausman test is postulated in the statistical significance of the P-value.

According to Zulfikar (2019), the assumption notes that the null hypothesis ( $H_0$ ) supports the use of a random effects methodology. Furthermore, when the P-value is greater than 0.05 (5%), the null hypothesis is accepted. The alternative hypothesis ( $H_1$ ) on the other hand states that the null hypothesis is rejected when the P-value is less than 0.05 (5%), in which a fixed effects methodology is best fit for the regression model (Zulfikar, 2019). Table 8 shows the subsequent Hausman test conducted. In accordance with the assumptions for the Hausman test as previously stated, the P-value is less the 0.05 (5%). Therefore, the null hypothesis ( $H_0$ ) is rejected. This demonstrates that a fixed effects methodology is best fit for this regression model.

### 5.3.3. COMMON EFFECTS

Table 9. Unbalanced Panel Generalised Least Squares Regression, Common Effects

VARIABLE	COEFFICIENT	STD.ERROR	T-STATISTIC	PROB.
C	-1931976.	544641.8	-3.547242	0.0004
DRIVING DISTANCE	5536.142	1471.909	3.761197	0.0002
DRIVING ACCURACY	1237504.	260453.0	4.751352	0.0000
IRON	3163471.	412356.1	7.761697	0.0000
PUREPUTTS	-3526407.	410057.5	-8.599785	0.0000
SAND	141518.8	138533.5	1.021542	0.3075
CHIP	2097803.	311988.9	6.723965	0.0000
EVENTS	-17644.71	14076.53	-1.253484	0.2106
EVENTSQRD	330.3008	409.5168	0.806562	0.4203
PURSE	0.012954	0.004093	3.164674	0.0016
R-squared	0.409342	Mean dependent variable	341834.7	
Adjusted R-squared	0.398624	S.D. dependent variable	587910.3	
S.E. of regression	455915.2	Akaike info criterion	28.91757	
Sum squared residual	1.03E+14	Schwarz criterion	29.00109	
Log likelihood	-7306.144	Hannan-Quinn criterion	28.95033	
F-statistic	38.19345	Durbin-Watson statistic	1.911953	
Prob (F-statistic)	0.000000			

The last panel effects regression analysis conducted is common effects, as shown in Table 9. For this regression both parameters, cross-section as well as period were estimated under common effects. Upon initial observation, the results from this regression analysis appear to be identical to

the random effects regression methodology. However, upon closer inspection, the outcomes differ slightly. In alignment with both fixed effects and random effects, all *a priori* expectations are met with regards to the *vector* (X) and *vector* (Y) performance measures and the inherent relationship with the dependent variable, real earnings. Identical to the random effects methodology, the R<sup>2</sup> goodness-of-fit indicator is observed at a value of 0.409 (41%), which postulates an identical indication that only 41% of the observed variations in the dependent variable of real earnings are explained by both *vector* (X) and *vector* (Y) independent performance measures. This demonstrates that with regards to the R<sup>2</sup> goodness-of-fit indicator among the different parameters of regression effects, the fixed effect reflects the greatest efficiency as a model with an R<sup>2</sup> value of 67%. Furthermore, as noted by the F- statistic, like both fixed effects and random effects, the observed value is less than 0.05 (5%). This encourages an indication that the probability of the null hypothesis (H<sub>0</sub>) holding true is less than 5%. Therefore, the alternative hypothesis (H<sub>1</sub>) is accepted.

### 5.3.3.1 OMITTED RANDOM EFFECTS - LAGRANGE MULTIPLIER TEST

Table 10. Summary of the Lagrange Multiplier Test

Test Hypothesis			
--	Cross-Section	Time	Both
Breusch-Pagan	0.054741 (0.8150)	1.355977 (0.2442)	1.410718 (0.2349)
Honda	0.233967 (0.4075)	1.164464 (0.1221)	0.988840 (0.1614)
King-Wu	0.233967 (0.4075)	1.164464 (0.1221)	1.183807 (0.1182)
Standardized Honda	0.404176 (0.3430)	2.644422 (0.0041)	-9.151339 (1.0000)
Standardized King-Wu	0.404176 (0.3430)	2.644422 (0.0041)	-1.340990 (0.9100)
Gourieroux, et al.	--	--	1.410718 (0.2410)

Table 10 is a representation of the Lagrange multiplier test. The function of this test is premised on investigating the goodness-of-fit between a random effects methodology and a common effects methodology towards the panel regression model. The assumptions of the Lagrange multiplier test as outlined by Zulfikar (2019), dictate that the null hypothesis ( $H_0$ ) supports the use of common effects, which will be accepted on the condition that the P-value (*Breusch-Pagen index*) is greater than 0.05 (5%). Therefore, naturally, the null hypothesis ( $H_0$ ) is rejected and the alternative hypothesis ( $H_1$ ) is accepted on the condition that the P-value is less than 0.05 (5%). Thus, a random effects methodology is adopted. In table 10, it is observed that the P-value is greater than 5% and therefore the null hypothesis ( $H_0$ ) of the common effects methodology is accepted.

#### 5.3.4. FIT VS. PARSIMONY

The principal assumption of fit vs. parsimony investigates the trade-off pertaining to the efficiency of a model. Focusing on the ability of explaining the variation in the dependent variable determined from the independent variables vs. the simplicity of the model (Statology, 2020). To identify a regression methodology which demonstrates the greatest significance, parsimony is considered. Assumptions thereof include predictive ability, and the simplicity of understanding towards the conformity of the model to the observed data (Statology, 2020). As the regression model in question is identical throughout in terms of number and type of parameters involved, simplicity of understanding would not vary.

However, the degree of predictability varies among the different regression methodologies, albeit identical parameters are included throughout. Therefore, in determining a parsimonious fit, several indicators are observed, namely the Akaike Information Criterion, the Bayesian Information criterion, and the Hannan-Quinn Criterion. With regards to the selection of a regression model based on the indices aforementioned, Statology (2020) note that the lowest observed value is an indication of a parsimonious fit. As identified in table 5 and table 9 above, as well as table 11 to follow, the range in which the values vary is miniscule as the highest value is 31.13 and the lowest value is 28.19. As the variables within the regression model are inherently complicated in nature given their prior determination through regression processes, the Akaike Information Criterion is best representative of its complexity. Thus, the regression methodology chosen to best represent the premise of this research based on the Akaike Information criterion of 29.21, is a generalised least square regression with a cross-section parameter utilising fixed effects and a period parameter utilising common effects.

5.3.5 FINAL EMPIRICAL ESTIMATION

Table 11. Unbalanced Panel Generalised Least Square Regression (Fixed-Common Effects)

VARIABLE	COEFFICIENT	STD.ERROR	T-STATISTIC	PROB.
C	-3710602.	1159905.	-3.199056	0.0015
DRIVING DISTANCE	9757.736	3224.757	3.025883	0.0027
DRIVING ACCURACY	1911053.	598292.4	3.194179	0.0016
IRON	1674305.	780449.3	2.145309	0.0328
PUREPUTTS	-5224800.	749720.3	-6.968999	0.0000
SAND	148296.6	240095.2	0.617657	0.5373
CHIP	3288883.	538159.6	6.111353	0.0000
EVENTS	10244.10	20999.51	0.487826	0.6261
EVENTSQRD	-109.0021	587.5775	-0.188397	0.8507
PURSE	-0.004299	0.005857	-0.734061	0.4635

**Effects Specification**

Cross-Section Fixed (Dummy Variable)

R-squared	0.664335	Mean dependent variable	341834.7
Adjusted R-squared	0.390248	S.D. dependent variable	587910.3
S.E. of regression	459079.2	Akaike info criterion	29.21410
Sum squared residual	5.86E+13	Schwarz criterion	31.11855
Log likelihood	-7163.168	Hannan-Quinn criterion	29.96102
F-statistic	2.423815	Durbin-Watson statistic	3.043162
Prob (F-statistic)	0.000000		

Table 11 is a representation of the regression model utilised for the purposes of this investigation in which the cross-section parameter was run under a fixed effects condition and the period parameter was run under a common effects condition. Like the regression methodologies aforementioned, all *a priori* expectations are met regarding the expected relationships with the *vector* (X) and *vector* (Y) independent variables to the dependant variable, real earnings of professional golfers on the Sunshine Tour. Upon observation of the R<sup>2</sup> goodness-of-fit measure, a value of 0.66 (66%) is evident, thus indicating that 66% of the observed variation in the real earnings is explained by the *vector* (X) and *vector* (Y) performance measures. Furthermore, according to the F-statistic, similar to the aforementioned regression methodologies, a value which is less than 0.05 (5%) is observed. Therefore, according to the assumption of the F-statistic, the probability of the null hypothesis (H<sub>0</sub>) holding true is less than 5%. Indicating that the alternative hypothesis (H<sub>1</sub>) is accepted, reflecting statistically significant relationships between both independent and dependant variables.

## CHAPTER 6

### ANALYSIS OF DRIVE FOR SHOW, PUTT FOR DOUGH ON THE SUNSHINE TOUR

#### 6.1 VALUE OF THE MARGINAL PRODUCT; A SCENARIO ANALYSIS

With reference to both Kern and Alexander (2005); Baugher et al. (2016) and additional empirical investigations, a similar methodology is utilised in the explanation and analysis of the marginal value associated with performance measures and the increase thereof. The observed mean values are considered and therefore interpreted, exploring the subsequent marginal impact noticed to real earnings. This analysis will further note the VMP's of the mean values towards real earnings. However, a centred focus will be emphasised towards investigating various scenarios and assumptions pertaining to selected players who have been by-yearly isolated within the panel data population of the investigation (*based on a similar annual purse value to events ratio*). Investigating the impact which the VMP's display to their real earnings in isolation of the long-game (*the long game comprises player performance measures including driving and iron-playing abilities*), the short-game (*the short game comprises player performance measures focused around the green such as chipping and putting ability*), non-player performance measures (*non-player performance measures comprise explanatory, indirect performance measures*) as well as a “drive for show, putt for dough” comparative account. To establish a definitive understanding of where the performance measures fit within the game, isolation of such performance measures into respective categories of relevance provide an insight into the true impact they have towards the determination of earnings in professional golf. The proposed scenario in which the following players encounter is observed in an increase to each “pure” performance measure to the effect of 5% to their relative season end performance index. With a further addition of the VMP value elicited from a 1% improvement for comparative measures. Therefore, demonstrating the impact a marginal improvement in each performance measure elicits to total annual remuneration and order of merit standing, *ceteris paribus*. An exception is made for (PUREPUTT) however, in which an independent assumption is made, *ceteris paribus*. The assumption conditions of which it has been calculated are stated below. Furthermore, the coefficients of variation correspond to the performance increases of 1% and 5%. Although the coefficients vary slightly given the respective increases, the change in skill variation is minimal.

## 6.2 SUNSHINE TOUR ORDER OF MERIT 2018

A comprehensive account of the 2018 Sunshine Tour season is conducted below, demonstrating the aforementioned. It is further noted that real earnings for 2018 are not adjusted for inflation as 2018 CPI prices were used as the base year from which the following years real earnings (2019, 2020, 2021) were adjusted accordingly. The subsequent VMP determinations for the Sunshine Tour season's 2019 through 2021 can be observed in appendix I, II, III whereby the methodology is consistent with a 5% VMP value. In addition, *ceteris paribus* is assumed for all *vector* (X) and *vector* (Y) performance measures as the analysis denotes an isolated emphasis towards real earnings.

Table 12. Sunshine Tour Order of Merit Selected Players 2018

<i>PLAYER 1 (MEAN)</i>	PHILIP ERIKSSON	KIETH HORNE	TYRON RYAN	STEVEN LECUYER	
<b>ORDER OF MERIT</b>	46*	5	29	50	98
<b>REAL EARNINGS</b>	<b>R341 834.70</b>	R1 059 233.75	R540 629.67	R319 557.33	R77 962.50
<b>DRIVING DISTANCE</b>	<b>295.94</b>	299.22	294.35	296.74	284.50
<b>DRIVING ACCURACY</b>	<b>56%</b>	59.81%	68.55%	56.97%	48.75%
<b>(IRON)</b>	<b>66%</b>	77.36%	73.29%	68.87%	64.98%
<b>(PUREPUTT)</b>	<b>1.80</b>	1.85	1,81	1.83	1,81
<b>(CHIP)</b>	<b>51%</b>	39.42%	50.95%	50.18%	48.97%
<b>(SAND)</b>	<b>60%</b>	47.95%	54.72%	46.48%	76.67%
<b>EVENTS</b>	<b>17.68</b>	21	15	21	11
<b>PURSE</b>	<b>R10 350 118.56</b>	R13 344 756.13	R9 519 605	R13 227 856.13	R6 967 755

*The total number of players in the 2018 season was 156.*

### 6.2.1 THE LONG-GAME

The first player performance measure within the long game is driving distance. In accordance with the summary statistics from table 2, the mean driving distance observed on the Sunshine Tour throughout the sample period was 296 meters (*the mean will be referred to as Player 1*). To establish the annual VMP, the product of the driving distance statistic and the coefficient derived from the empirical estimation was divided by the number of years within the sample period. The quotient thereof, is a representation of the annual VMP for driving distance. Therefore, if *Player 1* achieved

a driving distance of 296 meters, an increase to driving distance by 1% or 5% reflects a distance of 299 meters and 310 meters respectively. *Player 1's* real earnings would experience a subsequent increase of R722 072.46 and R756 224.54 respectively. The respective increase would result in real earnings quantum's of R1 071 225.46 and R1 099 857.44. A substantial increase to *Player 1's* annual remuneration, demonstrating a hypothetical fifth position on the order of merit for both 1% and 5%.

With reference to the Sunshine Tour players listed above, Philip Eriksson concluded the 2018 season with an order of merit ranking of fifth, accumulating a seasonal remuneration as shown in table 12. An increase in distance from 299,22 meters to 302,21 at 1% and 314,18 at 5%, determine VMP values of R729 927.44 and R766 423.81 respectively. Philip Eriksson would thus experience respective increases in total annual remuneration to R1 789 161.19 and R1 825 657.56. This reflects a final position on the Sunshine Tour order of merit from fifth to second for both 1% and 5%. Just outside the top-twenty, Kieth Horne concluded the 2018 season with an order of merit ranking of twenty-ninth. Accumulating a seasonal remuneration as shown in table 12. An annual VMP value was calculated to R718 047.40 in which an increase in driving distance of 1%, from 294,35 meters to 297,29 meters was achieved. In addition, a 5% increase in driving distance to 309,07 meters resulted in a VMP value of R753 949.77. Therefore, demonstrating total annual remuneration values of R 1 258 677.07 and R1 324 579.44. Furthermore, a gained position on the final Sunshine Tour order of merit to within the top-five, from twenty-ninth to fourth for 1% and 5%. Further down the order of merit within the top-fifty, is Tyrone Ryan. Achieving a total driving distance of 296,74, Ryan concluded the 2018 season ranked fiftieth out of 156 players with a total seasonal remuneration as observed in table 12. The annual VMP value for a 1% improvement in driving distance achieved was calculated to a R723 877.65 at 299,71 meters. An increase of 5% in driving distance achieved from 296,74 meters to 311,58 meters reflected in a VMP value of R760 071.53. The subsequent increases to total annual remuneration from a 1% and 5% increase in distance achieved, places the year-end remuneration at R1 043 434.98 and R1 079 628.86 respectively. Therefore, reflecting a respective change in the Sunshine Tour order of merit rankings from fiftieth, to seventh and fifth. Steven Lecuyer, upon the conclusion of the 2018 Sunshine Tour season was ranked within the top one-hundred players at ninety-eighth on the order of merit. Lecuyer's total seasonal remuneration is observed in table 12 above. An annual VMP value for a 1% increase in driving distance from 284,5 meters to 287,35 meters was calculated to R694 018.97. Additionally, an increase in driving distance of 5%, from 284.5 meters to 298,73 meters reflected a VMP value to the effect of R728 719.92. Demonstrating respective increases in total annual remuneration to R771 981.47 and R806 682.42. A vast improvement in the order of merit rankings

is noticed whereby Steven Lecuyer would find himself marginally outside the top-ten players in the position of fourteenth and eleventh respectively.

The second player performance measure within the segment of the long game is driving accuracy. According to the summary statistics in table 2, *Player 1* demonstrated a driving accuracy percentage of 56%. Therefore, in alignment with the methodology used in establishing the annual VMP's, the product of the driving accuracy statistic and the coefficient derived from the empirical estimation was divided by the number of years within the sample period. The quotient derived thereof, is a representation of annual VMP for driving accuracy. *Player 1* is observed to have a driving accuracy index of 56%. An increase of 1% and 5% determines driving accuracy indices of 56,56% and 58,8% respectively. The respective VMP values for *Player 1* are thus identified at R270 222.89 and R280 924.79. The subsequent impact of this is noticed in an increase to real earnings. The value of the VMP's would increase *Player 1's* total annual remuneration to R612 057.59 and R622 759.49. Therefore advancing *Player 1* to a hypothetical nineteenth position on the order of merit standings for both 1% and 5%.

Philip Eriksson's driving accuracy index for the 2018 season was recorded at 60%, with his total real earnings and order of merit standing as observed in table 12. An increase in Eriksson's driving accuracy index to the effect of 1% and 5% would result in concluding seasonal indices of 60,60% and 63,0%. Therefore, postulating respective VMP values of R286 657.95 as well as R300 035.32. To this effect, Eriksson's total annual remuneration would reflect relative increases to R1 347 850.53 and R1 359 269.07. The VMP's would result in an improved ranking on the Sunshine Tour order of merit by one position, from fifth to fourth for 1% and 5%. Again, further down the order of merit, Kieth Horne's concluding driving accuracy index for the 2018 season was observed at 68,55%. A relatively impressive feat to have achieved in comparison to *Player 1*. However, a 1% and 5% increase towards the driving accuracy index to 69,24% and 71,98% respectively, would encourage an increase in real earnings of R327 506.71 and R343 893.99. The increase to real earnings from the relative VMP values would result in Horne's annual seasonal remuneration to increase to R868 136.38 and R884 523.66. Therefore, an order of merit ranking improvement to within the top-ten, from twenty-ninth to eight position for both 1% and 5%. Upon the conclusion of the 2018 season, Tyrone Ryan achieved a driving accuracy index of 56,97%, with a real earnings quantum as observed in table 12. A 1% and 5% improvement in this index would result in driving accuracy indices of 57,54% and 59,82%. Therefore, affect an increase to real earnings by R272 181.72 and R285 797.98. The VMP's would result in a growth of Ryan's total annual remuneration to R591 739.05 and R605 355.31. Furthermore, position himself in twenty-second and twentieth position respectively. Lastly, Steven Lecuyer, upon the conclusion of

the 2018 Sunshine Tour season achieved a relatively low driving accuracy index of 48,75%, with a real earnings quantum as observed in table 12. A 1% and 5% improvement to this statistic would result in driving accuracy indices of 49,24% and 51,19% respectively. However, still relatively low in comparison to Lecuyer's competitors as well as *Player 1*. Nevertheless, these percentage improvements would affect an increase in real earnings to the value of R232 909.58 R244 567.01. Therefore, determine a resultant growth in Lecuyer's total annual remuneration to the value of R310 882.08 and R322 529.51 respectively. Ascending the Sunshine Tour order of merit from ninety-eighth to fifty-second and fiftieth.

Iron playing ability (IRON) is the last player performance measure comprising the long game. The summary statistics in table 2 note that *Player 1* achieved an iron-playing ability (IRON) index of 66%. Therefore, the methodology denotes that in establishing the annual VMP's, the product of the (IRON) statistic and the coefficient derived from the empirical estimation was divided by the number of years within the sample period. The quotient derived from this is a representation of the annual VMP for (IRON). *Player 1's* (IRON) index as aforementioned was 66%, a 1% and 5% increase to this statistic encourages (IRON) indices of 66,66% and 69,30% respectively. Therefore, postulating VMP's of R267 260.33 and R290 073.34. An increase to *Player 1's* total annual remuneration is subsequently affected to values of R609 095.03 and R631 908.04 respectively. Therefore, hypothetically placing *Player 1* in nineteenth position on the order of merit for both 1% and 5%.

Philip Eriksson concluded the 2018 Sunshine Tour season with an (IRON) index of 77,36%. An improvement of 1% and 5% to Eriksson's (IRON) index generates respective (IRON) indices of 78,13% and 81,23%. Therefore, VMP values of R323 810.59 and R340 009.49 are postulated thereof. These VMP values affect an increase to Eriksson's total annual remuneration to R1 383 044.34 and R1 399 234.24 respectively, encouraging an ascended position on the Sunshine Tour order of merit rankings from fifth to third for both 1% and 5%. Kieth Horne concluded the 2018 Sunshine Tour season with an (IRON) index of 73,29%. Furthermore, Horne's real earnings for the season are presented in table 12 above. A 1% and 5% increase to Horne's (IRON) index would result in indices of 74,02% and 76,95% respectively, postulating subsequent VMP values of R306 774.53 and R322 094.42. Such increases in real earnings by virtue of the VMP's, would increase Horne's total annual remuneration to values of R847 404,20 and R862 742,09 respectively. Therefore, demonstrating a much greater ascension to that of Philip Eriksson, albeit similar VMP values. Kieth Horne would have gained in position on the order of merit from twenty-ninth to within the top-ten, in ninth position for both 1% and 5%. Tyrone Ryan concluded the 2018 Sunshine Tour season with an (IRON) index of 68,87%. Additionally, Ryan's real earnings for the

2018 season are noted in table 12 above. An improvement of 1% and 5% in Ryan's (IRON) index would result in indices of 69,56% and 72,31%. Therefore, the associated respective VMP values are observed at R288 273.46 and R302 678.49. A subsequent increase to Ryan's total annual remuneration is noticed to the effect of R607 830.79 and R622 235.82 respectively. Furthermore, encouraging an ascension on the Sunshine Tour order of merit from fiftieth to nineteenth and twentieth. Lastly, Steven Lecuyer concluded the 2018 Sunshine Tour season with a (IRON) index of 64,98%. In which, Lecuyer's real earnings are observed in table 12. A 1% and 5% improvement in Lecuyer's (IRON) index determine indices of 65,63% and 68,23% respectively. The subsequent VMP's calculated to that effect are R271 990.85 and R285 594.58. Thus, the increase in real earnings by virtue of the VMP's would denote respective increases in Lecuyer's total annual remuneration to both R349 953.32 and R363 557.08. An order of merit ascension is therefore encouraged as Lecuyer would rise to within the top-fifty, from ninety-eight to forty-second and forty-sixth.

### 6.2.2 THE SHORT-GAME

The first player performance measure within the segment of the short game is putting ability (PUREPUTT). In order to calculate the VMP for (PUREPUTT), a slightly altered methodology was used to that of Kern and Alexander (2005). Similar to Kern and Alexander (2005), the coefficient value from the regression model for (PUREPUTT) was substantially higher than the other independent variables within the investigation. Therefore, Kern and Alexander (2005) engineered a solution which isolated the value for one less putt per round of golf played. Therefore, lowering the final score through 18 holes of golf by one, *ceteris paribus*. However, this investigation determines a new assumption. In order to record a score of level par on an 18-hole golf course, a score of 72 is required. Therefore, two assumptions are made for this player performance measure. Firstly, an average is determined for the leading putting statistics recorded from 2018 to 2021. Secondly, an assumption is made which is premised on an improvement in player's putting ability to the effect of 5%.

*Ceteris paribus*, a player makes 1.5 putts per hole, acquiring a total of 27 putts per round. The quotient of the par score (72), and the number of putts aforementioned (27), determines a parameter of 2.67 shots per round of golf. Through subtracting the parameter of 2.67 from the par score of 72, an ideal, realistic score per round (*as a result of putting performance, ceteris paribus*) of 69,33 is acquired. However, this value is rounded to a score 69 (*given golf scores can only be whole quantities*). Thus, implying that payers save 3 shots per round, *ceteris paribus*. Empirically, Kern and Alexander (2005) divided the coefficient by their calculated parameter of 13, given their data and methodology. Nevertheless, the (PUREPUTT) coefficient for this investigation is divided by 3 to establish a realistic,

plausible coefficient for this player performance measure. As aforementioned, in order to establish the annual VMP, the product of the (PUREPUTT) statistic and the new coefficient derived from the above assumption was divided by the number of years within the sample period. The quotient thereof, is a representation of the annual VMP for (PUREPUTT).

*Player 1* subsequently recorded 1.8 putts per green hit in regulation for the 2018 Sunshine Tour season. A 5% improvement in the statistic is represented by 1.71 putts per green in regulation and 31 putts per round. Thus, according to the assumption, the VMP value for achieving 1.5 putts per green hit in regulation denotes a VMP value of R744 534. Reflecting a difference of four strokes. Further observed in an increase to *Player 1's* total annual remuneration to R1 086 368.70. A hypothetical order of merit ranking position of fifth is achieved (*the inherent stroke differences are calculated by subtracting the less 5% putts per round statistic, (1.71 putts multiplied by 18 holes = 31 putts) from the assumption (1.5 putts multiplied by 18 holes = 27 putts). Putts per round are therefore rounded values given that a putt is a full stroke. Therefore, required to be a whole number*). Philip Eriksson, upon conclusion of the 2018 Sunshine Tour season recorded 1.85 putts per green hit in regulation with a real earnings value as seen in table 12. In assuming that Eriksson decreased this statistic by 5%, recording 1.76 putts per green hit in regulation and 32 total putts. According to the (PUREPUTT) assumption, the annual VMP value for the decrease in number of putts is calculated to R766 304. Therefore, with the additional (PUREPUTT) VMP, Eriksson's total annual remuneration would have increased to R1 825 537.75. Furthermore, having ascended the order of merit rankings from fifth to second position. Thus, reflecting a difference of five strokes per round. Kieth Horne held an order of merit ranking of twenty-ninth, with a real earnings value as observed in table 12. Horne recorded 1.81 putts per green hit in regulation. However, in assuming Horne's putts per green hit in regulation statistic decreased by 5% to 1.72 putts, the VMP value to this effect is calculated at R748 888. Therefore, upon the conclusion of the 2018 Sunshine Tour season, with a (PUREPUTT) VMP as aforementioned, Horne's total annual remuneration would have amounted to R1 289 517.67. Increasing his ranking position on the order of merit to fourth, reflecting a difference of four strokes. Tyrone Ryan concluded the 2018 Sunshine Tour season ranked fiftieth on the order of merit with a real earnings value as observed in table 12. With a decrease in Ryan's putts per green hit in regulation by 5% from 1.83 to 1.74, the (PUREPUTT) VMP value to this effect is calculated to R757 596. This in turn would result in an increase towards Ryan's total annual remuneration to a quantum of R1 077 153.33. Furthermore, promote an ascension on the order of merit rankings to within the top-ten players at fifth position, reflecting a difference of four strokes. Steven Lecuyer concluded the 2018 Sunshine Tour season with a ranking position on the order of merit of ninety-eighth, with real earnings as seen in table 12. Assuming Lecuyer decreased his putts per green hit

in regulation by 5%, from 1,81 to 1.72, the (PUREPUTT) VMP value to this effect is calculated to R748 888. The (PUREPUTT) VMP therefore, would reflect an increase in Lecuyer's total annual remuneration for the 2018 season to the value of R826 850.50. Further encouraging an ascension to within the top-ten on the order of merit rankings to ninth position. Thus, reflecting a difference of four strokes.

Chipping ability (CHIP) is the second player performance measure within the segment of the short game. As the annual VMP methodology for this investigation dictates, the product of the scrambling statistic and the coefficient derived from the empirical estimation was divided by the number of years within the sample period. The quotient thereof, is a representation of annual VMP's for (CHIP). Thus, the summary statistics in table 2 denote that *Player 1* demonstrated a (CHIP) index of 51%. An increase in this index of 1% and 5% to 51,51% and 53,55%, reflect an annual (CHIP) VMP's to the effect of R419 332.58 and R440 299.21 respectively. Therefore, indicating that *Player 1*'s respective total annual remuneration would increase to R761 165.28 and R782 131.91. Furthermore, *Player 1* would establish hypothetical order of merit standings of thirteenth and sixteenth.

Philip Eriksson concluded the 2018 Sunshine Tour season in fifth position with a real earnings value as observed in table 12. Eriksson's (CHIP) index was recorded at a relatively low 39,42%. An increase of both 1% and 5% would amount to (CHIP) indices of 39,81% and 41,39%. Subsequent VMP values to this effect are calculated to R324 119.42 and R340 317.17. Therefore, demonstrating that Eriksson's total annual remuneration would increase to R1 383 353.17 and R1 399 550.92 respectively, ascending to fourth and third position on the concluding Sunshine Tour order of merit. Kieth Horne concluded the 2018 Sunshine Tour season with a (CHIP) index of 50,95% with a real earnings value as observed in table 12. An increase in Horne's (CHIP) index of 1% and 5% would postulate indices of 51,46% and 53,50%. To this effect, Horne's annual (CHIP) VMP's were thus calculated to R418 921.47 and R439 888.10 respectively. Therefore, a subsequent increase to Horne's total annual remuneration per percentage increase is affected to the values of R959 551.14 and R980 517.77. In addition, a further ascension on the final order of merit is promoted to respective positions within the top-ten, of ninth and seventh. Tyrone Ryan's concluding order of merit ranking for the 2018 Sunshine Tour season was observed at fiftieth, with real earnings noted in table 12. Furthermore, concluding with a (CHIP) index of 50,18%. An increase of 1% and 5% to this index would affect improved indices of 50,68% as well as 52,69% respectively. Therefore, with calculated (CHIP) VMP's of R412 590.37 and R433 228.11, Ryan's total annual remuneration would increase to the relative values of R732 147.70 and R752 785.44. Improving his position on the concluded order of merit standings to sixteenth and fifteenth. Lastly, Steven Lecuyer concluded the 2018 Sunshine Tour season with a real earnings value as seen in

table 12, and a (CHIP) index of 48.97%. With an improvement to the degree of 1% and 5% towards this index, Lecuyer's (CHIP) VMP's are calculated to R402 641.50 at 49,46% and R422 785.91 at 51,42%. To this effect, Steven Lecuyer's total annual remuneration for the 2018 Sunshine Tour season would have increased to R480 604 and R500 748.41 respectively. Therefore, ascending Lecuyer on the concluded order of merit to thirty-third and thirty-second position.

The last player performance measure within the segment of the short game is sand-playing ability (SAND). In order to establish the annual VMP's, the product of the sand-save statistic and the coefficient derived from the empirical estimation was divided by the number of years within the sample period. The quotient derived thereof, is a representation of the annual VMP for sand-save ability (SAND). *Player 1* is observed to have a (SAND) index of 60% in which *Player 1's* real earnings are observed in table 12. An increase of 1% and 5% postulate (SAND) VMP's of R22 244.49 at 60,60% and R23 356.71 at 63%. Therefore, *Player 1's* total annual remuneration would increase to the values of R364 079.19 and R365 191.41 respectively. Demonstrating a hypothetical order of merit position adjustment to forty-third and forty-second.

Philip Eriksson concluded the 2018 Sunshine Tour season with a (SAND) index of 47,95% whereby Eriksson's real earnings for 2018 are observed in table 12. With an increase of 1% and 5%, (SAND) VMP's are calculated to the effect of R17 777.05 at 48,43% and R18 666.83 at 50,35%. Therefore, a total annual remuneration for 2018 is observed at R1 077 010.80 and R1 077 900.58 respectively. Philip Eriksson would retain fifth position at 5% and assume sixth position at 1% on the order of merit. Kieth Horne achieved a (SAND) index of 54,72% upon conclusion of the 2018 Sunshine Tour season with a real earnings value as observed in table 12. An increase of Horne's (SAND) index by 1% to 55,27% and 5% to 57,46%, postulates (SAND) VMP's to the values of both R20 286.97 and R21 302.81. The result of these VMP additions affect relative increases to total annual remuneration values of R560 916.64 and R561 932.48. Kieth Horne would therefore ascend the order of merit standings to twenty-seventh position as well as twenty-sixth position, respectively. Tyrone Ryan, upon conclusion of the 2018 Sunshine Tour season, achieved a (SAND) index of 46,48% and a total real earnings as noted in table 12. A 1% and 5% increase to this index denotes VMP values of both R17 232.06 at 46,94% and R18 092.19 at 48,80%. Thus, reflecting an increase in real earnings to R336 789.39 and R337 649.52 respectively, coupled by an ascension on the 2018 order of merit standing to forty-seventh and forty-sixth position. Lastly, Steven Lecuyer achieved a (SAND) index of 76,67%, a substantially higher index opposed to his fellow competitors. A 1% and 5% improvement in Lecuyer's (SAND) index postulates indices of 77,44% and 80,50%. Therefore, denoting respective VMP values of R28 424.75 and R29 844.69. To this effect, Lecuyer's total annual remuneration upon conclusion of the 2018

Sunshine Tour season would increase to R106 387.25 and R107 807.19 respectively, moving up the order of merit standing to ninetieth position and eighty-ninth position.

### 6.2.3 NON-PLAYER PERFORMANCE MEASURES

The non-player performance measures comprise (EVENTS) participated in as well as (PURSE). *Player 1* competed in 18 events in which the VMP value for participating in one additional event is calculated to R46 098.45. Therefore, real earnings as observed in table 12, would increase to a value of R387 933.15. Additionally, *Player 1* would ascend to thirty-ninth position on the order of merit. Phillip Eriksson during the 2018 Sunshine Tour season participated in 21 events in which the VMP value of competing in 1 additional event is calculated to the value of R 53 781.53. Given this determination, Eriksson's total annual remuneration for the concluded 2018 season would increase to R1 113 015.28. Therefore like (SAND), Eriksson would remain at fifth position on the order of merit standings. Kieth Horne only participated in 15 events throughout the 2018 Sunshine Tour season. The VMP value of participating in 1 additional event is calculated to the value of R38 415.38. Therefore, Horne's total annual remuneration would increase to the quantum of R579 045.05 for the 2018 season, resulting in an ascension to twenty-second on the final order of merit standings. Like Philip Eriksson, Tyrone Ryan too competed in 21 events throughout the 2018 Sunshine Tour season in which the VMP value for competing in 1 additional tournament is calculated to R 53 781.53. Thus, Ryan's total annual remuneration would increase to the value of R373 338.86, ascending to fourteenth position on the concluded order of merit standings for 2018. Steven Lecuyer participated in the least events, only competing in 11 events throughout the 2018 season of the Sunshine Tour. The VMP value calculated for competing in 1 additional event is R28 171.28. This denotes an increase in total annual remuneration for the 2018 season of R106 133.78. Ascending Lecuyer to ninety-first position on the concluded order of merit standings.

Unlike (EVENTS), (PURSE) demonstrated a negative impact on real earnings. In this regard, a host of partial explanations are noticed. Firstly, increased participation in tournaments does not necessarily reflect an increase in real earnings. Rather, an efficient performance is required to become eligible to earn, let alone make the tournament cut. Players are therefore required to exhibit playing performances which endorse opportunistic positions in golf tournaments. Secondly, the prestige attached to different events dictate larger purse's available per tournament and hence, availability of increased earnings potential. Although the size of a tournament purse increases with time through additional Sunshine Tour partnerships and the expansion of co-sanctioned events as mentioned by Baugher et al. (2016), an efficient performance is necessary. Difficult golf course

conditions due to layout provisioning, coupled with the increasing length of golf courses create heightened difficulty. Thus, regardless of purse size, players still need to excel through performance, as opportunistic earning positions are subject to playing performance. Therefore, creating an environment in which the margin for error is greatly diminished.

Nevertheless, competing in an increased number of events does display a positive relationship with earnings as players increase their earning opportunity. It was noticed however, that the 2020 Sunshine Tour season was heavily impacted by the COVID-19 pandemic in which only 11 tournaments were permitted. Thus, unlike the other periods within the sample data, the opportunity for prospective earnings growth through increased participation in events was not evident to the same degree. Albeit evident, given the tournament restrictions. Kern and Alexander (2005) identified that players within their sample period were observed to be competing in a range diminishing returns. A similar notion is identified in this investigation as observed by ( $EVENTS^2$ ). It is noted that the marginal impact of events played achieves a maximum of 27 events (*quotient of  $EVENTS^2$  coefficient and number of periods*). Therefore, none of the players aforementioned in the 2018 Sunshine Tour season competed in a in the range of diminishing returns. However, it was noticed that players were in fact competing in a range of diminishing returns in the 2021 Sunshine Tour season.

#### 6.2.4 DRIVE FOR SHOW, PUTT FOR DOUGH?

In considering the determined “pure” performance measure VMP values, the Sunshine Tour order of merit, and the resultant VMP order of merit conclusions for the investigation sample periods (2019, 2020 and 2021 found in appendices I, II, III), a determination is necessary with reference to Kern & Alexander (2005) and Baugher et al. (2016). Such determination considers which player performance measures, driving distance or (PUREPUTT) assumes the greatest value towards real earnings. Therefore, identifying the presence of a similar trend on the Sunshine Tour to the recently discovered spike in value attached to driving distance. Empirically, (PUREPUTT) does not follow an identical methodology with regards to the inherent assumption made. However, in a comparative notion, denotes accurate VMP determinations on the basis of the impact elicited to real earnings through the aforementioned shot saving required to match the calculated average of the putting statistic leaders from 2018 through to 2021.

The subsequent result from both Philip Eriksson’s driving distance at 1% and 5%, as well as (PUREPUTT) VMP values, encouraged an ascension on the order of merit from fifth to second position. The observed growth in real earnings associated to putting ability was marginally less than that of driving distance at the 5% level. However, greater at the 1% level, noted by the respective driving distance VMP values of R729 927.44 and R766 423.81. Eriksson’s VMP for

(PUREPUTT) was R766 304, indicating that (PUREPUTT) elicits greater value in terms of growth to real earnings than driving distance at the 1% level. However, a 5% increase in driving distance encourages marginally greater growth to real earnings. Kieth Horne recorded driving distance VMP's to the value of R718 047.40 at the 1% level and R753 949.77 at the 5% level. The result of the marginal growth in earning saw Horne concluding the 2018 Sunshine Tour season in fourth position on the order of merit for both performance level increases. The VMP quantum associated to (PUREPUTT) reflected marginal earnings to the effect of R748 888. Thereby, ascending Horne on the order of merit standings to again, fourth position. As observed, the real earnings growth depicted from driving distance at the 1% level is less than (PURPUTT). However, greater at the 5% level for Kieth Horne. Tyrone Ryan recorded driving distance VMP's to the value of R723 877.65 at the 1% level, and R760 071.53 at the 5% level. This therefore, encouraged an order of merit ranking ascension to seventh and fifth position respectively, from fifteenth. Ryan's VMP for (PUREPUTT) depicts a growth in real earnings to the effect of R757 596, subsequently placing him in the same position as his 5% driving distance VMP of fifth position on the order of merit standings. Therefore, upon observation, the growth in real earnings for an increase in efficiency in (PUREPUTT) is less than that of driving distance at the 5% level. However, greater at the 1% level for Tyrone Ryan. Lastly, Steven Lecuyer recorded a VMP for driving distance to the value of R694 018.97 at the 1% level and R728 719.92 at the 5% level. This marginal growth in real earnings reflected an ascension on the order of merit standings to fourteenth and eleventh position respectively. Lecuyer's VMP associated to (PUREPUTT), demonstrates a growth in real earnings for 2018 to the effect of R748888. Therefore, encouraging an ascension on the order of merit standings to ninth position. To the contrary of Lecuyer's competitors, the observed growth in real earnings for driving distance at the 1% level as well as the 5% level is less than that of (PUREPUTT) for Steven Lecuyer.

The remaining periods from the investigation determine similar observations with regards to the relative impact driving distance, to both the 1% and 5% levels as well as (PUREPUTT) display towards real earnings. An increase in driving distance to the 5% level shows consistency as eliciting the greatest VMP due to the degree of change in distance. Wilco (2018) mentions that for every mile per hour increase in the golf swing, the golf ball travels an additional three yards (*2.74 meters*). Furthermore, in a strokes gained driving perspective, driving distance elicited the greatest contribution opposed to driving accuracy at approximately two-thirds vs. one-third towards strokes gained driving. Thus, representing the inherent value attached to this player performance measure. A substantial increase in distance to the extent of 5% would no doubt be associated with a high VMP. However with reference to the appendices, the 2019, 2020 and 2021 Sunshine Tour season

illustrate that (PUREPUTT) elicited greater VMP's towards real earnings opposed to an increase in driving distance by 1%. Although, three exceptions were identified within the data population in which driving distance was more valuable than (PUREPUTT) at the 1% level.

Reflecting on the analysis of the long-game, the VMP for driving distance consistently demonstrates a more substantial contribution to real earnings opposed to both driving accuracy and (IRON). The 1% and 5% VMP increases to driving distance not only encourage a sizeable increase to annual real earnings, but also contributes to the ascension of player standings on the year end order of merit. The adjusted conclusion of the order of merit standings further secures a gain in the order of merit points structure, standing players in good stead with regards to tournament qualification as well as tour promotion. In addition to this, a similar trend identified by Baugher et al. (2016) is noticed in the value associated with driving distance.

Driving accuracy and (IRON) are closely matched in terms of their VMP impact on real earnings. The significance in the change in real earnings opposed to the change in order of merit ranking position varies per performance measure, per season. Therefore, as observed, both driving accuracy and (IRON) share a significant impact in the performance measure arsenal.

Within the short-game, (PUREPUTT) demonstrated the greatest impact on real earning throughout. Although a marginally lesser significance value to that of driving distance with a 5% increase, a greater significance was noticed in VMP value in comparison to driving distance to the 1% level. Therefore, demonstrating a similar effect to driving distance with regards to the subsequent ascensions on the adjusted order of merit standings in conjunction with the benefits associated. The (CHIP) VMP of players was observed at similar, but higher levels in comparison to driving accuracy and (IRON) as they all represent important aspects of a sound golf game. Thus, as noted above, the ascensions on the order of merit and growth to real earnings are a reflection of that. The (SAND) VMP's were all observed at a significantly lower level than the player-performance measures aforementioned. Due to relatively minute and insignificant impact towards adjusted real earnings, a resultant descent on the 2021 Sunshine Tour order of merit was noticed.

Although (EVENTS) demonstrated a positive relationship towards real earnings, (PURSE) did not follow suit as mentioned in the analysis above, highlighted by explanations to that effect. Furthermore, it was observed that competing in a range of diminishing returns was only evident in the 2021 Sunshine Tour season.

## CHAPTER 7

### DISCUSSION AND CONCLUSION: WHAT DOES THIS MEAN FOR THE ADAGE?

The adage “drive for show, putt for dough” will remain cemented in the foundations of the game of golf for some time to come given the delicate balance which exists between the two performance measures. As per the (USGA, 2021), the distance debate led by the distance insights project has only but reached the surface given the proposed AoI’s being continuously emphasised. The AoI’s as described by Kerr-Dineen (2021) are all categorised by a single fundamental objective, regulating the unsustainable impact in which distance achievable in golf presents to the current state of the game. The range in which these impacts extend are unprecedented. Golf course designers are faced with a variety of pressures, social as well as monetary. Subsequently, the current solution towards tackling the rapid increase of distance achievable in golf is to create the addition of length to design (USGA, 2021). As aforementioned, the social as well as monetary pressures which have made themselves ever-present, are accompanied by immense capital implications for golf courses in the need to outlay ever-increasing expenditure. As noted by Dusek, (2020), the foremost implication which the distance insights report is attempting to troubleshoot is the retention of “skills-based golf”. Distance has become an overwhelming advantage to established golf courses as strategically designed obstacles have, or are, on the fast-track to becoming obsolete. Therefore, regaining the fundamentals of the game such as strategy and risk vs. reward, are of utmost importance for the regulatory bodies of golf. The challenge thereof, aims at addressing the unsustainable path in which distance in golf finds itself. The proposed solutions are aimed at gaining a more advanced, technically orientated understanding of mitigation measures. Furthermore, the distance insights project is scheduled for an updated release regarding the decisions made concerning the AoI’s in question. Thus, taking the initial steps towards encouraging a more sustainable path for the future of the game.

The extent to which the capabilities of driving distance have been made possible are observed through technology and the effect to which it is incorporated into sport, and more specifically, golf. Omoregie (2016) identified five categories in which technology is recognised in sport. Spanning from concepts such as performance enhancement, pertaining to technology and the capabilities thereof. Highlighted by the contribution towards the aid of “golf fitness”, outlined by Brearley et al. (2019). This concept emphasised two aspects within golf. Firstly, the lifestyle of players is considered, as the modern game places an emphasis on physical fitness. This aspect ranges across the breadth of a healthy lifestyle, incorporating a training regime which prioritises a good diet,

consistent strength training as well as cardiovascular endurance. Not only does this support the requirements of a professional athlete, but further encourages increased speed and a greater range of motion within the golf swing. Thus, supporting the increased degree of distance which is now achievable. This notion is thus extendable to the highly technology orientated state of training in golf. Lieberman et al. (2002) identified the inherent benefits noticed in athletes with regards to feedback techniques, most notably, video-feedback. In utilising video-feedback and other sophisticated training aids, players are able to isolate efficiency hindering movements and apply necessary adjustment to swing techniques in order to maximize the efficiency of their swing. Coupled with the technology drive in equipment, noticed by Heiny (2008); Jorgensen (2006) and Titleist (2020). The objective thereof, emphasises testing the limits of manufacturing to create a product which delivers maximum efficiency. Therefore, utilising the most modern of technologies towards achieving better performance noticed in all aspects of the game such as control, consistency, feel as well as distance. The technology drive aforementioned, has subsequently contributed to the overall growth in the game. The distance which professional golfers are able to achieve, coupled with the entertainment factor for spectators, attracts many new entrants to golf, both internationally and within a South African perspective. As mentioned by Complete Golfer (2019), the increased popularity of the sport in South Africa was observed by the consistent, steadfast growth in the number of new official golf handicaps created. Therefore, given the premise of the adage in question, and the extent to which the impact of driving distance has contributed to the growth in the game, what monetary valuation is recognised in this regard?

In the identification thereof, an analysis of the human capital characteristics inherent to the game of golf were investigated in utilising an earnings-based production function. Profit maximization in the regard of professional sport is recognised as a function of human capital and the formation thereof. Thus, it was noticed that the individual aspects which comprise the game of golf are subject to the level of productivity and therefore, efficiency, resultant of ROI. The continual improvement and addition to the store of human capital therefore elicit a direct effect to the level and rate of the ROI in golf. Notably, the concept of “strokes gained” pioneered by Broadie (2014) has provided the platform for players to identify their respective ROI’s within their individual performance arsenal’s. Heckman et al. (2003) outlined the earnings function derived by Mincer (1958). Therefore, setting the premise for the investigation in which sport, was recognised in its underlying typology. As noted, this determinant of earnings function had empirically been applied to multiple sporting codes, one of which was professional golf.

The empirical relationship with determinants of earnings and golf originated from Davidson and Templin (1986). Subsequently, a host of investigations followed suit. The array of inquiries conducted, were focused on the PGA Tour, given the calibre of golfers participating and the vast availability of data necessary to conduct such investigations. Through exploration thereof, different regression methodologies were apparent. However, all methodologies were premised on an earnings-based production function, ranging from linear multiple regressions, step-wise multiple regressions as well as quantile regression analyses. With the exception of Scully (2002) and Callan and Thomas (2007), these earnings determination investigations shared similar production function characteristics with regards to earnings as the dependant variable, and performance measures in golf as the independent, regressor variables. Interestingly, all but one demonstrated the intrinsic value noticed in the ability of putting. Thus, contributing to the maintenance of the adage “drive for show, putt for dough”. Subjectively, this notion is accepted through a lens of general golfer-orientated logic in that the act of putting is the only performance variable which is utilised on every hole, with rare exceptions. Objectively however, recent statistically factual empirical accounts suggest to the contrary. Broadie (2014) notes that statistically, the adage has led to a misinterpretation and overvaluation of the putting variable, evident in a strokes gained perspective. Therefore, suggesting an overvaluation of “drive for show, putt for dough”.

Nevertheless, Kern & Alexander (2005) investigated the robustness of the adage on the PGA Tour utilising an adaptive methodology pioneered by Berry (1999). For Kern and Alexander (2005), the strength of the adage held true. In response to this, Baugher et al. (2016) revisited the investigation, identifying a modern trend in the rise in value associated with driving distance in surpassing putting ability. Therefore, for the first time, challenging the very foundation of the adage.

Conducting this investigation in the perspective of the Sunshine Tour presented an array of limitations and necessary adaptations. The first and second limitation work synonymously, noting the lack of data available through the Sunshine Tour. Empirically, data regarding sand saving ability and driving distance was unavailable through the Sunshine Tour platform. In addition, by-yearly data for several performance measures was unavailable. Therefore, hindering reliability. The second limitation promoted an adaptation to the Kern and Alexander (2005) investigation given the limited time parameters available, by virtue of data unreliability. Therefore, a lesser time parameter was used. The PGA Tour holds an incomprehensible advantage in their data capturing ability. This is realised in the sophistication of ShotLink, having the ability to capture statistics which the Sunshine Tour do not. Such statistics include those used in comprising (CHIP). Lastly, in estimating

the empirical model, parameters were unavailable with regards to random effects testing. Given the size of the cross-sectional data, as well as unbalanced nature thereof, the use of random effects was limited for both the cross section and period parameters.

Nevertheless, performance measures were arranged based on their intrinsic value in terms of direct player-performance measures and indirect non-player performance measures. Linear regressions were conducted with inter-related player-performance measures to generate “pure” measures of performance (Berry, 1999). The residuals thereof, represented the variation observed that is not explained by the other regressor variables which form part of a “pure” performance measure. Thus, in performing a GLS regression analysis, a determination was required based on the inherent parameter variations. The subsequent descriptive statistics reflected a number of interesting observations. In a Sunshine Tour perspective, multiple similarities in the statistics were found to that of both Fraser et al. (2015) as well as Botha et al. (2020). However interestingly, noticeable differences were observed in comparison to empirical PGA Tour descriptive statistics. Additionally, this too was identified in the coefficient of variation analysis. Suggesting an observed difference in the level of competitiveness within the Sunshine Tour and PGA Tour respectively. Following the GLS panel data regression and the VMP analysis thereof, a comprehensive scenario analysis was conducted. The scenario analysis focused on the 2018 Sunshine Tour season. Exploring the VMP effect towards real earnings, set in 2018 prices, for several selected individuals based on a determined ratio. The findings thereof, postulate an interesting perspective into the current state of the adage. A convincing, reoccurring trend was noticed throughout each period reflecting the sentiment identified by empirical literature. The consistent, significant value of putting ability was noticed. However, the sentiment postulated by Baugher et al. (2016) was further identified in the ever-increasing value attached to driving distance. The impact displayed by the VMP's toward real earnings for (PUREPUTT), marginally trumped driving distance at the 1% level throughout all periods within the panel data. However, exceptions were present. Although the adjusted order of merit standings postulates similar outcomes, the marginal value associated with driving distance demonstrated a marginally lesser ROI with an increase of 1% opposed to the (PUREPUTT) assumption, *ceteris paribus*. Albeit a greater ROI regarding a 5% increase in driving distance. What does this mean for the adage?

As noticed with the changing environment of modern golf, technological applications are ever-increasing the performance and capabilities which athletes are capable of. Movement technologies, information technologies, landscape technologies as well as implement technologies, have displayed an immense influence towards how golf, and sport in general, is conducted in this modern era. The globalisation of golf has not only contributed to the growth of the game, but also to global

adaptation of the game. Noticed in the recently evident capabilities of professional golfers. The rate at which technology in golf equipment is evolving is incomprehensible. As noted by Chamblee (2021), a consequence as well as a solution towards combating the capabilities of modern equipment is creating golf course conditions which are increasingly difficult. In addition to the prospective distance insights report conclusions which are approaching rapidly (USGA, 2021). This, however, highlights the importance of equal human capital formation among performance measures to achieve a balanced ROI. Having to make a trade-off in the interest of improvement between performance measures hinders the advantage of displaying a balanced, yet efficient arsenal of skills. As noted, (PURSE) displayed a negative relationship with real earnings. Unless players put themselves in opportunistic positions to earn, the quantum of the prize fund carries no significance. However, having the ability for players to consistently find themselves in these positions requires an all-round display of efficiency, in all aspects of the game. Thus, a VMP advantage to performance measures does have a significant impact towards the level of real earnings achievable, *ceteris paribus*. However, an increased quantum of real earnings originates from the ability for players to put themselves in consistent opportunistic positions through a comprehensive ability level. Therefore, the adage would dictate to “drive for dough to putt for dough”.

The outcome of this investigation statistically demonstrates the robustness of the adage. However, the evidently changing nature of performance measures in golf with regards to the recognition of the change in trend mentioned by Baugher et al. (2016) is ever-present. Although a convincing trend was identified by Baugher et al. (2016) on the PGA Tour, a lesser, although present trend is nevertheless evident on Sunshine Tour. Associated with the value which driving distance demonstrates over putting ability. This further highlights the very nature of the inception of the distance insights report as the governing bodies of golf recognised a driving distance problem was upon the horizon. Therefore, this investigation dictates that you indeed “drive for dough to putt for dough”.

An interesting recommendation to consider would be the inclusion of a driving proficiency performance measure as a combined variable. Davidson and Templin (1986) pioneered the variable in the first determinant of earnings study in golf. It would be fascinating to observe the inherent impact in both an isolated determinant of earnings setting as well as in revisiting the “pure” performance measure inquiry towards the “drive for show, putt for dough” debate. Furthermore, revisiting this debate with the aforementioned driving proficiency variable would postulate interesting findings upon further development of the Sunshine Tour data platform to the degree in which the PGA Tour conducts statistical analysis and representation. The LIV golf Tour is a new tour which has recently emerged, posing direct competition to the PGA Tour. An interesting

investigation is identified in the cost implications with regards to the inception of the tour, as well as maintenance costs involved in comparison to the PGA Tour and DP World Tour. Furthermore, a determinant of earnings inquiry, focusing on both the team aspect as well as the individual would be interesting to observe.

Additionally, given the lengthening of golf courses and the various pressures facing golf courses, an interesting investigation could emerge in conducting a cost-benefit analysis. This investigation could explore the pressures noted by the distance insights report. Therefore, costs include the increased use of water given its increasing scarcity. The increased use of chemicals (*herbicides, pesticides, fungicides*) inherent to an addition in the length of golf courses. The increase in capital outlay and maintenance expenditure. Destruction of habitats, as well as societal impacts which may be realised. Benefits may include growing use of the golf course given the length increase, as well as support to local communities through monetary investment or infrastructural investment. It would be an interesting prospect to investigate the true impact elicited by the lengthening of golf courses. Upon conclusion of distance insights report with consideration to the decisions made regarding the AoI's, further inquiry into the economic consequences thereof can be explored. However, the governing bodies of golf need to take careful consideration regarding the decisions made to ensure the sustainability and future growth of the game.

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## APPENDIX

### I. 2019 SUNSHINE TOUR 5% VMP VALUES

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2019	JACQUES BLAAUW	DYLAN NAIDOO	CJ DU PLASSIS	KEELAN VAN WYK
<b>REAL EARNINGS</b>	R860 099.56	R421 719.85	R341 241.45	R34 588.24
<b>DRIVING DISTANCE 5%</b>	R735 507.65	R762 761	R779 512.60	R779 307.69
<b>DRIVING DISTANCE 1%</b>	R700 483.47	R726 439.05	R742 392.93	R742 197.79
<b>DRIVING ACCURACY</b>	R297 328.79	R258 250.15	R302 545.97	R299 786.89
<b>IRON</b>	R266 515.87	R234 915.46	R243 002.35	R196 107.16
<b>PUREPUTT</b>	R731 472	R761 950	R744 534	R766 304
<b>CHIP</b>	R523 507.95	R461 430.28	R477 299.15	R385 210.42
<b>SAND</b>	R21 628.32	R23 956.20	R24 773.69	R22 706.62
<b>EVENTS</b>	R56 342.55	R61 464.60	R58 903.58	R38 415.38

### II. 2020 SUNSHINE TOUR 5% VMP VALUES

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2020	NIKHIL RAMA	MUSIWAL NETHUNZWI	SEAN BRADLEY	THABISO NGCOBO
<b>REAL EARNINGS</b>	R21 998.48	R 18 018.38	R12 605	R7 133.96
<b>DRIVING DISTANCE 5%</b>	R749 851.52	R 770 982.77	R776 105.93	R804 281.39
<b>DRIVING DISTANCE 1%</b>	R714 144.30	R734 269.63	R739 148.50	R765 982.28
<b>DRIVING ACCURACY</b>	R215 007.80	R 322 511.69	R197 098.84	R197 098.84
<b>IRON</b>	R293 018.03	R 207 534.30	R268 581.55	R219 752.54
<b>PUREPUTT</b>	R696 640	R 753 242	R770 658	R735 826
<b>CHIP</b>	R172 666.36	R 499 782.78	R431 665.90	R383 664.65
<b>SAND</b>	R9 731.97	R 24 329.91	R19 463.93	R16 684.48
<b>EVENTS</b>	R28 171.28	R 25 610.25	R25 610.25	R25 610.25

III. 2021 SUNSHINE TOUR 5% VMP VALUES

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2021	PIETER MOOLMAN	LUKE JERLING	MALCOM MITCHELL	PETER KARMIS
<b>REAL EARNINGS</b>	R927 653.62	R766 449.82	R385 549.54	R257 354
<b>DRIVING DISTANCE 5%</b>	R789 783.83	R755 845.21	R755 435.38	R714 811.49
<b>DRIVING DISTANCE 1%</b>	R752 175.08	R719 852.58	R719 462.27	R680 772.85
<b>DRIVING ACCURACY</b>	R307 462.16	R265 674.59	R284 938.01	R338 815.37
<b>IRON</b>	R300 621.47	R316 531.55	R299 610.60	R289 370.13
<b>PUREPUTT</b>	R722 764	R740 180	R735 826	R740 180
<b>CHIP</b>	R450 227.53	R456 788.85	R484 156.47	R544 071.70
<b>SAND</b>	R21 475.50	R21 390.86	R22 850.66	R20 211.35
<b>EVENTS</b>	R76 830.75	R74 269.73	R71 708.70	R56 342.55