

## Programming Assignment #6

### Invest in Your Future

CS 1428.253, Spring 2020

Instructor: Jill Seaman

**Due: Monday, 4/20/2020** (upload electronic copy by 11:59pm)

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#### Problem:

You have come into an unexpected inheritance and you want to know how much it will grow if you invest it for a certain number of years, at various interest rates.

Write a program that asks the user for an initial investment amount, the interest rate (compounded annually), and the number of years to let the investment grow.

Then calculate and output the final accumulated value of the investment, based on the input values.

The formula to compute the investment total is the **future value formula**:

$$F = P * (1 + r)^n$$

where F is the future value (the amount that will have accumulated at the end of the investment period), P is the present value (the amount deposited up front), r is the annual interest rate (between 0 and 1), and n is the number of years the money will be invested.

After displaying the future value, then output a table showing the balance of the investment at the end of each year that the money is invested. To output the table, you will calculate F using the input initial value and interest rate, with n taking on 1 through the total number of years. In other words, the first year will use P, r, and n=1, the second year will use the same P and r, but n=2, and so on up to the final number of years of the investment.

Finally, you will notify the user how many years it will take for the initial balance to double, and the year in which year the balance will reach one million dollars (\$1,000,000).

The formula to calculate the number of years for your investment to double is

$$n = .727/r$$

The formula to calculate the number of years to reach one million is:

$$n = (\log(1000000) - \log(P)) / \log(1 + r)$$

where `log` is a function in the `cmath` library. In either case, if the value `n` has a fractional part (12.34 years) it should be **rounded up** to the next whole number (13 years). The function `ceil` in the `cmath` library will do this. Then, for the million dollar year, add this to the current year (2020).

### **Input:**

Ask the user for the initial investment amount (the present value), the interest rate, and the number of years of the investment. The initial investment value and interest rate may have fractional values. You should validate the input.

- The initial investment should be at least \$100 but not more than \$1,000,000
- The interest rate should be greater than 0 and less than or equal to 50.
- The years should not be over 80 (and greater than 0).

If the input is out of range, use an informative prompt to ask the user to re-enter valid data until the input is valid.

For the calculations to work properly, you must convert the interest rate which is input as a percent between 0 and 100 (i.e. 3.5%) to a fractional value between 0 and 1 (i.e. 0.035).

**Processing:** You must use the following 5 functions in your program.

getInput: has three reference parameters to input initial investment value, interest rate, and number of years from the user.

calculateFV: has 3 parameters: present value, interest rate, and years of investment. Returns the calculated future value. Do not do any output from this function.

yearsToDouble: has 1 parameter: the interest rate. Returns the estimated number of years it will take for a balance to double. Do not do any output from this function.

yearsToOneMillion: has 2 parameters, the initial value and the interest rate. Returns the calculated number of years it takes for the balance to reach one million. Do not do any output from this function.

outputTable: has 3 parameters: initial investment (present value), interest rate, and total years. It outputs the table with column headers, and one row for each year from 0 to total years, showing the balance at the end of that year.

**Output:** Display the dollar amounts formatted to 2 decimal places. Do not show dollar signs in the table. The values in the table should be right-justified. The year values should be integers. Assume that the balance will fit within 20 characters.

## Sample output:

```
Enter your initial investment amount: 150000
Enter the annual interest rate: 12.5
Enter the number of years of the investment: 20
```

```
Future value of investment: $1581764.08
```

Year	Balance
0	150000.00
1	168750.00
2	189843.75
3	213574.22
4	240271.00
5	270304.87
6	304092.98
7	342104.60
8	384867.68
9	432976.14
10	487098.15
11	547985.42
12	616483.60
13	693544.05
14	780237.06
15	877766.69
16	987487.53
17	1110923.47
18	1249788.90
19	1406012.51
20	1581764.08

```
Investment will double in 6 years
```

```
One million dollar year: 2037
```

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## Additional Requirements:

- Your program **must compile** and run, otherwise you will receive a score of 0.
- Hint: Do the `getInput` function last. To get started, do your input from main, then call the other 4 functions appropriately. Once the program is working, create a `getInput` function and move your input code to that function (and call it from main).
- Do NOT use global variables!! All variables must be defined inside of functions. Use parameters in your functions.
- To receive full credit your program must define and call the functions described above.

- Named constants are NOT required for the limit values used in input validation.

### **Style:**

See the Style Guidelines document on the course website. **Especially pay attention to the comments required for functions.** The grader will deduct points if your program violates the style guidelines.

### **Note:**

Some common interest rates are: 2.10% (Certificates of Deposit), 2.255% (30 year US Treasury Bond), 10% (average for stocks (S&P 500) over a 30 year period), 20% (average of stocks from 1990 to 1999) and 32% (average of stocks in 2013).

You could use an on-line investment calculator to check your results, but keep in mind that these may compound the interest monthly, whereas our calculator compounds the interest yearly. You can use this one:

[An online investing calculator \(click here\)](#)

Fill in the years for the Number of Periods, the starting balance, the rate of return, 0 for Periodic Deposit. Click "Calculate" and see the Schedule below the graph.

### **Logistics:**

Name your file **assign6\_XXXXX.cpp** where XXXXX is your TX State NetID (your txstate.edu email id). The file name should look something like this: assign6\_js236.cpp

Submit an **electronic copy** using the Assignments tool on the Canvas course for this class ([canvas.txstate.edu](https://canvas.txstate.edu)). Submit the .cpp file, (NOT a .cbp or .xcodeproj file!).

See the assignment turn-in policy on the course website ([cs.txstate.edu/~js236/cs1428](https://cs.txstate.edu/~js236/cs1428)) for more details, including late deadlines and penalties.