

Example: Progressive Modification:Problem - Case #1 -

I have a sum of money to invest at a particular rate of interest for 10 years. How much money will I have at the end of 10 years, if compounded annually? What is my total interest earned?

Analysis:

a) output -

principal in 10 years - P
amount earned - E

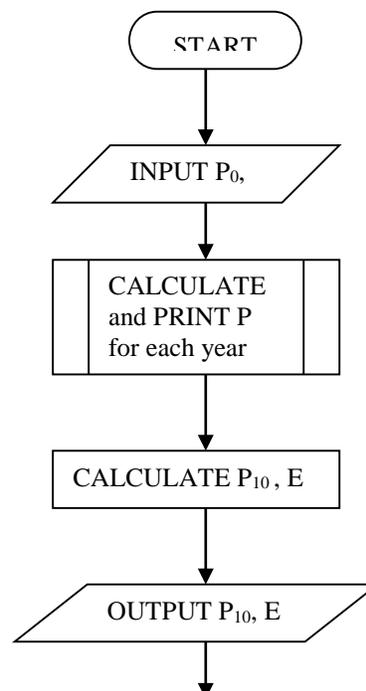
b) input -

initial amount of money - P_0
rate of interest - R

c) method - compound interest calculation - pseudocode or flowchart

Pseudocode:

- (1) Start working on program.
- (2) Input amount, interest rate.
- (3) Calculate P_1 (principal in year 1) as $P_0 + P_0 * R$
- (4) Output principal for year 1
- (5) Calculate P_2 (principal in year 2) as $P_1 + P_1 * R$
- (6) Output principal for year 2
- (7) For each of the remaining years, $N = 3$ through 10, repeat steps (5) and (6), for principal in year N .
- (8) Calculate $E: P_{10} - P_0$.
- (9) Output P_{10}, E .
- (10) Stop working on program.

Flowchart:

STOP

```

//case1.cpp
// Compound Interest Program - Case 1
// This program computes interest on some initial investment,
// compounded annually for 10 years.

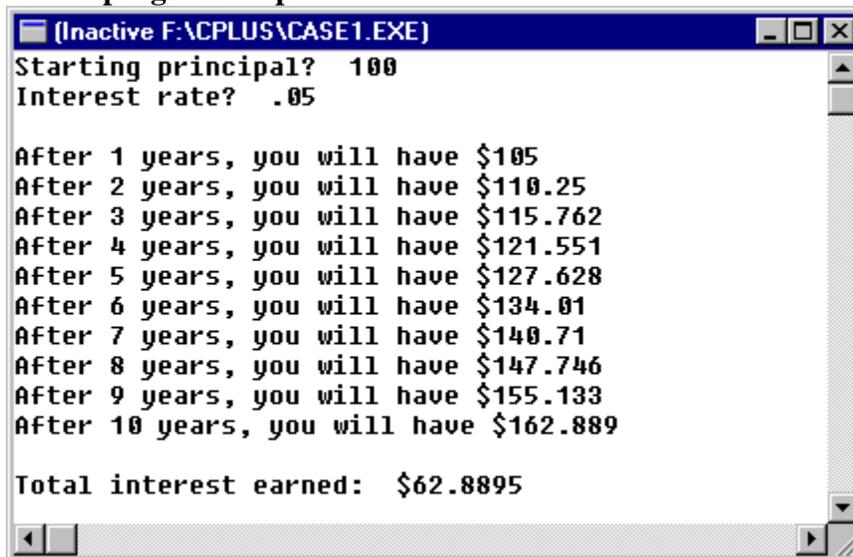
#include <iostream>

int main()
{
    int year;
    float pzero, p, rate, earned;

    cout << "Starting principal? ";
    cin >> pzero;
    cout << "Interest rate? ";
    cin >> rate;
    cout << endl;
    p = pzero;
    for (year=1; year<=10; year++){
        p = p + p * rate;
        cout << "After " << year << " years, you will have $" <<p <<endl;
    }
    earned = p - pzero;
    cout << "\nTotal interest earned: $" << earned <<endl;
    return 0; //successful termination
} //end main

```

Case 1 program output:



```

(Inactive F:\CPLUS\CASE1.EXE)
Starting principal? 100
Interest rate? .05

After 1 years, you will have $105
After 2 years, you will have $110.25
After 3 years, you will have $115.762
After 4 years, you will have $121.551
After 5 years, you will have $127.628
After 6 years, you will have $134.01
After 7 years, you will have $140.71
After 8 years, you will have $147.746
After 9 years, you will have $155.133
After 10 years, you will have $162.889

Total interest earned: $62.8895

```

Of course, we would really like the output to look like we are working with dollars and cents. We will use the stream manipulator functions of `<iomanip>`.

```
cout
```

```
/** Formatting for stream output**
```

```

<< setiosflags (ios::fixed | ios::showpoint) // fixed point |
// always print decimal point
<< setw(20) // field width is 20 characters
<< setprecision(2) // 2 digits after decimal point
<< var // variable to be output
<< endl; // newline

```

```

//casela.cpp
// Compound Interest Program - Case 1 - revised for nicer output
// This program computes interest on some initial investment,
// compounded annually for 10 years.

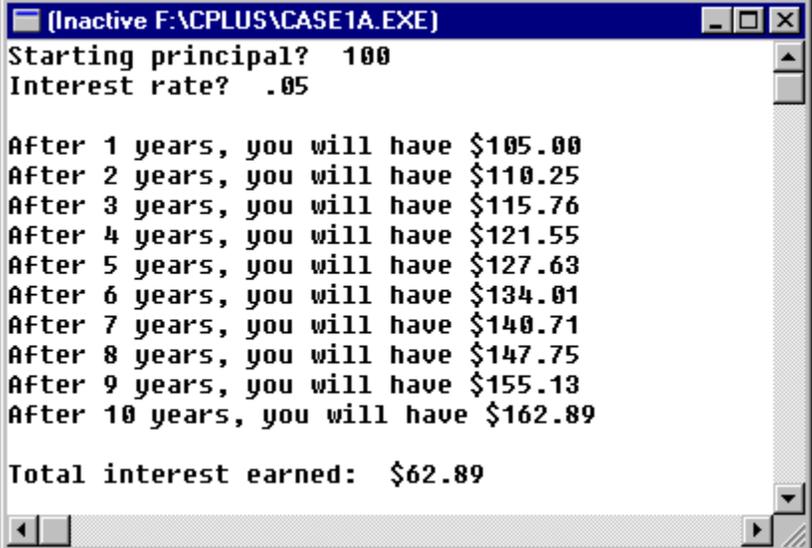
#include <iostream>
#include <iomanip>

int main()
{
    int year;
    float pzero, p, rate, earned;

    cout << "Starting principal? ";
    cin >> pzero;
    cout << "Interest rate? ";
    cin >> rate;
    cout << endl;
    cout << setiosflags(ios::fixed | ios::showpoint) << setprecision(2);
    p = pzero;
    for (year=1; year<=10; year++){
        p = p + p * rate;
        cout << "After " << year << " years, you will have $" <<p <<endl;
    }//end for
    earned = p - pzero;
    cout << "\nTotal interest earned: $" << earned <<endl;
    return 0; //successful termination
} //end main

```

Much nicer!



```
(Inactive F:\CPLUS\CASE1A.EXE)
Starting principal? 100
Interest rate? .05

After 1 years, you will have $105.00
After 2 years, you will have $110.25
After 3 years, you will have $115.76
After 4 years, you will have $121.55
After 5 years, you will have $127.63
After 6 years, you will have $134.01
After 7 years, you will have $140.71
After 8 years, you will have $147.75
After 9 years, you will have $155.13
After 10 years, you will have $162.89

Total interest earned: $62.89
```

Case 2 -- Suppose I wish to perform these calculations for 5 different sets of input data:

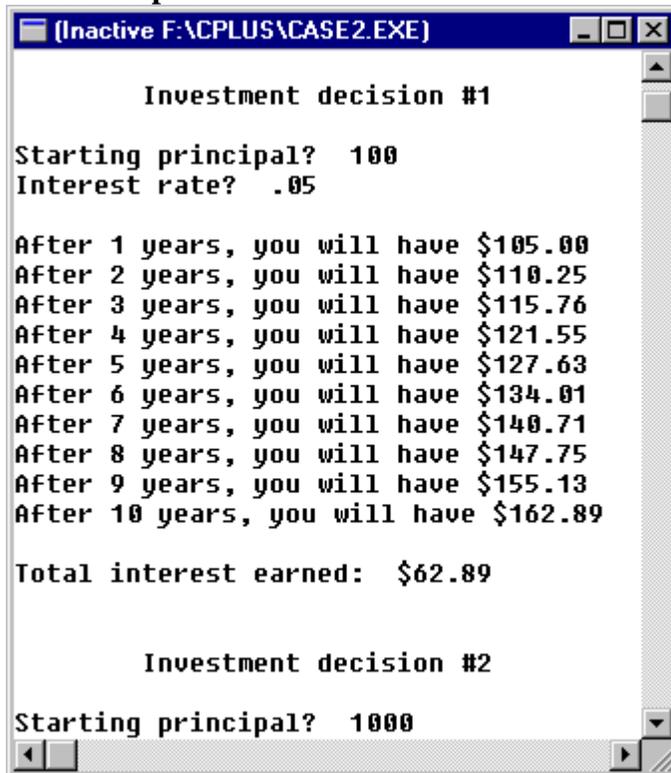
```
//case2.cpp
// Compound Interest Program - Case 2
// This program computes interest on some initial investment,
// compounded annually for 10 years.

#include <iostream>
#include <iomanip>

int main()
{
    int year;
    float pzero, p, rate, earned;

    for (int count = 1; count <=5; count++) {
        cout << "\n\n\tInvestment decision #" << count << endl;
        cout << "\nStarting principal? ";
        cin >> pzero;
        cout << "Interest rate? ";
        cin >> rate;
        cout << endl;
        cout << setiosflags(ios::fixed | ios::showpoint)
             << setprecision(2);
        p = pzero;
        for (year=1; year<=10; year++){
            p = p + p * rate;
            cout << "After " << year << " years, you will have $"
                 << p <<endl;
        } //end for
        earned = p - pzero;
        cout << "\nTotal interest earned: $" << earned <<endl;
    } //end for
    return 0; //successful termination of program
} //end main
```

Partial output:



```
(Inactive F:\CPLUS\CASE2.EXE)

      Investment decision #1

Starting principal? 100
Interest rate? .05

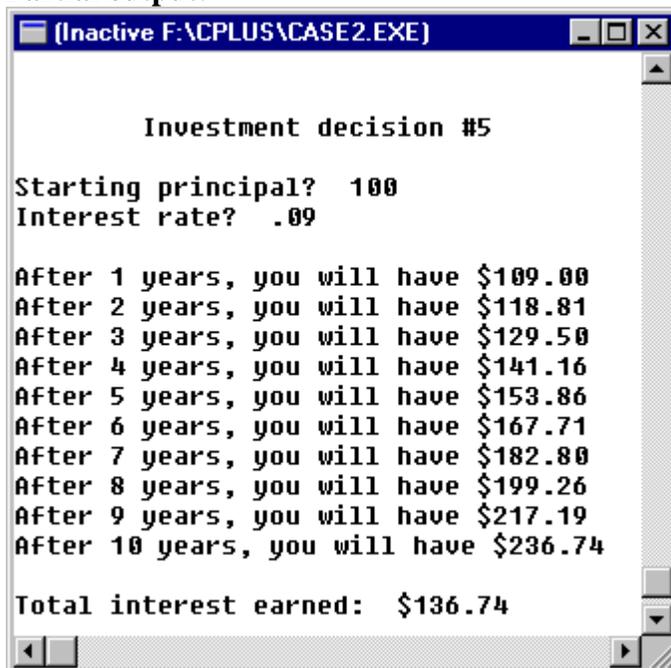
After 1 years, you will have $105.00
After 2 years, you will have $110.25
After 3 years, you will have $115.76
After 4 years, you will have $121.55
After 5 years, you will have $127.63
After 6 years, you will have $134.01
After 7 years, you will have $140.71
After 8 years, you will have $147.75
After 9 years, you will have $155.13
After 10 years, you will have $162.89

Total interest earned: $62.89

      Investment decision #2

Starting principal? 1000
```

Partial output:



```
(Inactive F:\CPLUS\CASE2.EXE)

      Investment decision #5

Starting principal? 100
Interest rate? .09

After 1 years, you will have $109.00
After 2 years, you will have $118.81
After 3 years, you will have $129.50
After 4 years, you will have $141.16
After 5 years, you will have $153.86
After 6 years, you will have $167.71
After 7 years, you will have $182.80
After 8 years, you will have $199.26
After 9 years, you will have $217.19
After 10 years, you will have $236.74

Total interest earned: $136.74
```

Case 3 - Why limit the investment to 10 years only?

```
//case3.cpp
// Compound Interest Program - Case 3
// This program computes interest on some initial investment,
// compounded annually for any number of years.

#include <iostream>
#include <iomanip>

int main()
{
    int n, year, years;
    float pzero, p, rate, earned;

    for (int count = 1; count<=5; count++) {
        cout << "\n\n\tInvestment decision #" << count << endl;
        cout << "\nStarting principal? ";
        cin >> pzero;
        cout << "Interest rate? ";
        cin >> rate;
        cout << "How many years? ";
        cin >> years;
        cout << endl;
        cout << setiosflags(ios::fixed | ios::showpoint)
            << setprecision(2);
        p = pzero;
        for (year=1; year<=years; year++){
            p = p + p * rate;
            cout << "After " << year << " years, you will have $"
                << p <<endl;
        } //end for
        earned = p - pzero;
        cout << "\nTotal interest earned: $" << earned <<endl;
    } //end for
    return 0; //successful termination of program
} //end main
```

Partial Output:

```
F:\ACPLUS\CASE3.EXE
      Investment decision #2

Starting principal? 1000
Interest rate? .08
How many years? 9

After 1 years, you will have $1080.00
After 2 years, you will have $1166.40
After 3 years, you will have $1259.71
After 4 years, you will have $1360.49
After 5 years, you will have $1469.33
After 6 years, you will have $1586.87
After 7 years, you will have $1713.82
After 8 years, you will have $1850.93
After 9 years, you will have $1999.00

Total interest earned: $999.00

      Investment decision #3

Starting principal? 100
Interest rate? .05
How many years? 10_
```

```
F:\ACPLUS\CASE3.EXE
After 10 years, you will have $162.89

Total interest earned: $62.89

      Investment decision #4

Starting principal? 1000
Interest rate? .15
How many years? 6

After 1 years, you will have $1150.00
After 2 years, you will have $1322.50
After 3 years, you will have $1520.88
After 4 years, you will have $1749.01
After 5 years, you will have $2011.36
After 6 years, you will have $2313.06

Total interest earned: $1313.06

      Investment decision #5

Starting principal? 2500_
```

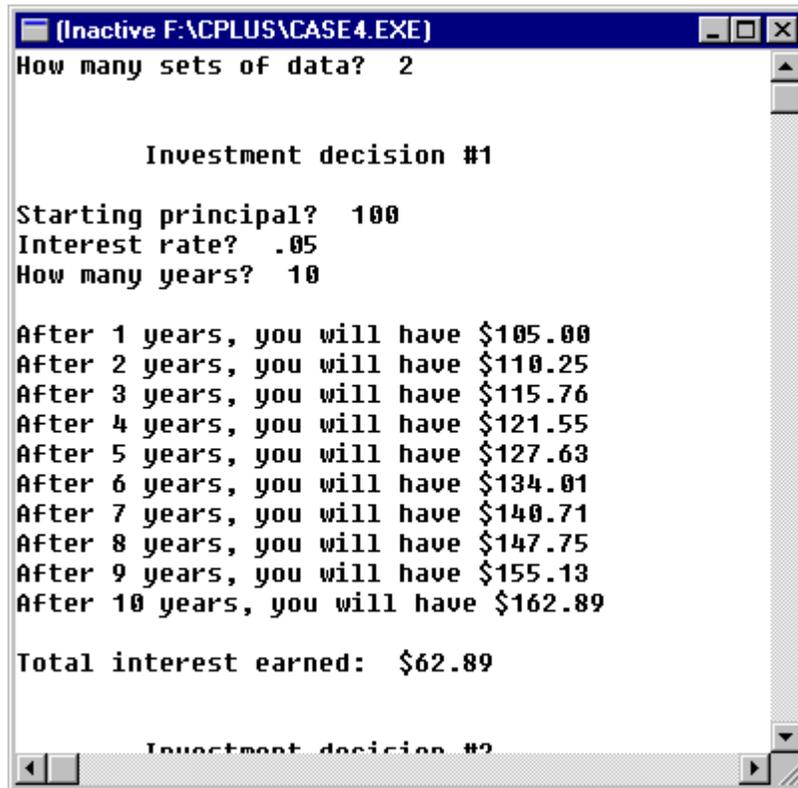
Case 4 - How about for N sets of data?

```
//case4.cpp
// Compound Interest Program - Case 4
// This program computes interest on some initial investment,
// compounded annually for any number of years.

#include <iostream>
#include <iomanip>

int main()
{
    int n, year, years;
    float pzero, p, rate, earned;

    cout << "How many sets of data? ";
    cin >> n;
    for (int count = 1; count <=n; count++) {
        cout << "\n\n\tInvestment decision #" << count << endl;
        cout << "\nStarting principal? ";
        cin >> pzero;
        cout << "Interest rate? ";
        cin >> rate;
        cout << "How many years? ";
        cin >> years;
        cout << endl;
        cout << setiosflags(ios::fixed |ios::showpoint)
            << setprecision(2);
        p = pzero;
        for (year=1; year<=years; year++){
            p = p + p * rate;
            cout << "After " << year << " years, you will have $"
                << p <<endl;
        } //end for
        earned = p - pzero;
        cout << "\nTotal interest earned: $" << earned <<endl;
    } //end for
    return 0;    //successful termination of program
} //end main
```

Partial output:

```
(Inactive F:\CPLUS\CASE4.EXE)
How many sets of data? 2

      Investment decision #1

Starting principal? 100
Interest rate? .05
How many years? 10

After 1 years, you will have $105.00
After 2 years, you will have $110.25
After 3 years, you will have $115.76
After 4 years, you will have $121.55
After 5 years, you will have $127.63
After 6 years, you will have $134.01
After 7 years, you will have $140.71
After 8 years, you will have $147.75
After 9 years, you will have $155.13
After 10 years, you will have $162.89

Total interest earned: $62.89

      Investment decision #2
```

Case 5 - Producing a simple report:

If you would like to learn how to send some output to an output file in order to create a report, see the lecture on “Producing a Simple Report.”

For even more practice with looping, do the following exercises, in order.

Write C++ code to produce each of the following outputs:

A. 1 2 3 4 5

B.

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

C.

100 1 2 3 4 5

200 1 2 3 4 5

300 1 2 3 4 5

400 1 2 3 4 5

D.

1 1 2 3 ... 100

2 1 2 3 ... 100

3 1 2 3 ... 100

...

100 1 2 3 ... 100

E.

11 12 13 14 15

21 22 23 24 25

31 32 33 34 35

41 42 43 44 45