Student name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Overview

In this assignment you will use mathematical models to simulate various retirement investment strategies using Microsoft Excel.

Objectives

- The student will demonstrate their ability to perform simulations using Microsoft Excel.

- The student will explore the expected outcomes of various retirement strategies.

- The student will demonstrate their ability to create an analyze simulation models.

Directions

Use this workbook as a guide to perform the prescribed operations in the Excel spreadsheet “financial\_simulations\_workbook.xlsx”. When prompted for an answer, delete the placeholder <write your answer here> with your answer.

Reminder: to view all cells as formulas, type **control** and **tilda** at the same time.

Part 1

Save this Word document to your computer or jump drive as: models\_workbook\_yourLastName

Open the MS Excel file **financial\_simulations\_workbook.xlsx**. Save the file as: financial\_simulations\_yourLastName.xlsx

In the Excel workbook, open the worksheet *simple\_retirement\_planner*

In cells C1-C4, values are listed for the age you begin retirement savings, your expected retirement age, the number of years you save, and inflation, respectively.

|  |  |
| --- | --- |
| Age\_saving\_begins | 25 |
| Retirement\_age | 60 |
| Years\_of\_saving | 35 |
| Inflation (average) | 3.00% |

(cut)

Note that the value *Years\_of\_saving* is equal to *Age\_saving\_begins* minus *Retirement\_age*

Now observe that there are several dozen scenarios listed. For each scenario, we vary the amount saved (*$\_Saved\_per\_month*) and the average annual return (*%\_return (yearly)*).

In the column *$\_at\_retirement*, we use the future value (FV) formula in excel to calculate the future value of your annual investments when you want to retire. The arguments for the FV formula are:

FV(rate, number of payments, periodic payment amount)

For example, in cell D7, we see the formula:

=FV(C7/12,$C$3\*12,-B7) <cut>

In this case, we want to know how much money we will have after 35 years (cell C3) if we invest $100 per month (cell B7) and earn 5% annually. <cut>

Note that we divide the annual rate of return by 12 to turn it into a monthly rate of return (eg: 5% annual is 0.4167% monthly). Also note that we multiply the years of savings by 12 to get the number of monthly payments (12 monthly for 35 years is 420 payments).

Finally, note that the amount we invest is negative (in this case –B7). This is because the payment represents a cash outflow, even if it is paid to oneself.

Therefore, the formula =FV(C7/12,$C$3\*12,-B7) evaluates as =FV(0.004167,420,-100), which gives us the value $113,609.24. <cut>

Consequently, if we invest $100 per month for 35 years and we earn 5% on it yearly (or 0.4167% monthly), we would end up with $113,609.24. This gives us scenario 1.

Scenario 2 evaluates the same problem but assumes that instead of earning 5% annually, we earn 7% annually. Copy the formula in D7 down through D62, and note what happens when you invest various amounts of money at various interest rates.

Question 1: Use the spreadsheet *simple\_retirement\_planner* to answer the following questions.

(Hint: change the values in your table by changing the values for Age\_saving\_begins or retirement\_age, etc., as prescribed.)

1. Assume that you start investing $200 per month at age 25 and you are able to earn 9% per year on your investments. How much money do you end up with at age 60? <write your answer here>
2. Assume that you wait until age 40 to start investing, but you are able to save $500 per month, and you are able to earn 13% on your investments every year until you retire at 60. How much money do you end up with at age 60? <write your answer here>
3. Now, assume that you start investing $200 per month at age 25 and you are able to earn 9% per year, but you are able to hold out and you don't retire until age 65. Now how much money do you have when you retire? <write your answer here>
4. Now, assume that you start investing $250 per month in a 401k at age 25, and that you are able to earn 7% per year on your investment until you retire at age 60. How much money do you have when you retire? <write your answer here>

Part 2

Now go to the worksheet *retirement\_simulations*.

In Model 1, we assume that you start saving $100 per month at 11% interest (compounded annually). For simplicity, let's assume that you put all your monthly savings in a piggy bank and don't invest it until the end of each year. If you examine cell E8, you see that at age 25, you invested a total of $1200. Then, at age 26, you invest another $1200 ($100 per month for 12 months). When you are 26, note that in addition to the money you saved when you were 25 (cell E8), you earned 11% (or $132) on the $1200 you saved at age 25 (cell F9). Therefore, your total savings at the end of your 26th year is equal to:

money you saved during year 25 <cut>

+ interest you earned on the money you saved during year 25 <cut>

+ money you saved during year 26 <cut>

or

$1200 + $132 + $1200 = $2532 <cut>

or

|  |  |  |
| --- | --- | --- |
| **Age** | **25** | **26** |
| Return |  | 11% |
| Yearly Savings | $1,200 | $1,200 |
| Investment gain/loss |  | $132 |
| Total Savings | $1,200 | $2,532 |

(cut)

Note that the formula in cell F10 is =E10+F8+F9

Reminder: to view all cells as formulas, type **control** and **tilda** (~) at the same time.

Question 2

Based on the results of Model 1…

1. At what age does the money you make on your investment earn more than the $1200 you contribute every year? <write your answer here>
2. At what age does your investment earn you double the $1200 you contribute every year? <write your answer here>

Question 3

Based on the results in Model 1…

1. You do pretty well for many years, but upon turning 51, you start to incur 3 years of losses. How old are you before your total savings is at or above the level it was at age 50?

<write your answer here>

1. Assume that you retire at age 65- how much money do you have?

<write your answer here>

Assume that you don't start saving at age 25- let's say you wait until age 30. To simulate this, replace the values in cells E8, F8, G8, H8, and I8 with zeros, so that you have:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Age | 25 | 26 | 27 | 28 | 29 | 30 |
| Return |  | 11% | 11% | 11% | 11% | 11% |
| Yearly Savings | $0 | $0 | $0 | $0 | $0 | $1,200 |
| Gain loss |  | $0 | $0 | $0 | $0 | $0 |
| Total Savings | $0 | $0 | $0 | $0 | $0 | $1,200 |

(cut)

Question 4

1. Using model 1, if you start investing at age 30 instead of age 25, how much money do you have at age 65?

<write your answer here>

1. So, given the other assumptions we make in model 1 (11% rate of return, invest $100 per month, etc.), how much more money do you have at age 65 if you started investing at age 25 instead of 30?

<write your answer here>

Examine Model 2a. In this model, we assume that you earn a tidy profit of 8% every year for four years, but then you take an 8% loss every fifth year, and this happens from age 25 until age 70. Let's also assume that every 10 years, you add another $100 per month to how much you are saving (so at age 35, you start saving $2400 per year, and at age 45 you start saving $3600 per year, etc.) Assume you stop working (and adding earned income to your savings) at age 60.

Question 5

Based on the results in Model 2a…

1. How much money do you have at age 65 in Model 2a? <write your answer here>
2. In cell B14, use the Excel AVERAGE formula to calculate the average (mean) yearly rates of return on your investments in Model 2a from age 26 to age 65. (That is- the average of cells F14 to AS14). What is the average yearly return? <write your answer here>
3. Enter numbers and formulas in cells E21 to AX24 that will model your total savings assuming: each year you save $1200 and invest it at the end of the year, you start saving at age 25, and each year you earn exactly the average return that you calculated for Model 2a (cell B14). <write your answer here>
4. Would you rather invest in a portfolio with returns expected to mirror those of Model A or Model B? Why? <write your answer here>

Now, let's consider Model 3. Notice that at the top of the model there is a random number for each year. For the return values (cell E24), there are several nested IF statements that will return a value based upon the random number calculated for that year:

=IF(E23<0.05,-0.3,IF(E23<0.15,-0.08,IF(E23<0.95,0.07,0.17))) <cut>

Effectively, these nested IF statements say:

If the value in cell E23 is less than 0.05, then assign a loss of 30%, otherwise <cut>

if the value in cell E23 is less than 0.15, then assign a loss of 8%, otherwise <cut>

if the value in cell E23 is less than 0.95, assign a gain of 7%, otherwise <cut>

assign a gain of 17%. <cut>

This has the effect of saying, "There is a 5% chance of a 30% loss, a 10% chance of an 8% loss, an 80% chance of a 7% gain, and a 5% chance of a 17% gain."

Question 6

6a) Run the simulation in model three 10 times and input the amount of money you end up with at age 70 for each simulation into Table 1. (To run one simulation quickly, put your cursor in cell AY23 and hit the sequence of keys "zero, return, up button".)

|  |  |
| --- | --- |
| **Simulation** | **$ at age 70** |
| **1** |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

Table 1

6b) What is the average amount of money from the 10 simulations? <write your answer here>

Question 7

In Model 4, assume that you invest $1200 from ages 25-34, $2400 per month from ages 35 to 44, $3600 per month from ages 45 to 54, and $4800 per month from ages 55 to 60. Assume the rate of return you earn on your investments is based on the following rule: "There is a 5% chance of a 20% loss, a 10% chance of a 15% loss, a 75% chance of a 7% gain, and a 10% chance of a 15% gain."

1. What is the formula you use to execute the rule that governs your returns?

<write your answer here>

1. Run the simulation 10 times and report the results below:

|  |  |
| --- | --- |
| **Simulation** | **$ at age 70** |
| **1** |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

Table 2

1. What is the average amount of money from the 10 simulations? <write your answer here>

More practice: Use "scenario 5" to run any other scenarios you may be curious about.

Submission instructions

Make sure your name is at the top of this document.

Go through this document and delete all of the blue colored text. *Be sure you don't delete any of the questions or your answers!!!*

Go through this document and delete all tables that say (cut) below them.

Go through this document and delete any lines that have <cut> in the right-hand side of the page.

Your document should now contain only questions and your answers.

Save this document.

Print out a hard copy of this document (do not include this page- submission instructions).

Make 2 electronic copies of this document (for backup).

Submit an electronic copy of this document AND YOUR EXCEL FILE to your instructor by assignment deadline.