Mathematics

Investigation 2 – Finance

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Task One

Introduction

The purpose of this task is to demonstrate how an initial investment made could grow over time, using realistic values, recurrence relations, different compounding and time periods and which is the best investment option compared using effective interest rates.

We are provided minimum information in what specific numbers to use however we must use realistic values, recurrence relations, different compounding and time periods and, we must use effective interest rates when conducting this investigation of investment growth

Information that I will need is a realistic values of initial investment, and realistic investment rates to show growth of an investments and to calculate investment returns using effective interest rates.

There are a number of factors to consider to conclude a realistic values, therefore in this investigation we assuming the initial investment is made by a subject from a middle socioeconomic class. The subject (Rob) “generates an average weekly income of $1,884 ( $97,986 pa),”( report made by Mike Mortlock, March 2nd 2021) . According to Financial planners they recommend a initial beginning investment of 5 percent of your pa income. Therefore the realistic value of a initial investment in this investigation will be $97,986 x 5/100 = $4899.3, which will be rounded to the nearest thousand for convenience sake $5000.

To find a realistic interest rate value we must ignore values presented in banks such as common wealth and others as they offer only below one percent for investments being far too low. We must look at Australia’s system of super fund performance to provide a realistic value 1993 to 2020 the fund has performed an average of 9.8% pa which will be the interest rate value of task one.

Furthermore that is needed is compounding and time periods and need a broad range of scenarios to explore these periods. For this investigation we will look at an overall of 9 scenarios, which will be dived into groups of three. Each group will explore daily, monthly, yearly compounding periods. Group one will look at a minimum period of 10 years, group 2 will look at a period of 20 years and group three will look at 40 years. Each scenario from previous statements will have a initial investment of $5000 and an interest rate of 9.8%.

Task One

Analysis Group one Time period 10 years, initial investment of $5000 compounded yearly, daily and monthly at an interest rate of 9.8%

Scenario one: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds yearly and is left in the investment account for 10 years.

Recurrence relation:

After a period of 10 years the initial investment of $5000 grows to $12735

The effective interest rate:

The effective interest rate for scenario one is 0.0098 x 100 = 9.8% pa

Scenario two: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds monthly and is left in the investment account for 10 years.

Recurrence relation:

After a period of 10 years the initial investment of $5000 grows to $ 13269

The effective interest rate:

The effective interest rate for scenario two is 0.1025 x 100 = 10.25% pa

Scenario three: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds daily and is left in the investment account for 10 years.

Recurrence relation:

After a period of 10 years the initial investment of $5000 grows to $ 13321

The effective interest rate:

The effective interest rate for scenario two is 0.103 x 100 = 10.3% pa

Analysis Group two Time period 20 years, initial investment of $5000 compounded yearly, daily and monthly at an interest rate of 9.8%

Scenario four: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds yearly and is left in the investment account for 20 years.

Recurrence relation:

After a period of 20 years the initial investment of $5000 grows to $32435

The effective interest rate:

The effective interest rate for scenario four is 0.0098 x 100 = 9.8% pa

Scenario five: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds monthly and is left in the investment account for 20 years.

Recurrence relation:

After a period of 20 years the initial investment of $5000 grows to $35215

The effective interest rate:

The effective interest rate for scenario two is 0.1025 x 100 = 10.25% pa

Scenario six: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds daily and is left in the investment account for 20 years.

Recurrence relation:

After a period of 20 years the initial investment of $5000 grows to $35487

The effective interest rate:

The effective interest rate for scenario two is 0.103 x 100 = 10.3% pa

Analysis Group three Time period 40 years, initial investment of $5000 compounded yearly, daily and monthly at an interest rate of 9.8%

Scenario seven: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds yearly and is left in the investment account for 40 years.

Recurrence relation:

After a period of 40 years the initial investment of $5000 grows to $210408.66

The effective interest rate:

The effective interest rate for scenario four is 0.0098 x 100 = 9.8% pa

Scenario eight: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds monthly and is left in the investment account for 40 years.

Recurrence relation:

After a period of 40 years the initial investment of $5000 grows to $248022.10

The effective interest rate:

The effective interest rate for scenario two is 0.1025 x 100 = 10.25% pa

Scenario nine: Rob invests $5000 dollars into an investment account which produced an average interest rate of 9.8% pa. The initial investment compounds daily and is left in the investment account for 40 years.

Recurrence relation:

After a period of 40 years the initial investment of $5000 grows to $251869.68

The effective interest rate:

The effective interest rate for scenario two is 0.103 x 100 = 10.3% pa

Conclusion

Through out task one multiple concluding points can be generated from the findings of our investigation.

The first point is that the most detrimental factor to maximise growth in investment is time. We can see this in our findings 10 years produced an investment between $12700 – $13400 depending on the compounding periods. Twenty years saw the investment produced between $32000 and $35000 depending on the compounding period, depicting the impact time has on your investment. Finally forty years in a investment account produced an investment between $210000 - $250000, the original investment $5000 dollars after 40 years turned the value of one dollar from the original to 50 dollars after 40 years. Therefore time is your best friend as more time an investment gains interest the more growth the original investment will experience.

The second point is that changing the compounding periods from yearly, monthly and daily will have an effect on your investment. To maximise growth a daily compounding period is preferred as creates the most growth. This can be proven from our results as it showcases a compounding period of per year produces an effective interest rate of 9.8%, while compounding period per monthly produced an effective interest rate of 10.25% and lastly a compounding period daily produces an effective interest of 10.3%. This is due the investment being compounded more frequently therefore daily compounding periods is the preferred option to maximise growth from original investment.

Task two

Introduction

The purpose of this task two is to showcase how a loan balance would reduce over time using realistic values, recurrence relations and different interest rates, time periods and repayments.

Similar to task one we are provided minimum information on what actual values to use however we must use realistic values, recurrence relationships, time periods and repayment to showcase how a loan balance would reduce over time.

The information that I need is realistic values for initial loan balance, varying interest rates, time periods and repayments. Different amounts of repayments and different repayment times e.g. daily, monthly and yearly.

There are many different types of loans, Personal loans, Credit cards, Home-equity loans, small business loans etc. For this investigation we shall use a Personal loan of $50000.

We will also assume that the interest rates used will be fixed. The interest rates we shall use is 7% and 5%.

The time periods will be once again be varied, because the time period will be dependent of the repayments made, due to it being a personal loan the repayments will not exceed to be over 15 years, as anything more then 15 years can be consider excessive.

We shall look at monthly, fortnightly and weekly repayment schedules and different amounts of repayments. The repayments will be representative of our previous subject Rob who “generates an average weekly income of $1,884 ( $97,986 pa),” for realistic purposes as we are simulating this investigation around a person of the middle class. Rob has no children or a partner. Rob has very minimum livening expense. Rob has three different minimum repayments that he can choose from $5500 and $10000 and 15000 paid overall annually which can be paid for in monthly fortnightly and daily repayment schedules throughout the course of the year. (the monthly, fortnightly or daily repayment schedule chosen, must at the end of the year add up to 5500, 10000 or 15000), The time period will be dependent on the repayments made.

Furthermore we can look at scenarios where Rob wants to pay of the loan in under a certain period of time as fastest as he can. Where the repayments will be dependent on the time period chosen. We can look at 2, 4 year time period for the loan at $50000, with a interest rate of 5% and 7% therefore we can find out how much repayment Rob would have to make to close the personal loan in 2 and 4 years, so too much extra interest does not accumulate on the loan.

Task two will be done in 24 different scenarios split into groups of 8. Group 1 to six will explore scenarios where the time period is dependent on the minimum repayments of $5500, $10000, $15000 annually done in monthly, fortnightly or weekly repayment schedule and interest rates of 5% and 7%. Group 7 to 8 will explore scenarios where the repayments are dependent on the time period, because of Rob wanting to pay of the loan, in a timely fashion before to much interest accumulates.

Analysis

Analysis Group one. There will be three different scenarios. Group one will be subjected to a interest rate of 7%. Overall Repayments of $5500 paid monthly, fortnightly and weekly.

Scenario one: Rob takes out a personal loan of $50000. interest rates of 7% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid monthly of $458.33, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 173 full repayments of $458.33 and one repayment of $423.1 to take the balance to zero, therefore it took 14.49 years or 173.92 months to repay the personal loan of $50000 at a repayment of $458.33 monthly at an interest rate of 7% pa compounded monthly.

Total extra interest paid on top of loan =

(458.33 x 173.92) = 79,714.95

79,714.95 – 50000 = $29,714.95 extra paid on top of initial loan

Scenario two: Rob takes out a personal loan of $50000. interest rates of 7% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $211.53, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 376 full repayments of $211.53 and one repayment of $56.97 to take the balance to zero, therefore it took 14.471 years or 376.26 fortnights to repay the personal loan of $50000 at a repayment of $211.53 fortnightly at an interest rate of 7% pa compounded fortnightly.

Total extra interest paid on top of loan =

(211.53 x 376.269) = 79,592.18

79,592.18 – 50000 = $29,592.18 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 7% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid per week of $105.76, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 752 full repayments of $105.76 and one repayment of $9.97 to take the balance to zero, therefore it took 14.463 years or 752.09 weeks to repay the personal loan of $50000 at a repayment of $105.76 fortnightly at an interest rate of 7% pa compounded weekly.

Total extra interest paid on top of loan =

(105.76 x 752.094) = 79,541.48

79,541.48 – 50000 = $29,541.48 extra paid on top of initial loan

Analysis Group two. Group one will be subjected to a interest rate of 5%. Overall Repayments of $5500 paid monthly, fortnightly and weekly to pay off $50000 personal loan.

Scenario one: : Rob takes out a personal loan of $50000. interest rates of 5% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid monthly of $458.33, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 145 full repayments of $458.33 and one repayment of $356.25 to take the balance to zero, therefore it took 12.14 years or 145.77 months to repay the personal loan of $50000 at a repayment of $458.33 monthly at an interest rate of 5% pa compounded monthly.

Total extra interest paid on top of loan =

(458.33 x 145.77) = 66810.76

66810.76 – 50000 = $16810.76 extra paid on top of initial loan

Scenario two: : Rob takes out a personal loan of $50000. interest rates of 5% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $211.53, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 315 full repayments of $211.53 and one repayment of $108.13 to take the balance to zero, therefore it took 12.135 years or 315.51 fortnights to repay the personal loan of $50000 at a repayment of $211.53 fortnightly at an interest rate of 5% pa compounded fortnightly.

Total extra interest paid on top of loan =

(211.53 x 315.51) = 66739.83

66739.83 – 50000 = $16739.83 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 5% pa, 5500 dollars is the minimum repayment for the year. This repayment is paid per week of $105.76, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 630 full repayments of $105.76 and one repayment of $80.38 to take the balance to zero, therefore it took 12.13 years or 630.76 weeks to repay the personal loan of $50000 at a repayment of $105.76 fortnightly at an interest rate of 5% pa compounded weekly.

Total extra interest paid on top of loan =

(105.76 x 630.76) = 66709.1776

66709.1776 – 50000 = $16709.18 extra paid on top of initial loan

Analysis Group three. There will be three different scenarios. Group one will be subjected to a interest rate of 7%. Overall Repayments of $10000 paid monthly, fortnightly and weekly.

Scenario one: : Rob takes out a personal loan of $50000. interest rates of 7% pa, $10000 is the minimum repayment for the year. This repayment is paid monthly of $833.33, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 74 full repayments of $833.33 and one repayment of $53.522 to take the balance to zero, therefore it took 6.17 years or 74.06 months to repay the personal loan of $50000 at a repayment of $833.33 monthly at an interest rate of 7% pa compounded monthly.

Total extra interest paid on top of loan =

(833.33 x 74.06) = 61716.4198

61716.4198 – 50000 = $11716.42 extra paid on top of initial loan

Scenario two: : Rob takes out a personal loan of $50000. interest rates of 7% pa, 10000 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $384.61, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 160 full repayments of $384.61 and one repayment of $ 85.92 to take the balance to zero, therefore it took 6.16 years or 160.23 fortnights to repay the personal loan of $50000 at a repayment of $384.61 fortnightly at an interest rate of 7% pa compounded fortnightly.

Total extra interest paid on top of loan =

(384.61 x 160.23) = 61626.0603

61626.0603 – 50000 = $11626.1 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 7% pa, 10000 dollars is the minimum repayment for the year. This repayment is paid per week of $192.30, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 320 full repayments of $192.30 and one repayment of $46.47 to take the balance to zero, therefore it took 6.15 years or 320.24 weeks to repay the personal loan of $50000 at a repayment of $192.30 fortnightly at an interest rate of 7% pa compounded fortnightly.

Total extra interest paid on top of loan =

(192.30 x 320.24) = 61582.152

61582.152 – 50000 = $11582.2 extra paid on top of initial loan

Analysis Group four. There will be three different scenarios. Group one will be subjected to a interest rate of 5%. Overall Repayments of $10000 paid monthly, fortnightly and weekly.

Scenario one: Rob takes out a personal loan of $50000. interest rates of 5% pa, $10000 is the minimum repayment for the year. This repayment is paid monthly of $833.33, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 69 full repayments of $833.33 and one repayment of $157.73 to take the balance to zero, therefore it took 5.765 years or 69.18 months to repay the personal loan of $50000 at a repayment of $833.33 monthly at an interest rate of 5% pa compounded monthly.

Total extra interest paid on top of loan =

(833.33 x 69.18) = 57649.7694

57649.7694 – 50000 = $7649.77 extra paid on top of initial loan

Scenario two: Rob takes out a personal loan of $50000. interest rates of 5% pa, 10000 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $384.61, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 149 full repayments of $384.61 and one repayment of $ 285.07 to take the balance to zero, therefore it took 5.759 years or 149.74 fortnights to repay the personal loan of $50000 at a repayment of $384.61 fortnightly at an interest rate of 5% pa compounded fortnightly.

Total extra interest paid on top of loan =

(384.61 x 149.74) = 57591.5014

57591.5014 – 50000 = $7591.50 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 5% pa, 10000 dollars is the minimum repayment for the year. This repayment is paid per week of $192.30, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 299 full repayments of $192.30 and one repayment of $66.694 to take the balance to zero, therefore it took 5.756 years or 299.347 weeks to repay the personal loan of $50000 at a repayment of $192.30 fortnightly at an interest rate of 5% pa compounded fortnightly.

Total extra interest paid on top of loan =

(192.30 x 299.347) = 57564.4281

57564.4281 – 50000 = $7564.43 extra paid on top of initial loan

Analysis Group five. There will be three different scenarios. Group six will be subjected to a interest rate of 7%. Overall Repayments of $15000 paid monthly, fortnightly and weekly.

Scenario one: : Rob takes out a personal loan of $50000. interest rates of 7% pa, $15000 is the minimum repayment for the year. This repayment is paid monthly of $1250, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 45 full repayments of $1250 and one repayment of $853.087 to take the balance to zero, therefore it took 3.80 years or 45.68 months to repay the personal loan of $50000 at a repayment of $1250 monthly at an interest rate of 7% pa compounded monthly.

Total extra interest paid on top of loan =

(1250 x 45.68) = $57100

57100 – 50000 = $7100 extra paid on top of initial loan

Scenario two: : Rob takes out a personal loan of $50000. interest rates of 7% pa, 15000 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $576.92, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 98 full repayments of $576.92 and one repayment of $475.00 to take the balance to zero, therefore it took 3.799 years or 98.82 fortnights to repay the personal loan of $50000 at a repayment of $576.92 fortnightly at an interest rate of 7% pa compounded fortnightly.

Total extra interest paid on top of loan =

(576.92 x 98.82) = $57011.2344

57011.2344 – 50000 = $7011.23 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 7% pa, 15000 dollars is the minimum repayment for the year. This repayment is paid per week of $288.461, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 197 full repayments of $288.461 and one repayment of $147.95 to take the balance to zero, therefore it took 3.798 years or 197.512 weeks to repay the personal loan of $50000 at a repayment of $288.461 weekly at an interest rate of 7% pa compounded weekly.

Total extra interest paid on top of loan =

(288.461 x 197.512) = $56974.50903

56974.5093 – 50000 = $6974.51 extra paid on top of initial loan

Analysis Group six. There will be three different scenarios. Group six will be subjected to a interest rate of 5%. Overall Repayments of $15000 paid monthly, fortnightly and weekly.

Scenario one: : Rob takes out a personal loan of $50000. interest rates of 5% pa, $15000 is the minimum repayment for the year. This repayment is paid monthly of $1250, the compounding period is monthly . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 43 full repayments of $1250 and one repayment of $1060 to take the balance to zero, therefore it took 3.653 years or 43.84 months to repay the personal loan of $50000 at a repayment of $1250 monthly at an interest rate of 5% pa compounded monthly.

Total extra interest paid on top of loan =

(1250 x 43.84) = $54800

54800 – 50000 = $4800 extra paid on top of initial loan

Scenario two: Rob takes out a personal loan of $50000. interest rates of 5% pa, 15000 dollars is the minimum repayment for the year. This repayment is paid per fortnight of $576.92, the compounding period is per fortnight . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 94 full repayments of $576.92 and one repayment of $518.645 to take the balance to zero, therefore it took 3.649 years or 94.98 fortnights to repay the personal loan of $50000 at a repayment of $576.92 fortnightly at an interest rate of 5% pa compounded fortnightly.

Total extra interest paid on top of loan =

(576.92 x 94.98) = $54795.8616

54795.8616 – 50000 = $4795.86 extra paid on top of initial loan

Scenario three: : Rob takes out a personal loan of $50000. interest rates of 5% pa, 15000 dollars is the minimum repayment for the year. This repayment is paid per week of $288.461, the compounding period is per week . When will the loan be reduced to a balance of zero.

Recurrence relation:

The loan takes 189 full repayments of $288.461 and one repayment of $203.67 to take the balance to zero, therefore it took 3.658 years or 189.705 weeks to repay the personal loan of $50000 at a repayment of $288.461 weekly at an interest rate of 5% pa compounded weekly.

Total extra interest paid on top of loan =

(288.461 x 189.705) = $54722.49

54722.49 – 50000 = $4722.5 extra paid on top of initial loan

Analysis Group seven. 2 different scenarios. Time period will be 2 years because Rob has minimum living, expense and he wants to pay of his loan as quick as possible so interest does not accumulate to much. The compounding periods will be fortnightly so the repayments made will be every fortnight. Scenario one will look at 5% interest rate and scenario two will look at 7% interest rate.

Scenario one: Rob wants to pay of his loan in 2 years. His loan is $50000 dollars which has a interest rate of 7% pa compounded every fortnight. Repayments are to be made every fortnight. If Rob wants to pay of his debt in 2 years, what will be the minimum repayment.

N = 52

I% = 7

PV = -50000

PMT = x PMT= $1031. 708

FV = 0

P/Y = 26

C/Y = 26

Recurrence relation:

For Rob to repay the loan in 2 years, he would have to pay 1031.708 every fortnight.

Total extra interest paid on top of loan =

(1031.708 x 52) = $53648.816

53648.816 – 50000 = $3648.82 extra paid on top of initial loan

Scenario two: Rob wants to pay of his loan in 2 years. His loan is $50000 dollars which has a interest rate of 5% pa compounded every fortnight. Repayments are to be made every fortnight. If Rob wants to pay of his debt in 2 years, what will be the minimum repayment.

N = 52

I% = 5

PV = -50000

PMT = x PMT= $1011. 34

FV = 0

P/Y = 26

C/Y = 26

Recurrence relation:

For Rob to repay the loan in 2 years, he would have to pay $1011.34 every fortnight

Total extra interest paid on top of loan =

(1011.34 x 52) = $52589.68

52589.68 – 50000 = $2589.68 extra paid on top of initial loan

Analysis Group seven. 2 different scenarios. Time period will be 4 years because Rob has minimum living, expense and he wants to pay of his loan as quick as possible so interest does not accumulate to much. The compounding periods will be fortnightly so the repayments made will be every fortnight. Scenario one will look at 5% interest rate and scenario two will look at 7% interest rate.

Scenario one: Rob wants to pay of his loan in 4 years. His loan is $50000 dollars which has a interest rate of 7% pa compounded every fortnight. Repayments are to be made every fortnight. If Rob wants to pay of his debt in 4 years, what will be the minimum repayment.

N = 104

I% = 7

PV = -50000

PMT = x PMT= $551.85

FV = 0

P/Y = 26

C/Y = 26

Recurrence relation: 551.85

For Rob to repay the loan in 4 years, he would have to pay $551.85 every fortnight for 4 years.

Total extra interest paid on top of loan =

(551.85 x 104) = $57392.4

57392.4 – 50000 = $7392.4 extra paid on top of initial loan

Scenario two: Rob wants to pay of his loan in 4 years. His loan is $50000 dollars which has a interest rate of 5% pa compounded every fortnight. Repayments are to be made every fortnight. If Rob wants to pay of his debt in 4 years, what will be the minimum repayment.

N = 104

I% = 7

PV = -50000

PMT = x PMT= $530.91

FV = 0

P/Y = 26

C/Y = 26

Recurrence relation:

For Rob to repay the loan in 4 years, he would have to pay $530.91 every fortnight for 4 years.

Total extra interest paid on top of loan =

(530.91 x 104) = $55214.64

55214.64 – 50000 = $5214.64 extra paid on top of initial loan

Conclusion

There are multiple points of conclusion that can be made through out investigating task two.

First point increasing the overall repayments made yearly reduces the total time period of a loan until it reaches a value of $0. Group one scenario 1-3 which explored a $5500 overall annual repayment plan resulted in repayment schedules that took an average of 14.4746 years. Group three, scenario 1-3 which explored a $10000 overall annual repayment plan resulted in repayment schedules that took an average of 6.16 years. Group five, scenario 1-3 explored a $15000 overall annual repayment plan resulted in a repayment schedule that took an average of 3.79 years. (Average number of years to reach the balance of $0 is calculated for each group, by adding up the years it takes each of the scenarios to reach the value of zero. each of the three scenarios are added up together and is divided by the number of scenarios to result an average number of years it takes to reach a balance of zero for each group). Keep in mind Group two, Group four and Group 6 also follow the similar pattern but their time periods to reduce the balance to zero takes a shorter amount of time due to the lower interest of 5%.

Another factor that we can conclude is the interest rate. The higher the interest rate, the longer it takes for the loan balance to reach zero. Group one, group three and group five which used a 7% interest rate resulted in longer time periods for the loan balance to reach $0, then their respective Groups two, four and six which use a 5% interest rate resulted in less time. Group one scenario one The loan takes 173 full repayments of $458.33 and one repayment of $423.1 to take the balance to zero, therefore it took 14.49 years or 173.92 months to repay the personal loan of $50000 at a repayment of $458.33 monthly at an interest rate of 7% pa compounded monthly. While Group 2 scenario one The loan takes 145 full repayments of $458.33 and one repayment of $356.25 to take the balance to zero, therefore it took 12.14 years or 145.77 months to repay the personal loan of $50000 at a repayment of $458.33 monthly at an interest rate of 5% pa compounded monthly. Showcasing how higher interest rates results in longer time periods to reduce the balance to $0, while lower interest rates takes less time to reduce the balance to 0. This factor is present through out all groups and scenarios. E.g. group 5 scenario one The loan takes 45 full repayments of $1250 and one repayment of $853.087 to take the balance to zero, therefore it took 3.80 years or 45.68 months to repay the personal loan of $50000 at a repayment of $1250 monthly at an interest rate of 7% pa compounded monthly. Group 6 scenario one The loan takes 43 full repayments of $1250 and one repayment of $1060 to take the balance to zero, therefore it took 3.653 years or 43.84 months to repay the personal loan of $50000 at a repayment of $1250 monthly at an interest rate of 5% pa compounded monthly. Depicting one again the effect interest rate has on the time periods.

Another point of of conclusion is increasing the frequency of compounding periods and repayment periods also results in faster time period for the loan to close. Group ones scenarios interest rate 7%, $5500 overall repayment annually are both kept constant. However the compounding and repayment periods change. Scenario one looks at monthly, Scenario two looks at fortnightly and scenario three looks at weekly. Scenario one takes 14.49 years compounding monthly and making repayments monthly of 423.1. While scenario two takes 14.471 years compounding fortnightly and making repayments of 211.53 fortnightly. While scenario three is takes 14.463 years compounding weekly, and making repayments of 105.76 weekly. This pattern can be seen through out the entire analysis of task two, as for every group 1-6 showcased increasing compounding frequency and repayment period results in faster time periods to reduce the loan balance to zero. To further reinforce this point we shall look at Group 5. Once again Groups 5 scenarios look at monthly, fortnightly and weekly compounding and repayment periods, while the interest rate of 7% and overall annual repayment of $15000 is kept constant. Scenario one of Group five takes 3.80 years compounding monthly with repayments of 1250 made monthly to reduce the balance to zero. While scenario two of Group five takes 3.799 years to reduce the balance to zero compounding fortnightly and with repayments of 576.92 every fortnight. Lastly scenario three of group five takes 3.798 years compounding weekly with repayments of 288.461 made weekly to reduce the balance to zero. This showcases the effect compounding and repayment frequencies has on the time period as higher frequencies results in less time periods. All other groups not mentioned also follow this pattern.

Total interest paid on top of loan chart groups 1-6

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Group one | Group two | Group three | Group four | Group five | Group six |
| Scenario one | $29,714.95 | $16810.76 | $11716.42 | $7649.77 | $7100 | $4800 |
| Scenario two | $29,592.18 | $16739.83 | $11626.1 | $7591.50 | $7011.23 | $4795.86 |
| Scenario three | $29,541.48 | $16709.18 | $11582.2 | $7564.43 | $6974.51 | $4722.5 |

The factors stated above resulted into the different interest paid onto of loan changes in Groups 1-6. Therefore we can conclude Higher repayments, highest frequency of compounding/repayment frequency and lower interest rate produces the lowest value when it comes to the extra money you pay on top of the initial loan. Therefore Group six scenario three will be the most ideal.

Group 7-8 looked at the different time periods a loan has to be paid of by. This resulted in lower time periods = higher repayments needed to made. For Rob to repay the loan of $50000, 7% pa compounded fortnightly in 2 years, he would have to pay 1031.708 every fortnight. For Rob to repay the loan of $50000, 7% pa compounded fortnightly in 4 years, he would have to pay $530.91 every fortnight for 4 years. Therefore showcasing lower time periods results in higher repayments that need to be made to reach the loan balance to zero in the requested amount of time. Group 7-8 also explored the impact of different interest rate on the repayments . Higher interest rate resulted in higher repayments that need to be made. For Rob to repay the loan of $50000, interest rate 7%pa compounded every fortnight in 2 years, he would have to pay 1031.708 every fortnight. While the Loan of $50000 loan with a interest rate of 5%pa compounded every fortnight and to pay of the loan required $1011.34 to be repaid every fortnight. This pattern is also reflective in group 8.

Hence compounding periods, repayment periods, time periods, interest rates all play factors when it comes to the reduction of a loan balance.

Task Three

Introduction

The purpose of task three is to demonstrate using realistic values and recurrence relations to showcase how annuities and perpetuities are set up. We must also consider how payments are effected with different interest rates, durations and initial investments.

In task three we are also given very minimum information on what exact values to use but we know that we must use realistic values for initial investments, the different interest rates, durations. We must also use recurrence relationships to conduct this investigation.

The information that I need is exact realistic values for different interest rates, durations and initial investments.

Setting the scene

Annuities are insurance products that can be used as a part of retirement plans or as a way to receive steady income over a set period of time. immediate payout or a deferred payout option. For this investigation we will be using a deferred payout option, as we want to build our initial investment up, to set up the annuity to receive substantial income over a set period of time. Fixed Annuity or a Variable Annuity, for this investigation we will be using Fixed annuities, as variable annuities leave the scope of the investigation.

Our subject Rob wants to retire at the age of 65. Rob is 20 years old, he chooses a deferred annuity plan to set up his annuity, because he wants another set of income when he retires. During the accumulation phase of the annuity to set up the initial investment of the Annuity Rob starts investing at the age of 20 into mutual funds. This investment made by rob set up the initial investments of the annuity. This investigation will be split into three groups. Group ones initial investment will be $250000. Group twos initial investment will be $500000. All groups will investigate scenarios of annuities providing 5% and 7.5% interest rates. These interest rates are gathered from insurance companies that provide a fixed annuity interest rate. All groups will investigate time periods of 5, 10 and 15 year payments when rob reaches the age of 65. To see what payments he would receive. The compounding periods will be made monthly and Rob will receive payments monthly.

Pre Analysis setting up the annuity

As mentioned before we want to explore three different annuities with different initial investments made by Rob. One group will explore $250000, the other group will explore $500000 Since this is a differed annuity, as Rob only wants to start receiving payments at the age of 65 as an retirement income. Therefore we have to set up the annuity first by building the investments of the three different groups. Rob from the age of 20 starts investing monthly into mutual funds to achieve this. To simplify this process we all assume the mutual funds he invests in offers an average return rate of 10% per year.

Setting up an initial investment of $250000 dollars for the deferred annuity in group one. Rob from the age of twenty invests $24 monthly into a mutual fund that offers an average return rate of 10% a year that compounds monthly for 45 years.

Recurrence relationship:

After 540 months or 45 years, we will have an initial amount of $250000 to set up the annuity for robs second retirement income.

Setting up an initial investment of $500000 dollars for the deferred annuity in group one. Rob from the age of twenty invests $48.5 monthly into a mutual fund that offers an average return rate of 10% a year that compounds monthly for 45 years.

Recurrence relationship:

After 540 months or 45 years, we will have an initial amount of approximately $500000 to set up the annuity for robs second retirement income.

The initial investments are now gathered and placed into annuities offering a fixed interest rate of 5% and 7.5%. Each Annuity set up be the different investment will explore varying time periods of 5, 10 and 15 years

Analysis

Group one: Rob sets up the initial investment of $250000 by the time Rob becomes age 65, accumulating it over a period of 45 years from small monthly investments made into index funds that provide a steady rate of interest. Group one will explore 6 different scenarios. Scenario 1-3 will look at a $250000 annuity at a interest rate of 7.5%, paid out over a time period of 5, 10 and 15 years. While Scenario 4-6 will look at a $250000 annuity at a interest rate of 5% paid out over a period of 5, 10 and 15 years. Therefore we want to know the different payments of each of these scenarios.

Scenario one: Annuity set up at $250000, Interest is paid at 7.5% pa compounded monthly over a period of 5 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 60

I% = 7.5

PV = 250000

PMT = x PMT= $5009.487

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 60 months or 5 years Rob will receive 60 full payments of $5009.487 per month, and on the 61 month, Rob will receive his final payment of $0.01106875.

Scenario two: Annuity set up at $250000, Interest is paid at 7.5% pa compounded monthly over a period of 10 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 120

I% = 7.5

PV = 250000

PMT = x PMT= $2967.544228

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 120 months or 10 years Rob will receives 120 full payments of 29767.54 per month, and on the 121 month, Rob will receive his final payment of $0.7567

Scenario three: Annuity set up at $250000, Interest is paid at 7.5% pa compounded monthly over a period of 15 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 180

I% = 7.5

PV = 250000

PMT = x PMT= $2317.53

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 180 months or 15 years Rob will receives 180 full payments of 2317.53 per month, and on the 121 month, Rob will receive his final payment of $0.3.

Scenario four: Annuity set up at $250000, Interest is paid at 5% pa compounded monthly over a period of 5 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 60

I% = 5

PV = 250000

PMT = x PMT= $4717.80

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 60 months or 5 years Rob will receive full payments of $4717.80 per month, and on the 61 month, Rob will receive his final payment of $0.574.

Scenario five: Annuity set up at $250000, Interest is paid at 5% pa compounded monthly over a period of 10 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 120

I% = 5

PV = 250000

PMT = x PMT= $2651.64

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 120 months or 10 years Rob will receives 120 full payments of 2651.64 per month, and on the 121 month, Rob will have to repay $0.018 back to the insurance company.

Scenario six: Annuity set up at $250000, Interest is paid at 5% pa compounded monthly over a period of 15 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 180

I% = 5

PV = 250000

PMT = x PMT= $1976.984

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 180 months or 15 years Rob will receives 180 full payments of 1976.984 per month, and on the 121 month, Rob will receive his final payment of $1.087

Group two: Rob sets up the initial investment of $500000 by the time Rob becomes age 65, accumulating it over a period of 45 years from small monthly investments made into index funds that provide a steady rate of interest. Group one will explore 6 different scenarios. Scenario 1-3 will look at a $500000 annuity at a interest rate of 7.5%, paid out over a time period of 5, 10 and 15 years. While Scenario 4-6 will look at a $500000 annuity at a interest rate of 5% paid out over a period of 5, 10 and 15 years. Therefore we want to know the different payments of each of these scenarios.

Scenario one: Annuity set up at $500000, Interest is paid at 7.5% pa compounded monthly over a period of 5 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 60

I% = 7.5

PV = 500000

PMT = x PMT= $10018.974

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 60 months or 5 years Rob will receive 59 full payments of $10018.974 per month, and on the 60th month, Rob will receive his final payment of $10018.996

Scenario two: Annuity set up at $500000, Interest is paid at 7.5% pa compounded monthly over a period of 10 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 120

I% = 7.5

PV = 500000

PMT = x PMT= $5935.088

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 120 months or 10 years Rob will receives 119 full payments of 5935.088 per month, and on the 120th month, Rob will receive his final payment of $5935.169

Scenario three: Annuity set up at $500000, Interest is paid at 7.5% pa compounded monthly over a period of 15 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 180

I% = 7.5

PV = 500000

PMT = x PMT= $4635.062

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 180 months or 15 years Rob will receives 179 full payments of 4635.062 per month, and on the 180th month, Rob will receive his final payment of $4634.995

Scenario four: Annuity set up at $500000, Interest is paid at 5% pa compounded monthly over a period of 5 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 60

I% = 5

PV = 500000

PMT = x PMT= $9435.617

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 60 months or 5 years Rob will receive 59 full payments of $9435.617 per month, and on the 60 month, Rob will receive his final payment of $9435.604

Scenario five: Annuity set up at $500000, Interest is paid at 5% pa compounded monthly over a period of 10 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 120

I% = 5

PV = 500000

PMT = x PMT= $5303.276

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 120 months or 10 years Rob will receives 119 full payments of 5303.276 per month, and on the 120 month, Rob will receive his final payment of $5303.24.

Scenario six: Annuity set up at $500000, Interest is paid at 5% pa compounded monthly over a period of 15 years, what payments must Rob receive for the value of the annuity to hit zero

Recurrence relationship:

N = 180

I% = 5

PV = 500000

PMT = x PMT= $3953.968

FV = 0

P/Y = 12

C/Y = 12

Recurrence relationship:

After a period of 180 months or 15 years Rob will receives 179 full payments of 3953.968 per month, and on the 120th month, Rob will receive his final payment of $3954.

Conclusion

Once again multiple conclusions can be reached.

During this investigation I found out that a larger investment will produce larger payments offered. Group ones initial investment was $250000 dollars for all scenarios. Scenario 1-3 looked at the initial investment compounded monthly for time periods 5, 10 and 15 years with an interest rate of 7.5%pa, payments are taken out monthly. Groupe one Scenario one payment was $5009.487, while Group one scenario two payment was 2967.5442 and Group one Scenario three payment is $2317.53. While Group 2 scenario 1-3 had larger payments due to the larger investment of $500000 compounded monthly at 7.5pa and payments are were taken out monthly. Group 2 scenario one payment was $10018.974, Group two scenario two payment Is $5935.088 and Group two scenario three payment is $4635.062. Therefore allowing me to conclude that larger investments will result in larger payouts in set time periods. This pattern is followed in the lower interest rate option of 5 percent of group 1,2 scenarios 4-6, but they result in a smaller value due to the smaller interest.

The second point that we can conclude is that as the time period increases, the payment gets smaller. As the investment needs to be stretched out to reach the set time period. This is seen in all groups. However we will only showcase Group 2 scenario 4-6 to save time. For a 5 year time period Group two scenario 4 payout option is $$9435.617. For a 10 year time period Group two scenario 5 payout option is $$5303.276. For a 15 year time period Group two scenario six payout option is $3953.968. Therefore this data is represented is representative of all the scenarios and groups in task three as the time period increases the payment decreases, as Rob wants to make his investment last. Also longer time periods allows more significant gains in the investment then the 5 year period therefore overall making more money then the shorter term investments that reduce the balance to zero in a period of 5 years.

Interest rates is also a critical factor when it comes to annuities. Through our investigation we have concluded that a higher interest rate, results in a higher investment, therefore more/or larger payments can be offered. E.g Group one scenario one After a period of 60 months or 5 years Rob will receive 60 full payments of $5009.487 per month. While Group one scenario four After a period of 60 months or 5 years Rob will receive full payments of $4717.80 per month. The only differences between these scenarios are the interest rates as scenario one compounds monthly at 7.5pa, while the scenario four compounds monthly at a 5%pa therefore showcasing that higher interest rate effects your payments by increasing it.

Overall a conclusion can be made from task three when investing into annuities. Higher interest rate is preferred. And a longer period payment plan, as a 5 year payout plan is far too short so the investment cannot compounded for a considerable amount of time. Therefore the 15 year payout plan is preferred as the investment will compound more over the period of 15 years, and eventually producing an investment/payout out put far greater then the 5 year payout.