Graphical user interface, application

Description automatically generated

SCHOOL OF MATHEMATICAL SCIENCES

**School of Mathematical Sciences**

**Vocational Mathematics**

**Vocational Financial Mathematics**

**Math4045 & Math 4055**

|  |
| --- |
| **Advanced Savings**  **Calculator/Advisor** |
|  |

**Session 2020 – 2021**

**Project 2 – Group 6**

**Tomas Walters**

**Luke Hind**

**Ethan Dreyer**

**Evagoras Theophanous**

**Munish Chopra**

**Mahin Ali**

Table of Contents

[1 Abstract 1](#_Toc57460648)

[2 Introduction 1](#_Toc57460649)

[3 Modelling Content 2](#_Toc57460650)

[3.1 Current Savings Calculators 2](#_Toc57460651)

[3.2 Savings Tools 3](#_Toc57460652)

[3.2.1 Cash ISA 3](#_Toc57460653)

[3.2.2 Lifetime ISAs 4](#_Toc57460654)

[3.2.3 Pension Funds 4](#_Toc57460655)

[3.2.4 Pensions Vs. Lifetime ISAs 4](#_Toc57460656)

[3.2.5 Government Bonds 4](#_Toc57460657)

[3.2.6 Fixed Rate ISAs 5](#_Toc57460658)

[3.2.7 Savings Bonds Vs. Fixed Rate ISAs 5](#_Toc57460659)

[4 Analysis, Mathematical Techniques 5](#_Toc57460660)

[4.1 Interest Rates 6](#_Toc57460661)

[4.2 Savings Product Analysis 6](#_Toc57460662)

[4.2.1 Future Value Annuities 6](#_Toc57460663)

[4.2.2 Bond Valuation 7](#_Toc57460664)

[4.3 Assumptions 7](#_Toc57460665)

[5 Results 8](#_Toc57460666)

[5.1 Finding the right Savings Tool 8](#_Toc57460667)

[5.2 Savings Tool Questionnaire 8](#_Toc57460668)

[5.3 Tax Rate Calculator 9](#_Toc57460669)

[5.4 Calculating the Average Inflation Rate 9](#_Toc57460670)

[5.5 The Calculators 9](#_Toc57460671)

[5.6 Limitations of the Calculators 10](#_Toc57460672)

[5.7 Tax on Pension Funds 10](#_Toc57460673)

[6 Further Model Development 11](#_Toc57460674)

[6.1 Ranking Accounts based on Stability 11](#_Toc57460675)

[6.2 More Advanced Savings Tools 12](#_Toc57460676)

[6.3 Complex Formulae 12](#_Toc57460677)

[7 Conclusion 12](#_Toc57460678)

[8 Appendices 14](#_Toc57460679)

[9 References 14](#_Toc57460680)

# Abstract

Our task is to produce an innovative savings calculator to not only rival competition in the market but improve upon them. As a group we have initially outlined aims and completed critical research into the competition for our calculator to guarantee improvement on the current marketplace.

Our main findings found some calculators to be too complicated, not explaining different inputs requiring background knowledge, which is not in line with our target market, an average UK household. We also require our calculator to be both accurate and thus trustworthy, so results give a reliable idea of possible savings. Our calculator had to be adaptable, so that new products could be added, and more investors could find an account suited to them. Finally, our calculator had to be tailored; no two investors are the same. We need to account from risk-averse investors, to those with broad ranges of background knowledge; our research into current calculators show these factors will be vast advancements on the current market. We have outlined in the analysis section our maths behind the calculator, and in the results section exactly how we plan to make these improvements.

As a team we strongly believe our calculator can fill a current gap in the market and improve on competition, providing not only a frustration free and informed product, but an accurate and tailored saving solution. Throughout this report we will give reason to this claim.

# Introduction

Today savers in the marketplace are met with low returns and too many complicated products, amid various rules and regulations. A combination of products being difficult to understand and benefits being in the long term can deter people from investing. This leaves an opportunity and gap in the market for a well-informed savings calculator, providing professional advice tailored to the consumer’s needs. Once the product has been launched, we hope this will not only increase customer satisfaction and help millions of people invest their money efficiently but will also allow our company to flourish in a time of uncertainty.

Our aim is to provide a trustworthy savings calculator, comparing a wide variety of savings tools, detailing exactly which investment is right for the consumers preferences. Providing multiple calculators for a variety of different savings tools will allow the addition of new products to be easily configured into our product, given their parameters. This is important so the most up to date savings products are available and our website users will have their best chance of saving money. Continuously changing markets mean an adaptable product is of the upmost importance. For that reason, being able to quickly adjust the product whilst maintaining an easy user interface will be key to making sure that the user’s investment is safe and accurate; hence, the multiple calculator feature is particularly desirable.

Our calculator will be aimed at the general public with a standard household income. Products should be applicable to someone with little to no experience of financial instruments and should only require inputs obvious to someone looking to invest. The rest will be provided by the calculator or savings account, such as inflation, taxation and interest rates.

To best support our models, we have used sophisticated financial mathematics, such as annuities, compound interest and inflation rate calculators. All of the formulae used within our calculator are contained within this report and have been explained in some detail. Many of our ideas for further progression of the product are given below. As a team, we strongly believe this product will exceed in the market; in a time like this, a product of this type is essential to help not only the general public, but the marketplace.

# Modelling Content

In the savings account market, there are a large variety of different tools. We have considered the most effective accounts after some careful and rigorous research as to follow our aims. Before implementing the savings tools, we will discuss what existing calculators entail; thus, discovering some advantages and disadvantages so that we can build upon and improve our product to overcome these shortcomings; resulting in a much more useful and effective final product.

## Current Savings Calculators

To standout out from existing products we must critically analyse existing calculators; the idea is to build a calculator which is more versatile and sophisticated. To achieve this, the scrutiny of the savings tools needs to include what is beneficial, detrimental, and thus what we should do differently.

One of the main competitors in the comparison industry will be “MoneySuperMarket”, consequently making it one of the most important to analyse. The savings calculator starts off with an in-depth initialization, allowing the calculator to adapt to the inputs received from the user. Practically, this is one of the best features, since it makes the calculator more unique and fitting for the specific individual. Clear outputs also represent how the user may save with respect to their own desires. On the other hand, the calculator is very reliant on the user having the knowledge and information to provide inputs, meaning those who are less informed may have issues. We can conclude from this, savings accounts require a level of input for personalisation, so the account is best for the user, however, not so much that someone may be put off from investing. In addition, for the given output, all interest is received without any tax being deducted, which results in a loss of accuracy for some forms of saving tools. Learning from these observations, we can attract a higher number of clients to our product by implementing effective changes and making a more user friendly, accurate product.

Another major competitor is “Nationwide”, with a broad range of saving tools to pick from. Whilst this means they have a lot of different options; this can be very confusing for a lot of potential customers. In fact, in their initial questionnaire you can answer some very basic questions to help you pick a saving tool, but instead of giving you just one option based on your needs, it gives multiple. Offering multiple fits can be the cause of confusion and frustration for a lot of users. Learning from this, we can build a much more effective questionnaire by removing any potential confusion and just give one best fit saving tool based on answers to a questionnaire. This will end up being a much more attractive and user-friendly product. Another useful feature the “Nationwide” calculator has is the specific descriptions of each saving tool. However, once again this may cause a lot of confusion as these specifics are not detailed or comparative enough to allow the user to make an informed decision on which saving tool is best for them. We can improve on this by providing a more detailed summary on every saving tool. We can take advantage of these issues and make significant improvements on competitors to produce a much more effective and confusion free calculator.

Graphical user interface, application

Description automatically generated

Note the simplicity of this popular ISA calculator (Figure 1, ISA.co.uk, 2020).

Concluding on all the above information, to improve the user accessibility, a lot of the current calculators in the market could offer more detail into what is expected from the user; therefore, minimising the miscalculations and any confusion caused. Therefore, our calculator will have a much clearer questionnaire to answer and follow. For the calculator to be sophisticated, we put forward adding in more variability, such as inflation rate. This would allow more accurate predictions for a wide range of customers, achieving our overall aim, to provide superior savings to our users.

## Savings Tools

In the marketplace, products offered contain similar main characteristics; interest on cash put into the account and tax on the gain. Each type of account however has varying parameters, each making one beneficial over another for a certain consumers preference. For this reason, multiple types of account should be offered.

### Cash ISA

A cash ISA is a type of savings account, which allows the customer to earn tax-free interest on savings. In the current tax year (2020/21), users can pay up to £20,000 into a cash ISA, with this allowance being renewed each tax year. These accounts may differ from provider to provider, in the flexibility, rates and terms. They’re available to anyone over 16 and living in the UK, ideal for our target consumer (Richardson, 2020).

If the account is not chosen carefully, the customers savings may be losing money if the interest is unfavourable compared to inflation (THEMONEYBROKER, 2020). We have included Inflation in our calculator to avoid this. Some accounts also allow customers to transfer into ISAs money already invested in the previous tax year, to maximise returns, tax free (MoneySuperMarket, 2020).

### Lifetime ISAs

A lifetime ISA is a type of individual savings account to help 18-39-year olds save for retirement or a new home. The benefit of a lifetime ISA over other savings accounts is the 25% bonus of what you pay in, up to a certain limit, every tax year, all paid for by the government. The account lets you save up to £4,000 per year and similarly to other ISAs you won’t pay tax on the interest or income (Lewis, 2020).

### Pension Funds

A pension fund is a scheme to provide retirement income. A pension can be personal or occupational meaning the employee can solely pay into the account by themselves or the employer will contribute a minority amount (Davies, 2020). The employer will pay in a percentage of the employee’s average salaries, over their final years of employment. (Whiteside, 2020). Between 2016 and 2018 pension wealth accounted for 42% of all wealth in Britain (Kidd, 2019); consequently, it is a product which should be available in our calculator.

### Pensions Vs. Lifetime ISAs

Both ISAs and pensions provide compound interest and tax relief on the interest accumulated. Employer contributions make the pension fund more appealing, as you will be able to gain more money from your account and won’t pay tax on the employer contribution to your pension. Pension accounts can however be hard to access and can be restricted until the age of 55, whereas ISA investors can access their money at any time; this can be considered both a disadvantage and advantage (Angliss, 2020). Also, you pay tax on a pension when you come to reap the rewards and take money out; because of this we have included a tax band calculator in our product, as this may sway the investors decisions.

The products have some similarities in the form of the risk of poor returns; but a positive of these returns being guaranteed. Both ISAs and pensions provide traits tailored to a specific user’s preferences which is why both should be offered in our product.

### Government Bonds

Treasury Bonds are government debt-securities with a maturity usually between 10-30 years. The bonds earn interest and coupons depending on the type. We will focus on government treasury bonds as they’re tax free and usually pay a coupon. The treasury bonds also have an active secondary market, however, as our target market will be a standard UK household, we expect the growth in value to be made from interest accrued rather than trading. Face values are usually £1,000 and although returns are usually small the credit risk is negligible (Chen, 2020). Government Bonds should be offered in our calculator to guarantee returns with very little risk to allow for risk-averse investors.

### Fixed Rate ISAs

A fixed rate ISA is another tax-free savings account that guarantees the user a specific level of interest for a given period. This interest rate is dependent on the length of the term, these typically range from one to five years. It is expected that the best rates are acquired in the longer agreements, however, once the money is deposited into this account, it is locked away until the end of the term; consequently, if a withdrawal is needed, a significant exit fee is imposed on the user to pay (CompareTheMarket, 2020). To be eligible for these accounts, it is typical to expect a minimum initial deposit requirement, which are heavily variable from provider to provider (THEMONEYBROKER, 2020).

### Savings Bonds Vs. Fixed Rate ISAs

Although providing similar benefits, there are large differences which could affect a decision between investing in a fixed rate bond or a fixed rate ISA.

Both accounts offer tax-free interest, however this benefit is only up to your personal savings allowance (i.e., £1,000 for a basic tax-rate payer) for a savings bond, whereas for a fixed term ISA the tax allowance is £20,000 pa. Government bonds are usually exempt from income tax so they will be more appealing for our calculator. Also, opposed to an ISA, a bond has no limit to how much money you can add whereas the £20,000 tax free allowance is the annual limit of the ISA. You can also pay into as many bonds as you would like up to the allowance depending on type of bond, but you can only pay into each type of ISA once a year (Richardson, 2018).

As stated, both accounts offer similar benefits, however the parameters for putting money into the accounts vary drastically, so a consumer should consider both when looking to invest.

Evidently, there are a whole range of diverse savings tools that clients can pick from. Depending on what the client’s requirements and desires are, different savings tools will suit different people which is why the variety is so important. This decision must of course be an informed one and one made easy for the client. For this reason, in our product we have included a questionnaire which can be filled out by clients making it more obvious to them which saving tool they should opt for. This is discussed in more detail in the results section of the report.

# Analysis, Mathematical Techniques

In order to produce various calculators and an overall effective product, we must research and determine sophisticated mathematical models and formulae. All the formulae below have been explained in detail to portray the mathematical thinking and working behind our product. Alongside this, there are some important assumptions discussed which are important to implement and understand consistently.

## Interest Rates

Interest rates should be thought of as the cost of money, and thus a very important aspect of our calculator. For most products different banks and governments will offer competitive interest rates in order to sell their accounts. In current calculators’ nominal interest is the value used denoted, r. There is no problem with using r and gives a correct indication of possible earnings, however with our aims at mind, we want to make this value as accurate as possible, considering the current economic environment. Real rate of return, R, is the interest on a savings tool with inflation considered. Using R will provide us an edge over and help us stand out amongst the other calculators in the market (Hargrave, 2020).

Using R will give a more accurate calculation of the value of savings, however, requires an accurate inflation forecast.

## Savings Product Analysis

### Future Value Annuities

Luckily for the computation of our product most savings accounts, although containing different parameters, require similar calculations. The following inputs are required for calculating compound interest with contributions monthly (Hazel, 2020):

* Initial Deposit, D
* Value of Each termly payment in, P
* Interest Rate, r
* The number of times interest compounded per year, n
* The Time money is invested for, t
* Future Value, FV
* Present Value, PV

The FV of the contributions is found using the FV formula for an annuity.

For ISAs this formula will work well as each of the parameters are usually fixed at the opening of the account. The bonuses paid back by the government are however not included. As we have stated for a lifetime ISA, 25% is contributed by the government each tax year. We will assume that all the annual allowance is put into the account so each year 25% is paid back. Although not guaranteed as many assumptions are required, this calculation will give a good idea of the savings possible.

Pension funds are one of the more technical savings accounts to calculate due to the employer contributions being factored in. The pensionable salary is used to calculate employer contributions. For Pension funds we will have employer contribution as an input, due to the varying policies on contributions from various employers. Payment in, P, will be the sum of the employer and employee contributions.

### Bond Valuation

Treasury bonds from the government are simple to calculate as they have fixed coupon rates and single payment in. Coupon payments are found from the product of the coupon rate and face value. Inputs are:

* Coupon Payments, C
* Par Value, P
* Interest Rate, r
* Yield to Maturity, Y
* Face Value, F
* Time to Maturity, t
* Present Value, PV

For completeness the equation for calculating Yield to Maturity has been included, however we will mostly deal with cases where the bond price is the par value so the Yield to Maturity will be the interest rate; real interest rate will then be used incorporating the nominal interest to make the calculation even more accurate.

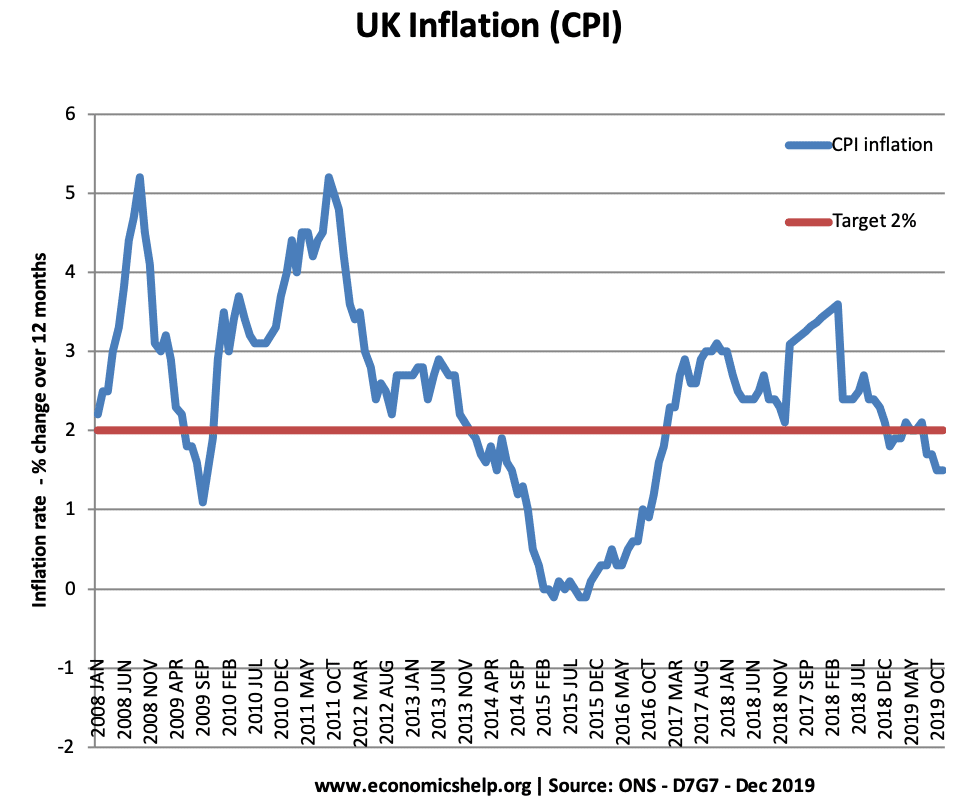
## Assumptions

For ISA valuation we will have to assume that the contribution will be constant both in time increments and amount. We will also assume the market is ‘steady’, meaning the rates of interest will not be volatile and will be productive to earnings (ISA.co.uk, 2020). Otherwise, investors would not be interested in ISAs. We will assume no withdrawals will be made on the account, indicating the value input is simply allowed to accrue interest.

For Bond valuation there are not many changes a consumer could make, however we will assume the consumer keeps the bond until maturity date. As talked about before a bond market does exist however we will assume an average UK household looking to invest will not take notice of such actions.

These assumptions are used by all calculators in the marketplace so will be of no detriment to our product.

For the inflation rate, we decided to take CPI data in the UK from the past 10 years and use the data as an estimate for a forecasted inflation rate (Media, 2020). We use CPI as it considers consumer spending which is useful for developed economies such as the UK (Why the Consumer Price Index (CPI) is Important – SmartAsset, 2020). We also decided to use the past 10 years since this data is more relevant and consistent than earlier data.



(Figure 2, Economicshelp.org, 2020)

Overall, there are numerous equations and assumptions that have been implemented and considered whilst making our product. These mathematical calculations will provide much more accurate results allowing us to provide a confusion free, accurate solution to savings, customised for the user.

# Results

Joining the savings tool marketplace, we had several outlined aims and objectives in order to improve on what is already available in the marketplace Our first aim was to make the calculator as tailored to the consumer as possible. Secondly, we had to make sure the calculator is accurate and trustworthy. Thirdly, we wanted a product which provides multiple calculators, to stay up to date with the current savings tools and make it easy to adapt. Fourthly, we wanted to make a calculator widely available and simple so an average UK household can use this product without difficulty. Lastly, the results of the calculator had to be clear, so there is no confusion of the results. These are the main aims that we wanted to include to ensure that we produced a useful and innovative product, advancing on current calculators. In this section we will show how we have achieved these aims.

## Savings Tool Questionnaire

In order to fulfil the consumers preferences, at the start of the website we have included a short and easy to follow questionnaire. The questionnaire asks short simple questions, with drop down answers. Answers allow us to narrow down which calculator the consumer should use, thus saving time over other online calculators. The home page also makes sure you know exactly which questions to answer next as only the questions relevant to your previous answer appear.

Graphical user interface, application

Description automatically generated

(Figure 3, Savings Tool Questionnaire)

This avoids any possible confusion for the consumer but also makes the interface easy to adapt and use. Most online calculator websites only provide savings predictions for one savings tool; providing multiple calculators on one page, accompanied by this short questionnaire means we can offer more savings tools, without making the calculator more confusing and time consuming.

Graphical user interface, application

Description automatically generated

(Figure 4, Savings Tool Questionnaire)

The questionnaire fulfils our aims from the outset by producing a product that is not just an improvement on other calculators in the market, but is also tailored to every individual consumer, easy to use by any average UK household and widely available to adapt. New products can be added alongside new questions, so the general format doesn’t need to be altered.

## Tax Rate Calculator

It is important for someone looking to invest to consider tax rates when deciding which savings tool to opt for. Subject to which tax bracket you fall under, you may opt for different savings tools. For example, if you fall under a high tax bracket you may prefer to choose a more tax secure savings account. Pensions are affected by tax when you decide to take the money out of the account, whereas government bonds are exempt from taxation. Additionally, both the Lifetime and Cash ISA’s are tax free. If you fall into a low tax bracket however, this does not have as heavy an effect on your decision of which savings calculator to choose. Thus, implementing this tax rate calculator into our product ensures that our customers can make an informed decision which is in line with our aims.

Graphical user interface, application

Description automatically generated

(Figure 5, Tax Rate Calculator)

## Calculating the Average Inflation Rate

Many calculators in the market use nominal interest, r. Whilst this is not a problem, as discussed earlier we want to be as accurate as possible in order to stay in line with our aims. As a result of this and together with our assumptions, we have calculated the average inflation rate over the last decade and included this in the calculation for real interest rate, R. Real interest rate will give our customers a much more realistic view of what their potential savings will look like. Providing a completely transparent view of savings to our consumers is not just in line with our aims but will also increase customer satisfaction and help us improve in the marketplace. At a time like this, markets fluctuate regularly meaning our inclusion of this feature is particularly essential and has the potential to give us the upper hand amid numerous competitors.

Table

Description automatically generated

(Figure 6, Inflation Rate Calculator)

## The Calculators

The very first thing to realise about all the calculators is the ease of use, only requiring basic personal information and account details, all of which are inputs easily accessible to an average UK household. This is directly in line with one of our main aims. In addition to this, all the calculators provide a clear result in the form of ‘Growth of Value’. In every calculator the growth is simply calculated by working out the difference between the future value and the amount paid into the account. The future values are determined multiple different ways using formulae which can be found under the Analysis and Mathematical Techniques section. The amount paid into the account values are calculated from the input values.

Table

Description automatically generated Table

Description automatically generated

(Figure 7, Government Bond Calculator) (Figure 8, ISA Calculator)

Creating a simple, yet effective design not only creates less confusion for the consumer but also makes it easier for us as the company to adapt the product quickly given changing circumstances. This is particularly advantageous for consumers saving them the hassle of understanding any financial terminology. Consequently, this is in line with two key aims of simplicity and personalisation to the consumer.

The main result the consumer wants to know is how much money they will be saving over a given number of years and the growth in value of their savings. This will help the consumer make a more informed decision on which saving tool to opt for and also provides a realistic view of how much can be saved. Whilst of course the value of the growth is completely dependent on the input values the consumer provides, key outputs allow the user to make informed decisions from the information they receive.

Accordingly, it is quite clear that our calculator fulfils all of our initial aims. We have created a product that is confusion and frustration free, more transparent than any other calculator in the market, easy to use no matter the level of financial understanding, easily adaptable, individual to the consumer and most importantly, accurate. All these features stem from our research. Other calculators incorporated one or two factors however, we have attempted to incorporate them all.

## Limitations of the Calculators

Some of the major limitations of all the calculators are down to situations that cannot be accounted for or predicted. These can include scenarios such as, changes in tax or pension or ISA and government bond regulations set by HMRC and other regulatory bodies. It is also important to realise that these numbers are just a guide based on the values the consumer provides. None of these values are guaranteed and they should not be treated as such. It is also important to understand, we are providing a product to aid consumers choose a savings tool, this is not in any way exact financial advice based on a consumer’s particular circumstances. These calculators can only provide you with easily accessible information which can help the consumer make their own decision. The calculator cannot accurately predict inflation rates 5 years from now. These limitations are problems that all calculators in the market must confront. Once again, the aim of being trustworthy and as accurate as possible is very important for us as a company and it is essential to maintain a good public perception in order to break into a new marketplace.

One simple drawback is the nominal interest value as input by the user. Consumers may be confused where to find this information. For this reason, on the website we can provide an explanation as to where this value comes from supplying reliable sources and providing details of lots of accounts from various banks, for users to choose from. On the other hand, members of a typical UK household may know how to find this value, nonetheless, this sort of thinking is not in line with our aims. In order to accommodate for those who do not understand interest values we should provide examples on the website. Furthermore, this will help reduce confusion and provide an extra sense of security and trust in the calculator.

## Tax on Pension Funds

For the Personal Pension Fund calculator, the inputs required are very basic and include consumers’ annual salary before tax, age, existing pension funds, planned retirement age and personal pension contribution per annum.

The major drawback of this calculator is tax not being considered. When the account holder takes money out, the income can be taxed. In the future, we could improve on this by providing a value of growth that takes tax into account rather than relying on the consumer to use tax in their decision making. This would provide the consumer with an even clearer picture of how much money the saving tool will provide. Helping us achieve one of our aims of being trustworthy and accurate to a greater extent.

Table

Description automatically generated Table

Description automatically generated

(Figure 9, Personal Pension Calculator) (Figure 10, Occupational Pension Calculator)

The Occupational pension fund requires the same inputs as the personal pension fund but with an extra input, the employer pension contribution per annum. Similarly, to the personal pension fund, this calculator fails to provide the value of the saved money that is specifically tax-free. We could provide a pop-up message to the consumer as well as the message on the home page warning them of taxation. This would make the calculator completely clear that the savings will be taxed eventually.

It is also important to realise the limitations we have outlined are to do with the very nature of the saving tools and if the limitations did not exist, the marketplace for calculating value would not be relevant as savings would be as expected. The best way to resolve these issues is by providing accurate information and calculations with the most up to date data and mathematical formulae.

# Further Model Development

Given more time, more research could be put into finding new and advanced accounts, offered by different governments and banks. Many different preferences and knowledge bases of investors mean the more accounts we explain and offer, the more likely a consumer will find an account which suits them. Alongside this, with the rapid advancements of technology it is very likely that new savings tools might enter the market, or more efficient ways to calculate results from current savings tools could be found. In order to stay ahead of the competition, it is imperative to keep updating our model.

## Ranking Accounts based on Stability

A further advancement would be not to judge possible savings based on interest rates but overall stability as well. All of the savings tools have a different amount of risk involved making the stability of each different.

Table

Description automatically generated

(Figure 11, Examples of ISAs)

Pension funds and ISA’s have risk due to the consumer being able to invest the money they save. Which means the value can change drastically based on how this money is invested. A consumer who wishes to take on more risk for the reward of higher interest and increased portfolio value has the option to do so. Thus, we can say that these savings tools are the least stable out of all the savings tools. In fact, pension funds are even more unstable as they are affected by inflation and tax when the money is recovered from the account. Of course, we cannot predict these values when the consumer retires so pension funds could be considered more unstable.

Government bonds have very minimal default risk due to the borrower being a government, however some governments are more stable than others; for a risk averse investor this would be more appealing and could be the difference between using our calculator over another. In our current model we have assumed interest rates will directly reflect risk of the account, but this may not be common knowledge to the average UK household.

Overall, we can see that different savings tools have a different stability, but this helps accommodate all consumers. There may even be consumers who want to invest some of their savings into a stable savings tool and some into an unstable one. We can accommodate any preferences.

## More Advanced Savings Tools

Many advanced savings tools require more financial knowledge. For example, the Stocks and Shares ISA is a savings tool aimed at investors who are happy to take on a bit more risk for their investment.

In the given timeframe, it would have been very difficult to quantify for a Stocks and Shares ISA, however, with accurate figures for expected returns and more research this could be a viable option. The calculator would have to be updated regularly for changes in interest rates and returns, making the calculator a lot more complex to maintain. Stocks and shares ISAs also carry a lot more risk than cash ISAs and usually take up to 5 years of investment for bumps or losses in the market to flatten out (Roberts, 2020). Whilst a few consumers may prefer this, the average UK household member would not want to opt for this as they would feel too unsure about where to invest their money. Our current product is designed in such a way that if in the future we do decide to include this calculator, we can.

As new savings tools are created and introduced, we can adapt and create innovative solutions, to provide consumers with more options to accommodate for all consumers preferences and stay a step ahead of our competitors. More risky accounts such as Peer-to-Peer Lending and Corporate Bonds could have been included however, we only incorporated safe accounts protected up to £85,000 by the FSCS.

## Complex Formulae

When calculating government bond yields there are very complex formulae that were already provided in a government document, however, under the 4-week time constraint we couldn’t implement them as bonds are not the only part of our calculator and allocating such a large portion of time to learning the necessary skills for these formulae may have been detrimental to our overall product (United Kingdom. Debt Management Office, 1998). In the future these and other complex formulae could be implemented to give very accurate forecasting.

Diagram

Description automatically generated

(Figure 12, Debt Management Office, 1998)

# Conclusion

Our extensive research shows each savings product has different benefits indicating that the key to the comparison website is to make sure the consumer invests in the right product. We had a lot of aims to achieve, producing a calculator that would provide an average UK household a significant improvement on current calculators in the market. Some of our main aims were to provide accurate results, being able to both maximise returns and minimise risk, whilst not complicating the process. We also wanted to make a product that could be adapted quickly and easily.

Our product fulfils all of our aims and displays a calculator that is less confusing without any loss of accuracy. The calculator is easy to follow and builds upon factors from multiple already successful calculators; thus, producing a calculator which can appeal to anyone. Using the questionnaire, we have split our calculators into main categories to avoid complication. It is much easier to compare many different Pension Funds than a Pension compared to a Government Bond. Linking each calculator page ensures that the consumer will go to the correct calculator and avoid any computational errors. The implementation of drop-down menus also ensures consumers pick only from the available options following their needs, making sure they always reach the calculator required.

The overall design of our calculator, with each type of savings tool having its own page, will allow new accounts to be added quickly and effectively, to the users benefit. Further model developments can then be introduced with more time, as we will be updating key areas individually, rather than having to update the whole calculator. This makes for an adaptable product.

Whilst our calculator does have a few drawbacks and limitations these are not necessarily a worry as every calculator in the market must deal with these limitations. As discussed in some detail above, the best way to resolve these issues is to provide the consumer with information and be as transparent and trustworthy as possible, alongside our aims.

In terms of further model development, it is important to realise that a lot of these more complicated savings tools can only be implemented after more time and research. It is also important to realise that if we do want to make our product broader and more complicated, we must innovate a solution to convey the information and present results in such a way that any average UK household could understand. Consequently, there is lots of future potential for this product. We have designed a product that accommodates all consumers and is significantly better than any current calculator. Providing a product with savings tools of such a wide variety of stabilities, also allows every consumer to have a tailored result, again in line with our aims.

Looking to the future, whilst we can implement these future model developments in time, we can also investigate protecting our calculators from any potential crisis. Many current calculators are often prone to hacking especially with the rapid technological advancements during this period of uncertainty. As a result, it is very advisable that as a company we protect ourselves from such unfortunate events by researching and implementing fraud prevention schemes.

Overall, we have therefore produced a calculator that is in line with and achieves all of our aims. The savings calculator will help consumers be less confused where to invest their money and is a market where we could flourish ahead of our competitors.

# Appendices

* **Coupon Payment** – Percentage of Face Value, paid out each period by the borrower to the lender of the bond.
* **FSCS** – Financial Services Compensation Scheme, used to protect assets when a financial firm fails.
* **Pensionable Salary** – Basic salary received in previous year, with final pensionable salary being the average of the three years prior to retirement.
* **PSA** – Personal Savings Allowance, the limit of money you can input into an account per tax year.

# References

* Angliss, R. (2020). Online Money Advisor. *What are the Main Benefits of a Personal Pension?* Available at: <https://www.onlinemoneyadvisor.co.uk/pensions/personal-pensions/personal-pension-pros-and-cons/>
* Chen, J. (2020). Investopedia. *Treasury Bond.* Available at: <https://www.investopedia.com/terms/t/treasurybond.asp>
* CompareTheMarket. (2020). *Compare Fixed Rate Cash ISAs – What is a fixed-rate ISA?* Available at: <https://www.comparethemarket.com/savings-accounts/fixed-rate-isa/>
* Davies, P. (2020) Which? *Pension Calculator – How much money you’ll have.* Available at: <https://www.which.co.uk/money/pensions-and-retirement/options-for-cashing-in-your-pensions/overview-of-options-for-cashing-in-your-pension/pension-calculator-how-much-money-youll-have-a1jxm4d809k8>
* Economicshelp.org. *Current UK Inflation.* (2020).Available at: <https://www.economicshelp.org/blog/5720/economics/inflation-stats-and-graphs/>
* *Formulae for Calculating Gilt Prices from Yields.* Available at: <https://www.dmo.gov.uk/media/15011/yldeqns_v1.pdf>
* Hargrave, M. (2020). Investopedia. *Real Rate of Return.* Available at: <https://www.investopedia.com/terms/r/realrateofreturn.asp>
* Hazel, A. (2020). The Calculator Site. *Compound Interest Formula with Examples.* Available at: <https://www.thecalculatorsite.com/articles/finance/compound-interest-formula.php>Available at: <https://www.economicshelp.org/blog/5720/economics/inflation-stats-and-graphs/>
* *How do Pension Funds work?*  Available at: <https://www.investopedia.com/articles/investing-strategy/090916/how-do-pension-funds-work.asp>
* ISA.co.uk. (2020). Cash ISA calculator. *How much could your ISA be worth?* Available at: <https://www.isa.co.uk/cash-isa-calculator/>
* Kidd, C. (2019). Office for National Statistics. *Pension Wealth in Great Britain.* Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/pensionwealthingreatbritain/april2016tomarch2018>
* Lewis, M. (2020). Money Saving Expert. *Lifetime ISAs.* Available at: <https://www.moneysavingexpert.com/savings/lifetime-isas/>
* Media, T. (2020). *Historic Inflation Great Britain – Historic CPI Inflation Great Britain*. Inflation.eu. Available at: <https://www.inflation.eu/en/inflation-rates/great-britain/historic-inflation/cpi-inflation-great-britain.aspx>
* MoneySuperMarket. (2020). *ISAs – Choosing the best ISA.* Available at: <https://www.moneysupermarket.com/savings/isas/>
* Nationwide. (2020). *Savings accounts - Let us help you choose a savings account from our range.* Available at: <https://www.nationwide.co.uk/products/savings/find-an-account#tab:Findanaccount>
* Richardson, D. (2018). Which? *Should I save my money in a fixed term bond or an ISA?* Available at: <https://www.which.co.uk/news/2018/04/ask-an-expert-should-i-save-my-money-in-a-fixed-term-bond-or-an-isa/>https://www.moneysupermarket.com/savings/isas/
* Richardson, D. (2020) Which? *Tax-free savings.* Available at: <https://www.which.co.uk/money/tax/income-tax/income-tax-on-savings-and-investments/tax-free-savings-aybk72d7g3yf#:~:text=As%20with%20Isas%2C%20any%20interest%20or%20investment%20returns,increase%20from%20the%202019-20%20maximum%20deposit%20of%20%C2%A34%2C368>
* Roberts, A. (2020). Money Saving Expert. *Stocks and Shares ISAs.* Available at: <https://www.moneysavingexpert.com/savings/stocks-shares-isas/>
* SmartAsset. (2020). *Why The Consumer Price Index (CPI) Is Important - Smartasset*. Available at: https://www.inflation.eu/en/inflation-rates/great-britain/historic-inflation/cpi-inflation-great-britain.aspx
* THEMONEYBROKER. (2020). *TheMoneyBroker’s guide to savings accounts.* Available at: <https://themoneybroker.co.uk/11/themoneybrokers-guide-to-savings-accounts>
* United Kingdom. Debt Management Office. (1998). *Formulae for Calculating Gilt Prices from Yields.* Available at: <https://www.dmo.gov.uk/media/15011/yldeqns_v1.pdf>https://www.inflation.eu/en/inflation-rates/great-britain/historic-inflation/cpi-inflation-great-britain.aspx
* Whiteside, E. (2020). Investopedia. *How do Pension Funds work?*  Available at: <https://www.investopedia.com/articles/investing-strategy/090916/how-do-pension-funds-work.asp>